Appendix F

Technical Support Document (TSD): Preparation of Emissions Inventories for the 2022v1 North American Emissions Modeling Platform

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Technical Support Document (TSD) Preparation of Emissions Inventories for the 2022v1 North American Emissions Modeling Platform

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Acronyms

AADT	Annual average daily traffic
AE6	CMAQ Aerosol Module, version 6, introduced in CMAQ v5.0
AEO	Annual Energy Outlook
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AIS	Automated Identification System
APU	Auxiliary power unit
BEIS	Biogenic Emissions Inventory System
BELD	Biogenic Emissions Land use Database
BenMAP	Benefits Mapping and Analysis Program
BPS	Bulk Plant Storage
BSP	Blue Sky Pipeline
BTP	Bulk Terminal (Plant) to Pump
C1C2	Category 1 and 2 commercial marine vessels
C3	Category 3 (commercial marine vessels)
CAMD	EPA's Clean Air Markets Division
CAM_X	Comprehensive Air Quality Model with Extensions
CAP	Criteria Air Pollutant
CARB	California Air Resources Board
CB05	Carbon Bond 2005 chemical mechanism
CB6	Version 6 of the Carbon Bond mechanism
CBM	Coal-bed methane
CDB	County database (input to MOVES model)
CEMS	Continuous Emissions Monitoring System
CISWI	Commercial and Industrial Solid Waste Incinerators
CMAQ	Community Multiscale Air Quality
CMV	Commercial Marine Vessel
CNG	Compressed natural gas
CO	Carbon monoxide
CONUS	Continental United States
CoST	Control Strategy Tool
CRC	Coordinating Research Council
CSAPR	Cross-State Air Pollution Rule
E0, E10, E85	0%, 10% and 85% Ethanol blend gasoline, respectively
ECA	Emissions Control Area
ECCC	Environment and Climate Change Canada
EF	Emission Factor
EGU	Electric Generating Units
EIA	Energy Information Administration
EIS	Emissions Inventory System
EPA	Environmental Protection Agency
EMFAC	EMission FACtor (California's onroad mobile model)
EPIC	Environmental Policy Integrated Climate modeling system
FAA	Federal Aviation Administration
FCCS	Fuel Characteristic Classification System

FEST-C	Fertilizer Emission Scenario Tool for CMAQ
FF10	Flat File 2010
FINN	Fire Inventory from the National Center for Atmospheric Research
FIPS	Federal Information Processing Standards
FHWA	Federal Highway Administration
HAP	Hazardous Air Pollutant
HMS	Hazard Mapping System
HPMS	Highway Performance Monitoring System
ICI	Industrial/Commercial/Institutional (boilers and process heaters)
I/M	Inspection and Maintenance
IMO	International Marine Organization
IPM	Integrated Planning Model
LADCO	Lake Michigan Air Directors Consortium
LDV	Light-Duty Vehicle
LPG	Liquified Petroleum Gas
MACT	Maximum Achievable Control Technology
MARAMA	Mid-Atlantic Regional Air Management Association
MATS	Mercury and Air Toxics Standards
MCIP	Meteorology-Chemistry Interface Processor
MMS	Minerals Management Service (now known as the Bureau of Energy Management, Regulation and Enforcement (BOEMRE)
MOVES	Motor Vehicle Emissions Simulator
MSA	Metropolitan Statistical Area
MTBE	Methyl tert-butyl ether
MWC	Municipal waste combustor
MY	Model year
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NBAFM	Naphthalene, Benzene, Acetaldehyde, Formaldehyde and Methanol
NCAR	National Center for Atmospheric Research
NEEDS	National Electric Energy Database System
NEI	National Emission Inventory
NESCAUM	Northeast States for Coordinated Air Use Management
NH_3	Ammonia
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NONROAD	OTAQ's model for estimation of nonroad mobile emissions
NO_X	Nitrogen oxides
NSPS	New Source Performance Standards
OHH	Outdoor Hydronic Heater
ONI	Off network idling
OTAQ	EPA's Office of Transportation and Air Quality
ORIS	Office of Regulatory Information System
ORD	EPA's Office of Research and Development
OSAT	Ozone Source Apportionment Technology
pcSOA	Potential combustion Secondary Organic Aerosol
PFC	Portable Fuel Container

$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns
PM_{10}	Particulate matter less than or equal to 10 microns
POA	Primary Organic Aerosol
ppm	Parts per million
ppmv	Parts per million by volume
PSAT	Particulate Matter Source Apportionment Technology
RACT	Reasonably Available Control Technology
RBT	Refinery to Bulk Terminal
RIA	Regulatory Impact Analysis
RICE	Reciprocating Internal Combustion Engine
RWC	Residential Wood Combustion
RPD	Rate-per-vehicle (emission mode used in SMOKE-MOVES)
RPH	Rate-per-hour for hoteling (emission mode used in SMOKE-MOVES)
RPHO	Rate-per-hour for off-network idling (emission mode used in SMOKE-MOVES)
RPP	Rate-per-profile (emission mode used in SMOKE-MOVES)
RPS	Rate-per-start (emission mode used in SMOKE-MOVES)
RPV	Rate-per-vehicle (emission mode used in SMOKE-MOVES)
RVP	Reid Vapor Pressure
SCC	Source Classification Code
SMARTFIRE2	Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation version 2
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	Sulfur dioxide
SOA	Secondary Organic Aerosol
SIP	State Implementation Plan
SPDPRO	Hourly Speed Profiles for weekday versus weekend
S/L/T	state, local, and tribal
TAF	Terminal Area Forecast
TCEQ	Texas Commission on Environmental Quality
TOG	Total Organic Gas
TSD	Technical support document
USDA	United States Department of Agriculture
VIIRS	Visible Infrared Imaging Radiometer Suite
VOC	Volatile organic compounds
VMT	Vehicle miles traveled
VPOP	Vehicle Population
WRAP	Western Regional Air Partnership
WRF	Weather Research and Forecasting Model
2014NEIv2	2014 National Emissions Inventory (NEI), version 2

1 Introduction

The U.S. Environmental Protection Agency (EPA), in conjunction with the National Emissions Collaborative, developed an air quality modeling platform for criteria air pollutants that represents the year 2022. The platform is based on the 2020 National Emissions Inventory (2020 NEI) published in April 2023 (EPA, 2023), with many sectors adjusted to better reflect 2022 and/or using data specific to the year 2022. The air quality modeling platform consists of all the emissions inventories and ancillary data files used for emissions modeling, as well as the meteorological, initial condition, and boundary condition files needed to run the air quality model. This document focuses on the emissions modeling component of the 2022 air quality modeling platform, including the emission inventories, the ancillary data files, and the approaches used to transform inventories for use in air quality modeling.

The emissions data in the modeling platform include criteria air pollutants and their precursors (CAPs), two groups of hazardous air pollutants (HAPs), and diesel particulate matter. The first group of HAPs are those explicitly used by the chemical mechanism in the Community Multiscale Air Quality (CMAQ) model (Appel, 2018) for ozone/particulate matter (PM): chlorine (Cl), hydrogen chloride (HCl), naphthalene, benzene, acetaldehyde, formaldehyde, and methanol (the last five are abbreviated as NBAFM in subsequent sections of the document). The second group of HAPs consists of over 50 HAPs or HAP groups (such as polycyclic aromatic hydrocarbon groups) that are included in the emissions inventories for the purposes of air quality modeling for a HAP+CAP platform, although HAP+CAP modeling is not planned with version 1 of the 2022 platform.

Emissions were prepared for the Community Multiscale Air Quality (CMAQ) model version 5.4,[2] which is used to model ozone (O_3) particulate matter (PM), and HAP concentrations. CMAQ requires hourly and gridded emissions of the following inventory pollutants: carbon monoxide (CO), nitrogen oxides (NO_X), volatile organic compounds (VOC), sulfur dioxide (SO_2), ammonia (NH_3), primary particulate matter less than or equal to 10 microns (PM_{10}), and individual component species for primary particulate matter less than or equal to 2.5 microns ($PM_{2.5}$). In addition, the Carbon Bond mechanism version 6 (CB6) with chlorine chemistry within CMAQ allows for explicit treatment of the VOC HAPs naphthalene, benzene, acetaldehyde, formaldehyde and methanol (NBAFM), includes anthropogenic HAP emissions of HCl and Cl, and can model additional HAPs as described in Section 3. The short abbreviation for the modeling case name was "2022hc", where 2022 is the year modeled, 'h' represents that it was based on the 2020 NEI, and 'c' represents that it was the third version of a 2020 NEI-based platform.

This TSD discusses the application of the emissions modeling platform for which CMAQ and the Comprehensive Air Quality Model with Extensions (CAMx) were run. The effort to create the emissions inputs for this study included development of emission inventories to represent emissions during the year of 2022, along with application of emissions modeling tools to convert the inventories into the format and resolution needed by CMAQ and CAMx, although this platform is not designed to be used for analyses with the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD).

[2] CMAQ version 5.4: https://zenodo.org/record/7218076. CMAQ is also available from https://www.epa.gov/cmaq and the Community Modeling and Analysis System (CMAS) Center at: https://www.cmascenter.org.

In addition to the base year emissions representing 2022, emissions were projected to the year 2026. The year 2026 emissions are needed by states to develop State Implementation Plans (SIPs) for nonattainment areas classified as serious for the 2015 National Ambient Air Quality Standards (NAAQS) for ozone. The analytic year emissions reflect on-the-books Federal and some state regulations that were effective as of April, 2024.

The emissions modeling platform includes point sources, nonpoint sources, onroad mobile sources, nonroad mobile sources, biogenic emissions and fires for the U.S., Canada, and Mexico. Some platform categories use more disaggregated data than are made available in the NEI. For example, in the platform, onroad mobile source emissions are represented as hourly emissions by vehicle type, fuel type, road type and process, while the NEI emissions are aggregated to vehicle type/fuel type totals and annual temporal resolution. Emissions used in the CMAQ modeling from Canada are provided by Environment and Climate Change Canada (ECCC) and Mexico are mostly provided by SEMARNAT and are not part of the NEI. Year-specific emissions were used for fires, biogenic sources, fertilizer, point sources, and onroad and nonroad mobile sources. Where available, hourly continuous emission monitoring system (CEMS) data were used for electric generating unit (EGU) emissions.

The primary emissions modeling tool used to create the CMAQ model-ready emissions was the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. SMOKE version 5.1 was used to create CMAQ-ready emissions files for a 12-km grid covering the continental U.S. Additional information about SMOKE is available from http://www.cmascenter.org/smoke.

The gridded meteorological model used to provide input data for the emissions modeling was developed using the Weather Research and Forecasting Model (WRF, https://github.com/wrf-model/WRF/releases) version 4.2, Advanced Research WRF core (Skamarock, et al., 2008). The WRF Model is a mesoscale numerical weather prediction system developed for both operational forecasting and atmospheric research applications. The WRF model was run for 2022 over a domain covering the continental U.S. (CONUS) at both 12km resolution and 36km resolution with 35 vertical layers, and also for domains that cover Alaska, Hawaii, and Puerto Rico plus the Virgin Islands. The run for this platform included high resolution sea surface temperature data from the Group for High Resolution Sea Surface Temperature (GHRSST) (see https://www.ghrsst.org/) and is given the EPA meteorological case abbreviation "22m." The full case abbreviation includes this suffix following the emissions portion of the case name to fully specify the abbreviation of the case as "2022hc_cb6_22m."

Data files and summaries for this platform are available from this section of the air emissions modeling website https://www.epa.gov/air-emissions-modeling/2022v1-emissions-modeling-platform.

This document contains five additional sections. Section 2 describes the emission inventories input to SMOKE. Section 3 describes the emissions modeling and the ancillary files used to process the emission inventories into air quality model-ready inputs. The analytic year emissions are described in Section 4. Data summaries are provided in Section 5, and Section 6 provides references.

2 Base Year Emissions Inventories and Approaches

This section describes the emissions inventories created for input to SMOKE, which are based on the April 2023 version of the 2020 NEI with updates to reflect emissions in the year 2022. The NEI includes four main data categories: a) nonpoint sources (which now include fires); b) point sources; c) nonroad mobile sources; and d) onroad mobile sources. For CAPs, the NEI data are largely compiled from data submitted by state, local and tribal (S/L/T) agencies. HAP emissions data are often augmented (generated through speciation of relevant CAPs, e.g., VOC and $PM_{2.5}$) by EPA when they are not voluntarily submitted to the NEI by S/L/T agencies. The NEI was compiled using the Emissions Inventory System (EIS). EIS collects and stores facility inventory and emissions data for the NEI and includes hundreds of automated QA checks to improve data quality, and it also supports release point (stack) coordinates separately from facility coordinates. EPA collaboration with S/L/T agencies helped prevent duplication between point and nonpoint source categories such as industrial boilers. The 2020 NEI Technical Support Document describes in detail the development of the 2020 emission inventories and is available at https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-technical-support-document-tsd (EPA, 2023).

A complete set of emissions for all source categories is developed for the NEI every three years, with 2020 being the most recent year represented with a full "triennial" NEI. S/L/T agencies are required to submit all applicable point sources to the NEI in triennial years, including the year 2020. Because only point source emissions were submitted by S/L/T agencies for 2022, emissions for any point sources not submitted for 2022, and not marked as shutdown, were pulled forward from the 2020 NEI. The SMARTFIRE2 system and the BlueSky Pipeline (https://github.com/pnwairfire/bluesky) emissions modeling system were used to develop the fire emissions. SMARTFIRE2 categorizes all fires as either prescribed burning or wildfire, and the BlueSky Pipeline system includes fuel loading, consumption and emission factor estimates for both types of fires. Onroad and nonroad mobile source emissions were developed for this project using MOVES4 (https://www.epa.gov/moves).

With the exception of fire emissions, Canadian emissions were provided by Environment Canada and Climate Change (ECCC) for the years 2020 and 2023 and most 2022 emissions were developed by interpolating between 2020 and 2023. For point EGUs, instead of interpolating from 2020 and 2023 (which unlike other point sources, has different sources in 2020 vs 2023), the provided 2023 emissions were used as is to represent 2022. For Mexico, year 2016-based inventories from the 2019 emissions modeling platform (EPA, 2022b) were used as the starting point with area, nonroad, and point data for border states (i.e., Baja California, Chihuahua, Coahuila, Nuevo Leon, Sonora, and Tamaulipas) supplemented with data for calendar year 2018, which is newer than the data used in the 2019 platform, developed by SEMARNAT in collaboration with U.S. EPA.

The emissions modeling process was performed using SMOKE v5.1. Through this process, the emissions inventories were apportioned into the grid cells used by CMAQ and temporally allocated into hourly values. In addition, the pollutants in the inventories (e.g., NOx, PM and VOC) were split into the chemical species needed by CMAQ. For the purposes of preparing the CMAQ- ready emissions, the NEI emissions inventories by data category were split into emissions modeling platform "sectors"; and emissions from sources other than the NEI are added, such as the Canadian, Mexican, and offshore inventories. Emissions within the emissions modeling platform were separated into sectors for groups of related emissions source categories that were run through the appropriate SMOKE programs, except the final

merge, independently from emissions categories in the other sectors. The final merge program called Mrggrid combines low-level sector-specific gridded, speciated and temporalized emissions to create the final CMAQ-ready emissions inputs. For biogenic and fertilizer emissions, the CMAQ model allows for these emissions to be included in the CMAQ-ready emissions inputs, or to be computed within CMAQ itself (the "inline" option). This study used the option to compute biogenic emissions within the model and the CMAQ bidirectional ammonia process to compute the fertilizer emissions.

Following the compilation of the initial draft of the base year emission inventories within the 2022v1 Emissions Modeling Platform, the inventories were posted to the 2022v1 EPA website and to the Data Retrieval Tool associated with the platform. Stakeholders were then given the opportunity to comment on the inventory during an approximate 30-day period, with comments submitted to the 2022v1 Sharepoint site setup by the EPA. Following the comment period, where possible, EPA incorporated the comments into the inventories prior to finalization. In total, 30 individual organizations submitted 127 comments during the base-year review. A similar process was followed when the inventories for 2026 were completed.

Table 2-1 presents the sectors in the emissions modeling platform used to develop the year 2022 emissions for this project. The sector abbreviations are provided in italics and start with lower case letters; these abbreviations are used in the SMOKE modeling scripts, the inventory file names, and throughout the remainder of this section. Note that while the fires sectors are in nonpoint NEI data category, in the modeling platform they are treated as day-specific point sources.

Table 2-1. Platform sectors used in the Emissions Modeling Process

Platform Sector: *abbreviation*	NEI Data Category	Description and resolution of the data input to SMOKE
EGU units: ***ptegu***	Point	2022 NEI point source EGUs, replaced with hourly Continuous Emissions Monitoring System (CEMS) values for NO_X and SO_2, and the remaining pollutants temporally allocated according to CEMS heat input where the units are matched to the NEI. Emissions for all sources not matched to CEMS data come from the 2022 NEI point inventory. EGUs closed in 2022 are not part of the inventory. Annual resolution for sources not matched to CEMS data, hourly for CEMS sources.
Point source oil and gas: ***pt_oilgas***	Point	2022 NEI point sources that include oil and gas production emissions processes for facilities with North American Industry Classification System (NAICS) codes related to Oil and Gas Extraction, Natural Gas Distribution, Drilling Oil and Gas Wells, Support Activities for Oil and Gas Operations, Pipeline Transportation of Crude Oil, and Pipeline Transportation of Natural Gas. Includes U.S. offshore oil production. Annual resolution.
Aircraft and ground support equipment: ***airports***	Point	EPA estimated 2022 emissions, including aircraft and airport ground support for the top 51 airports. Smaller airports, including aircraft and airport ground support were projected from 2020 NEI to 2022 based on the 2023 Terminal Area Forecast (TAF). Georgia provided emissions for HJAIA. Annual resolution.

Platform Sector: *abbreviation*	NEI Data Category	Description and resolution of the data input to SMOKE
Remaining non-EGU point: *ptnonipm*	Point	All 2022 NEI point source records not matched to the airports, ptegu, or pt_oilgas sectors. Includes 2020 NEI rail yard emissions projected to 2022 using updated R-1 reported yard fuel usage. Annual resolution.
Livestock: *livestock*	Nonpoint	2022 nonpoint livestock emissions developed using a similar method to 2020 NEI but with adjusted animal counts and using 2022 meteorology. Livestock includes ammonia and other pollutants (except $PM_{2.5}$). County and annual resolution.
Agricultural Fertilizer: *fertilizer*	Nonpoint	2022 agricultural fertilizer ammonia emissions based on bidirectional flux calculations computed inline within CMAQ.
Area fugitive dust: *afdust_adj*	Nonpoint	PM_{10} and $PM_{2.5}$ nonpoint fugitive dust sources including building construction, road construction, agricultural dust from crops, and mining and quarrying which were all held constant. Additional dust sources not held constant include paved road dust and agricultural dust from livestock, where paved road dust emissions were adjusted to 2022 based on VMT and dust from livestock based on animal count differences. The emissions modeling system applies a transportable fraction reduction and zero-out adjustments based on the year-specific gridded hourly meteorology (precipitation and snow/ice cover). County and annual resolution.
Biogenic: *beis*	Nonpoint	Year 2022 emissions from biogenic sources. These were left out of the CMAQ-ready merged emissions, in favor of inline biogenic emissions produced during the CMAQ model run itself. Version 4 of the Biogenic Emissions Inventory System (BEIS) was used with Version 6 of the Biogenic Emissions Landuse Database (BELD6). The CMAQ-generated emissions are similar to the biogenic emissions generated through running SMOKE, but they are not exactly the same. Gridded and hourly resolution.
Category 1, 2 CMV: *cmv_c1c2*	Nonpoint	2022 Category 1 (C1) and Category 2 (C2), commercial marine vessel (CMV) emissions based on 2022 Automatic Identification System (AIS) data categorized using SCCs specific to ship type. Point and hourly resolution.
Category 3 CMV: *cmv_c3*	Nonpoint	2022 Category 3 (C3) commercial marine vessel (CMV) emissions based on 2022 AIS data categorized using SCCs specific to ship type. Point and hourly resolution.
Locomotives : *rail*	Nonpoint	Class I line haul rail locomotives emissions from 2020 NEI projected to 2022 using R-1 reported fuel usage. County and annual resolution. Class II and III locomotive emissions were projected from 2020 based on the 2021 U.S. Energy Information Administration's Annual Energy Outlook. Commuter rail was projected from 2020 using fuel use per company from the Federal Transit Administration's (FTA) 2022 National Transit Database. Amtrak emissions were adjusted down based on 2020 fuel use reported in Amtrak's FY22 AMTRAK Sustainability Report. County and annual resolution.

Platform Sector: *abbreviation*	NEI Data Category	Description and resolution of the data input to SMOKE
Nonpoint source oil and gas: ***np_oilgas***	Nonpoint	2022 well activity data (production and exploration of oil, gas, etc.) run through Oil and Gas tool. Abandoned wells based on 2022, plus other state-specific inputs. County and annual resolution. County and annual resolution.
Open Burning: ***openburn***	Nonpoint	This new sector for the 2022v1 platform was split out from the prior nonpt sector and includes emissions from yard waste, land clearing, and residential household waste burning. These are SCCs starting with 261. County and annual resolution.
Residential Wood Combustion: ***rwc***	Nonpoint	2020 NEI nonpoint sources with residential wood combustion (RWC) processes, projected to 2022 with state-level adjustment factors derived from the State Energy Data System (SEDS) plus specific adjustments for California and Idaho. County and annual resolution.
Solvents: ***np_solvents***	Nonpoint	Emissions of solvents based on methods used for the 2020 NEI. 2021 emissions are used to represent 2022. Includes household cleaners, personal care products, adhesives, architectural and aerosol coatings, printing inks, and pesticides. Annual and county resolution.
Remaining nonpoint: ***nonpt***	Nonpoint	Nonpoint sources not included in other platform sectors. Mostly held constant at 2020 levels, but with some SCCs adjusted to 2022 based on population, energy consumption ratios and employment data. County and annual resolution.
Nonroad: ***nonroad***	Nonroad	2022 nonroad equipment emissions developed with MOVES4, including the updates made to spatial apportionment that were developed with the 2016v1 platform. MOVES4 was used for all states except California, which submitted their own emissions for 2020 and 2023 that were then interpolated to 2022. County and monthly resolution.
Onroad: ***onroad***	Onroad	Onroad mobile source gasoline and diesel vehicles from parking lots and moving vehicles for 2022 developed using VMT from many states, along with VMT data from 2020 NEI projected to 2022 using factors based on FHWA VM-2 data. Includes the following emission processes: exhaust, extended idle, auxiliary power units, evaporative, permeation, refueling, vehicle starts, off network idling, long-haul truck hoteling, and brake and tire wear. MOVES4 was run for 2022 to generate year-specific emission factors. County/gridded and hourly resolution.
Onroad California: ***onroad_ca_adj***	Onroad	California-provided 2022 emissions for CAPs. VOC HAPs were projected from California-provided 2020 NEI HAP emissions using CAP trends. Onroad mobile source gasoline and diesel vehicles from parking lots and moving vehicles based on Emission Factor (EMFAC), gridded and temporalized based on outputs from MOVES4. County/gridded and hourly resolution.

Platform Sector: *abbreviation*	NEI Data Category	Description and resolution of the data input to SMOKE
Point source agricultural fires: ***ptagfire***	Nonpoint	Agricultural fire sources for 2022 developed by EPA as point and day-specific emissions.[3] Includes 2022 satellite data and land use. Florida, Georgia, Idaho, and North Carolina have separate datasets and are removed from the national datasets. Washington has supplemental datasets, to be used along with WA from the national datasets. Agricultural fires are in the nonpoint data category of the NEI, but in the modeling platform, they are treated as day-specific point sources. Point and daily resolution.
Point source prescribed fires: ***ptfire-rx***	Nonpoint	Point source day-specific prescribed fires for 2022 computed using SMARTFIRE 2 and BlueSky Pipeline. The ptfire emissions were run as two separate sectors: ptfire-rx (prescribed, including Flint Hills / grasslands) and ptfire-wild. Point and daily resolution
Point source wildfires: ***ptfire-wild***	Nonpoint	Point source day-specific wildfires for 2022 computed using SMARTFIRE 2 and BlueSky Pipeline. Point and daily resolution
Non-US. Fires: ***ptfire_othna***	N/A	Point source day-specific wildfires and agricultural fires outside of the U.S. for 2022. Canadian fires were computed using SMARTFIRE 2 and BlueSky Pipeline. Mexico, Caribbean, Central American, and other international fires, are from v2.5 of the Fire INventory (FINN) from National Center for Atmospheric Research (Wiedinmyer, C., 2023). Point and daily resolution.
Canada Area Fugitive dust sources: ***canada_afdust***	N/A	Area fugitive dust sources from ECCC for 2022 (interpolated between provided 2020 and 2023 emissions) with transport fraction and snow/ice adjustments based on 2022 meteorological data. Annual and province resolution.
Canada Point Fugitive dust sources: ***canada_ptdust***	N/A	Point source fugitive dust sources from ECCC for 2022 (interpolated between provided 2020 and 2023 emissions) with transport fraction and snow/ice adjustments based on 2022 meteorological data. Monthly and province resolution.
Canada and Mexico stationary point sources: ***canmex_point***	N/A	Canada and Mexico point source emissions not included in other sectors. Canada point sources were provided by ECCC for 2020 and 2023 and interpolated to 2022. Mexico point source emissions for six border states represent 2018 and were developed by SEMARNAT in collaboration with EPA, while emissions for all other states were carried forward from 2019ge (EPA, 2022b). Annual and monthly point resolution.
Canada and Mexico agricultural sources: ***canmex_ag***	N/A	Canada and Mexico agricultural emissions. Canada emissions were provided by ECCC for 2020 and 2023; EGUs for 2023 were used directly, and other point inventories were interpolated to 2022. Mexico agricultural emissions were provided by SEMARNAT and include updated emissions for six border states representing 2018 developed by SEMARNAT in collaboration with EPA, while emissions for all other states were carried forward from 2019ge. Annual municipio and province resolution.

[3] Only EPA-developed agricultural fire data were included in this study; data submitted by states to the NEI were excluded.

Platform Sector: *abbreviation*	NEI Data Category	Description and resolution of the data input to SMOKE
Canada low-level oil and gas sources: *canada_og2D*	N/A	Canada emissions from upstream oil and gas, provided by ECCC for 2020 and 2023 and interpolated to 2022. This sector contains the portion of oil and gas emissions which are not subject to plume rise. The rest of the Canada oil and gas emissions are in the canmex_point sector. Annual province resolution.
Canada and Mexico nonpoint and nonroad sources: *canmex_area*	N/A	Canada and Mexico nonpoint source emissions not included in other sectors. Canada: ECCC provided surrogates and 2020 and 2023 inventories, that were interpolated to 2022. Mexico: included updated emissions for six border states representing 2018 developed by SEMARNAT in collaboration with EPA, while emissions for all other states were carried forward from 2019ge. Annual and monthly municipio and province resolution.
Canada onroad sources: *canada_onroad*	N/A	Canada onroad emissions. 2020 and 2023 Canada inventories provided by ECCC and interpolated to 2022; processed using updated surrogates. Province monthly resolution.
Mexico onroad sources: *mexico_onroad*	N/A	Mexico onroad emissions. 2020 and 2023 emissions output from MOVES-Mexico were interpolated to 2022. Municipio monthly resolution.

Ocean chlorine emissions were also merged in with the above sectors. The ocean chlorine gas emission estimates are based on the build-up of molecular chlorine (Cl_2) concentrations in oceanic air masses (Bullock and Brehme, 2002). Ocean chlorine data at 12 km resolution were available from earlier studies and were not modified other than the name "CHLORINE" was changed to "CL2" because that is the name required by the CMAQ model.

The emission inventories in SMOKE input formats for the platform are available from EPA's Air Emissions Modeling website: https://www.epa.gov/air-emissions-modeling/2022v1-emissions-modeling-platform. The platform informational text file indicates the zipped files associated with each platform sector. Some emissions data summaries are available with the data files for the 2022v1 platform. The types of reports include state summaries of inventory pollutants and model species by modeling platform sector and county annual totals by modeling platform sector.

2.1Point sources (ptegu, pt_oilgas, ptnonipm, airports)

Point sources are sources of emissions for which specific geographic coordinates (e.g., latitude and longitude) are specified, as in the case of an individual facility. A facility may have multiple emission release points that may be characterized as units such as boilers, reactors, spray booths, kilns, waste piles, etc. A unit may have multiple processes (e.g., a boiler that sometimes burns residual oil and sometimes burns natural gas). With a couple of minor exceptions, this section describes only NEI point sources within the contiguous U.S. The offshore oil platform (pt_oilgas sector) and CMV emissions (cmv_c1c2 and cmv_c3 sectors) are processed by SMOKE as point source inventories and are discussed later in this section. A complete NEI is developed every three years. At the time of this writing, 2020 is the most recently finished complete NEI. A comprehensive description about the development of the 2020 NEI is available in the 2020 NEI TSD (EPA, 2023). Point inventories are also available in EIS for non-triennial NEI years such as 2019 and 2021. In the interim year point inventories, states are required to update large sources with the emissions that occurred in that year, while sources not updated by states

for the interim year were either carried forward from the most recent triennial NEI or marked as closed and removed.

In preparation for modeling, the complete set of point sources in the NEI was exported from EIS for the year 2022 into the Flat File 2010 (FF10) format that is compatible with SMOKE (see https://cmascenter.org/smoke/documentation/5.1/html/ch06s02s08.html) and was then split into several sectors for modeling. Any sources without specific locations (i.e., the FIPS code ends in 777) were dropped and inventories for the other point source sectors were created from the remaining point sources. The point sectors are: EGUs (ptegu), point source oil and gas extraction-related sources (pt_oilgas), airport emissions (airports), and the remaining non-EGUs (ptnonipm). The EGU emissions were split out from the other sources to facilitate the use of distinct SMOKE temporal processing and future-year projection techniques. The oil and gas sector emissions (pt_oilgas) and airport emissions (airports) were processed separately for the purposes of developing emissions summaries and due to distinct projection techniques from the remaining non-EGU emissions (ptnonipm).

In some cases, data about facility or unit closures are entered into EIS after the inventory modeling inventory flat files have been extracted. Prior to processing through SMOKE, submitted facility and unit closures were reviewed and where closed sources were found in the inventory, those were removed.

For this platform, an analysis of point source stack parameters (e.g., stack height, diameter, temperature, and velocity) was performed due to the presence of unrealistic and repeated stack parameters. The defaulted values were noticed in data submissions for the states of Illinois, Louisiana, Michigan, Pennsylvania, Texas, and Wisconsin. Where these defaults were detected and deemed to be unreasonable for the specific process, the affected stack parameters were replaced by values from the PSTK file that is input to SMOKE. PSTK contains default stack parameters by source classification code (SCC). These updates impacted the ptnonipm and pt_oilgas inventories.

The inventory pollutants processed through SMOKE for input to CMAQ for the ptegu, pt_oilgas, ptnonipm, and airports sectors included: CO, NO_X, VOC, SO_2, NH_3, PM_{10}, and $PM_{2.5}$ and the following HAPs: HCl (pollutant code = 7647010), Cl (code = 7782505), and several dozen other HAPs listed in Section 3. NBAFM pollutants from the point sectors were utilized.

The ptnonipm, pt_oilgas, and airports sector emissions were provided to SMOKE as annual emissions. For sources in the ptegu sector that could be matched to 2022 CEMS data, hourly CEMS NO_X and SO_2 emissions for 2022 from EPA's Acid Rain Program were used rather than annual inventory emissions. For all other pollutants (e.g., VOC, $PM_{2.5}$, HCl), annual emissions were used as-is from the annual inventory but were allocated to hourly values using heat input from the CEMS data. For the unmatched units in the ptegu sector, annual emissions were allocated to daily values using IPM region- and pollutant-specific profiles, and similarly, region- and pollutant-specific diurnal profiles were applied to create hourly emissions.

The non-EGU stationary point source (ptnonipm) emissions were used as inputs to SMOKE as annual emissions. The full description of how the NEI emissions were developed is provided in the NEI documentation - a brief summary of their development follows:

a. CAP and HAP data were provided by States, locals and tribes under the Air Emissions Reporting

Rule (AERR) [the reporting size threshold is larger for inventory years between the triennial inventory years of 2011, 2014, 2017, 2020, …].

b. EPA corrected known issues and filled PM data gaps.

c. EPA added HAP data from the Toxic Release Inventory (TRI) where corresponding data was not already provided by states/locals.

d. EPA stored and applied matches of the point source units to units with CEMS data and also for all EGU units modeled by EPA's Integrated Planning Model (IPM).

e. Data for airports and rail yards were incorporated.

f. Off-shore platform data were added from the Bureau of Ocean Energy Management (BOEM).

The changes made to the NEI point sources prior to modeling with SMOKE are as follows:

- The tribal data, which do not use state/county Federal Information Processing Standards (FIPS) codes in the NEI, but rather use the tribal code, were assigned a state/county FIPS code of 88XXX, where XXX is the 3-digit tribal code in the NEI. This change was made because SMOKE requires all sources to have a state/county FIPS code.
- Sources that did not have specific counties assigned (i.e., the county code ends in 777) were not included in the modeling because it was only possible to know the state in which the sources resided, but no more specific details related to the location of the sources were available.

Each of the point sectors is processed separately through SMOKE as described in the following subsections.

2.1.1 EGU sector (ptegu)

The ptegu sector contains emissions from EGUs in the 2022 point source inventory that could be matched to units found in the National Electric Energy Database System (NEEDS) v6 that is used by the Integrated Planning Model (IPM) to develop projected EGU emissions. It was necessary to put these EGUs into a separate sector in the platform because EGUs use different temporal profiles than other sources in the point sector and it is useful to segregate these emissions from the rest of the point sources to facilitate summaries of the data. Sources not matched to units found in NEEDS were placed into the pt_oilgas or ptnonipm sectors. For studies that include analytic years, the sources in the ptegu sector are fully replaced with analytic year emissions computed by IPM or through engineering analysis. It is therefore important that the matching between the NEI and NEEDS database be as complete as possible because there can be double-counting of emissions in analytic year modeling scenarios if emissions for units projected by IPM are not properly matched to the units in the base year point source inventory.

The 2022 ptegu emissions inventory is a subset of the point source flat file exported from the Emissions Inventory System (EIS). In the point source flat file, emission records for sources that have been matched to the NEEDS database have a value filled into the IPM_YN column based on the matches stored within EIS. Thus, unit-level emissions were split into a separate EGU flat file for units that have a populated

(non-null) ipm_yn field. A populated ipm_yn field indicates that a match was found for the EIS unit in the NEEDS v6 database. Updates were made to the flat file output from EIS as follows:

- ORIS facility and unit identifiers were updated based on additional matches in a cross-platform spreadsheet, based on state comments, and using the EIS alternate identifiers table as described later in this section.

Some units in the ptegu sector are matched to Continuous Emissions Monitoring System (CEMS) data via Office of Regulatory Information System (ORIS) facility codes and boiler IDs. For the matched units, the annual emissions of NO_X and SO_2 in the flat file were replaced with the hourly CEMS emissions in base year modeling. For other pollutants at matched units, the hourly CEMS heat input data were used to allocate the NEI annual emissions to hourly values. All stack parameters, stack locations, and Source Classification Codes (SCCs) for these sources come from the flat file. If CEMS data exists for a unit, but the unit is not matched to the NEI, the CEMS data for that unit were not used in the modeling platform. However, if the source exists in the NEI and is not matched to a CEMS unit, the emissions from that source are still modeled using the annual emission value in the NEI temporally allocated to hourly values.

EIS stores many matches from NEI units to the ORIS facility codes and boiler IDs used to reference the CEMS data. In the flat file, emission records for point sources matched to CEMS data have values filled into the ORIS_FACILITY_CODE and ORIS_BOILER_ID columns. The CEMS data are available at https://campd.epa.gov/data. Many smaller emitters in the CEMS program cannot be matched to the NEI due to differences in the way a unit is defined between the NEI and CEMS datasets, or due to uncertainties in source identification such as inconsistent plant names in the two data systems. In addition, the NEEDS database of units modeled by IPM includes many smaller emitting EGUs that do not have CEMS. Therefore, there will be more units in the ptegu sector than have CEMS data.

Matches from the NEI to ORIS codes and the NEEDS database were improved in the platform where applicable. In some cases, NEI units in EIS match to many CAMD units. In these cases, a new entry was made in the flat file with a "_M_" in the ipm_yn field of the flat file to indicate that there are "multiple" ORIS IDs that match that unit. This helps facilitate appropriate temporal allocation of the emissions by SMOKE. Temporal allocation for EGUs is discussed in more detail in the Ancillary Data section below.

The EGU flat file was split into two flat files: those that have unit-level matches to CEMS data using the oris_facility_code and oris_boiler_id fields (egu_cems) and those that do not (egu_noncems) so that different temporal profiles could be applied. In addition, the hourly CEMS data were processed through v2.1 of the CEMCorrect tool to mitigate the impact of unmeasured values in the data.

Some comments were received on the base year EGU inventories and were addressed as follows:

- Many units in the engineering analysis had NOX and/or SO2 but did not have the other CAPs, and that those pollutants needed to be gapfilled. The gapfilling process added 1,500 tpy of PM2.5 nationally, across several states. Most increases outside of NOX and SO2 can be attributed to the gapfilling process.

- The drop in Iowa SO2, and the increases in Wisconsin NOX/SO2, are based on corrections provided by Michael Cohen. I believe the Iowa change was from a state comment, and Wisconsin concerned unit(s) that were previously zero but shouldn't have been.

- Facilities in CT, MA, MI, MN, VA, and WA were closed between draft and final, based mostly on state comments, and also based on the NEEDS DB showing some of these were dropped. Most of these were non-engineering-analysis facilities that had previously been carried forward from 2022.

- Kentucky emissions decreased because some units moved from ptegu to ptnonipm.

2.1.2 Point source oil and gas sector (pt_oilgas)

The pt_oilgas sector was separated from the ptnonipm sector by selecting sources with specific North American Industry Classification System (NAICS) codes shown in Table 2-2. The emissions and other source characteristics in the pt_oilgas sector are submitted by states, while EPA developed a dataset of nonpoint oil and gas emissions for each county in the U.S. with oil and gas activity that was available for states to use. Nonpoint oil and gas emissions can be found in the np_oilgas sector. The pt_oilgas sector includes emissions from offshore oil platforms. Where available, the point source emissions submitted as part of the 2022 NEI process with refinements based on the Collaborative data review process were used. Sources without data submitted for 2022 were projected to 2022 from 2020 NEI emissions, or where applicable, from 2021 NEI emissions.

Table 2-2. Point source oil and gas sector NAICS Codes

NAICS	NAICS description
2111	Oil and Gas Extraction
211112	Natural Gas Liquid Extraction (although no emissions for this NAICS code exist in the 2022 inventory)
21112	Crude Petroleum Extraction
211120	Crude Petroleum Extraction
21113	Natural Gas Extraction
211130	Natural Gas Extraction
213111	Drilling Oil and Gas Wells
213112	Support Activities for Oil and Gas Operations
2212	Natural Gas Distribution
22121	Natural Gas Distribution
221210	Natural Gas Distribution
237120	Oil and Gas Pipeline and Related Structures Construction
4861	Pipeline Transportation of Crude Oil
48611	Pipeline Transportation of Crude Oil
486110	Pipeline Transportation of Crude Oil
4862	Pipeline Transportation of Natural Gas
48621	Pipeline Transportation of Natural Gas
486210	Pipeline Transportation of Natural Gas

Information on the development of the 2020 NEI oil and gas emissions can be found in Section 13 of the 2020 NEI TSD. The point oil and gas emissions for 2022 by state are shown in Table 2-3.

Table 2-3. Point source oil and gas sector emissions for 2022

State	2022 NOx	2022 VOC
Alabama	10,608	1,209
Alaska	38,698	1,730
Arizona	2,374	180
Arkansas	4,029	320
California	2,564	2,430
Colorado	13,642	11,074
Connecticut	59	35
Delaware	6	1
Florida	6,192	696
Georgia	3,114	526
Idaho	1,291	38
Illinois	4,567	1,039
Indiana	949	136
Iowa	3,962	223
Kansas	17,741	3,009
Kentucky	9,201	1,125
Louisiana	27,882	8,160
Maine	32	64
Maryland	188	164
Massachusetts	235	69
Michigan	9,134	990
Minnesota	2,377	172
Mississippi	22,452	1,930
Missouri	2,342	92
Montana	812	1,027
Nebraska	2,757	266
Nevada	236	22
New Jersey	95	94
New Mexico	34,981	63,796
New York	1,072	256
North Carolina	1,681	237
North Dakota	4,197	2,736
Ohio	8,828	1,584
Oklahoma	33,870	26,113
Oregon	1,019	94
Pennsylvania	3,027	918
Puerto Rico	39	25

State	2022 NOx	2022 VOC
Rhode Island	315	121
South Carolina	358	10
South Dakota	6,452	532
Tennessee	46,513	20,607
Texas	2,453	652
Utah	95	94
Virginia	2,725	428
Washington	874	56
West Virginia	8,335	3,263
Wisconsin	429	205
Wyoming	13,283	50,751
Offshore	34,660	31,406
Tribal Data	7,813	2,213

2.1.3 Aircraft and ground support equipment (airports)

Emissions at airports were separated from other sources in the point inventory based on sources that have the facility source type of 100 (airports). The airports sector includes all aircraft types used for public, private, and military purposes and aircraft ground support equipment. The Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT) is used to estimate emissions for this sector. Additional information about aircraft emission estimates can be found in section 3 of the 2020 NEI TSD (EPA, 2023). EPA ran AEDT for 2022 for the largest (51) airports in the United States. For more information on the estimation of emissions from larger airports, please see, 2022 National Emissions Inventory: Aviation Component (ERG, 2024a). Smaller airport emissions were projected from the 2020 NEI to 2022 using factors derived from the 2023 Terminal Area Forecast (TAF)[4] data. EPA used airport-specific factors where available. Emissions for Hartsfield-Jackson (ATL) airport were provided by Georgia EPD. Airport emissions were spread out into multiple 12km grid cells when the airport runways were determined to overlap multiple grid cells. Otherwise, airport emissions for a specific airport are confined to one air quality model grid cell. The SCCs included in the airport sector are shown in Table 2-4.

Table 2-4. SCCs for the airports sector

SCC	Tier 1 description	Tier 2 description	Tier 3 description	Tier 4 description
2265008005	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Airport Ground Support Equipment	Total
2270008005	Mobile Sources	Off-highway Vehicle Diesel	Airport Ground Support Equipment	Total
2275001000	Mobile Sources	Aircraft	Military Aircraft	Total
2275020000	Mobile Sources	Aircraft	Commercial Aircraft	Total: All Types
2275050011	Mobile Sources	Aircraft	General Aviation	Piston
2275050012	Mobile Sources	Aircraft	General Aviation	Turbine

[4] See https://www.faa.gov/data_research/aviation/taf for 2023 TAF released in January 2024.

SCC	Tier 1 description	Tier 2 description	Tier 3 description	Tier 4 description
2275060011	Mobile Sources	Aircraft	Air Taxi	Piston
2275060012	Mobile Sources	Aircraft	Air Taxi	Turbine
2275070000	Mobile Sources	Aircraft	Auxiliary Power Units	Total

2.1.4 Non-IPM sector (ptnonipm)

With some exceptions, the ptnonipm sector contains the point sources that are not in the ptegu, pt_oilgas, or airports sectors. For the most part, the ptnonipm sector reflects non-EGU emissions sources and rail yards. However, it is possible that some low-emitting EGUs not matched to units in the NEEDS database or to CEMS data are in the ptnonipm sector.

The ptnonipm sector contains a small amount of fugitive dust PM emissions from vehicular traffic on paved or unpaved roads at industrial facilities, coal handling at coal mines, and grain elevators. Sources with state/county FIPS code ending with "777" are in the NEI but are not included in any modeling sectors. These sources typically represent mobile (temporary) asphalt plants that are only reported for some states and are generally in a fixed location for only a part of the year and are therefore difficult to allocate to specific places and days as is needed for modeling. Therefore, these sources are dropped from the point-based sectors in the modeling platform.

The ptnonipm sources (i.e., not EGUs and non -oil and gas sources) were used as-is from the 2022 NEI point inventory following updates from the Collaborative review. Solvent emissions from point sources were removed from the np_solvents sector to prevent double-counting, so that all point sources can be retained in the modeling as point sources rather than as area sources. The modeling was based on the point flat file exported from EIS on June 15, 2024, and included updates from the Collaborative review process for the 2022 base year, and updates specific to ethylene oxide. The np_solvents sector is described in more detail in Section 2.2.6.

Emissions from rail yards are included in the ptnonipm sector. Railyards are from the 2020 NEI railyard inventory with a projection factor applied. Additional information about railyard estimates can be found in section 3 of the 2020 NEI TSD.

2.2 Nonpoint sources (afdust, fertilizer, livestock, np_oilgas, rwc, np_solvents, nonpt)

This section describes the *stationary* nonpoint sources in the NEI nonpoint data category. Locomotives, C1 and C2 CMV, and C3 CMV are included in the NEI nonpoint data category but are mobile sources that are described in Section 2.4. The 2020 NEI TSD includes documentation for the nonpoint data.

Nonpoint tribal emissions submitted to the NEI are dropped during spatial processing with SMOKE due to the configuration of the spatial surrogates. Part of the reason for this is to prevent possible double-counting with county-level emissions and also because spatial surrogates for tribal data are not currently available. These omissions are not expected to have an impact on the results of the air quality modeling at the 12-km resolution used for this platform.

The following subsections describe how the sources in the NEI nonpoint inventory were separated into modeling platform sectors, along with any data that were updated (replaced) with non-NEI data.

2.2.1 Area fugitive dust sector (afdust)

The area-source fugitive dust (afdust) sector contains PM_{10} and $PM_{2.5}$ emission estimates for nonpoint SCCs identified by EPA as dust sources. Categories included in the afdust sector are paved roads, unpaved roads and airstrips, construction (residential, industrial, road and total), agriculture production, and mining and quarrying. It does not include fugitive dust from grain elevators, coal handling at coal mines, or vehicular traffic on paved or unpaved roads at industrial facilities because these are treated as point sources so they are properly located. Table 2-5 is a listing of the Source Classification Codes (SCCs) in the afdust sector.

Table 2-5. Afdust sector SCCs

SCC	Tier 1 description	Tier 2 description	Tier 3 description	Tier 4 description
2294000000	Mobile Sources	Paved Roads	All Paved Roads	Total: Fugitives
2296000000	Mobile Sources	Unpaved Roads	All Unpaved Roads	Total: Fugitives
2311010000	Industrial Processes	Construction: SIC 15 - 17	Residential	Total
2311020000	Industrial Processes	Construction: SIC 15 - 17	Industrial/Commercial/ Institutional	Total
2311030000	Industrial Processes	Construction: SIC 15 - 17	Road Construction	Total
2325000000	Industrial Processes	Mining and Quarrying: SIC 14	All Processes	Total
2325020000	Industrial Processes	Mining and Quarrying: SIC 14	Crushed and Broken Stone	Total
2325030000	Industrial Processes	Mining and Quarrying: SIC 14	Sand and Gravel	Total
2325060000	Industrial Processes	Mining and Quarrying: SIC 10	Lead Ore Mining and Milling	Total
2801000000	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture – Crops	Total
2801000003	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture – Crops	Tilling
2801000005	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture – Crops	Harvesting
2801000008	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture - Crops	Transport
2805100010	Miscellaneous Area Sources	Ag. Production – Livestock	Dust kicked up by Livestock	Beef cattle - finishing operations on feedlots (drylots)
2805100020	Miscellaneous Area Sources	Ag. Production – Livestock	Dust kicked up by Livestock	Dairy Cattle
2805100030	Miscellaneous Area Sources	Ag. Production – Livestock	Dust kicked up by Livestock	Broilers
2805100040	Miscellaneous Area Sources	Ag. Production – Livestock	Dust kicked up by Livestock	Layers
2805100050	Miscellaneous Area Sources	Ag. Production – Livestock	Dust kicked up by Livestock	Swine
2805100060	Miscellaneous Area Sources	Ag. Production – Livestock	Dust kicked up by Livestock	Turkeys

Area Fugitive Dust Transportable Fraction Adjustments

The afdust sector was separated from other nonpoint sectors to allow for the application of a "transportable fraction" and meteorological/precipitation reductions. These adjustments were applied using a script that applies land use-based gridded transport fractions based on landscape roughness, followed by another script that performs meteorological adjustments that zeroes out emissions for days on which at least 0.01 inches of precipitation occurs or there is snow cover on the ground. The land use data used to reduce the NEI emissions determines the amount of emissions that are subject to transport. For example, less dust would be transported on a forest floor, than would be on an open plain. This methodology is discussed in Pouliot, et al., 2010, and in "Fugitive Dust Modeling for the 2008 Emissions Modeling Platform" (Adelman, 2012). Both the transportable fraction and meteorological adjustments are based on the gridded resolution of the platform (i.e., 12km grid cells); therefore, different emissions will result if the process were applied to different grid resolutions. A limitation of the transportable fraction approach is the lack of monthly variability that would be expected with seasonal changes in vegetative cover. While wind speed and direction were not accounted for in the emissions processing, the hourly variability due to soil moisture, snow cover and precipitation were accounted for in the subsequent meteorological adjustment. The factor is treated as a multiplicative factor for the emissions. Thus, if the factor is 1 (i.e., water), the dust emissions are not reduced at all, and if the factor is near 0, the emissions are substantially reduced.

Area Fugitive Dust 2020-2022 Projection Factors

Paved road dust emissions were from the 2020 NEI adjusted to 2022 levels based on changes between 2020 and 2022 VMT. Dust from livestock hooves were also adjusted based on ratios of 2022 to 2020 livestock counts but all other types of dust emissions were held constant from 2020 to 2022. For the fugitive dust emissions compiled into the 2020 NEI, meteorological adjustments were applied to paved and unpaved road SCCs but not transport-related adjustments. This is because the modeling platform applies meteorological adjustments and transportable fraction adjustments based on unadjusted NEI values. For the 2022 platform, the meteorological adjustments that were applied in the NEI for the paved and unpaved road SCCs were backed out and reapplied in SMOKE at an hourly resolution for each grid cell. The FF10 that is run through SMOKE consists of 100% unadjusted emissions, and after SMOKE all afdust sources have both transportable and meteorological adjustments applied according to year 2022 meteorology. The total impacts of the transportable fraction and meteorological adjustments are shown in Table 2-6.

Table 2-6. Total impact of 2022 fugitive dust adjustments to the unadjusted inventory

State	Unadjusted PM_{10}	Unadjusted $PM_{2.5}$	Change in PM_{10}	Change in $PM_{2.5}$	PM_{10} Reduction	$PM_{2.5}$ Reduction
Alabama	274,336	35,494	-202,367	-25,972	73.4%	72.8%
Arizona	153,731	20,858	-56,262	-7,470	36.0%	35.3%
Arkansas	398,457	55,506	-276,216	-37,439	69.1%	67.2%
California	336,443	43,093	-140,763	-17,470	41.3%	40.0%
Colorado	276,997	39,377	-145,222	-19,463	52.1%	49.1%
Connecticut	21,526	3,333	-15,568	-2,400	71.6%	71.3%
Delaware	16,535	2,554	-9,619	-1,483	57.3%	57.2%

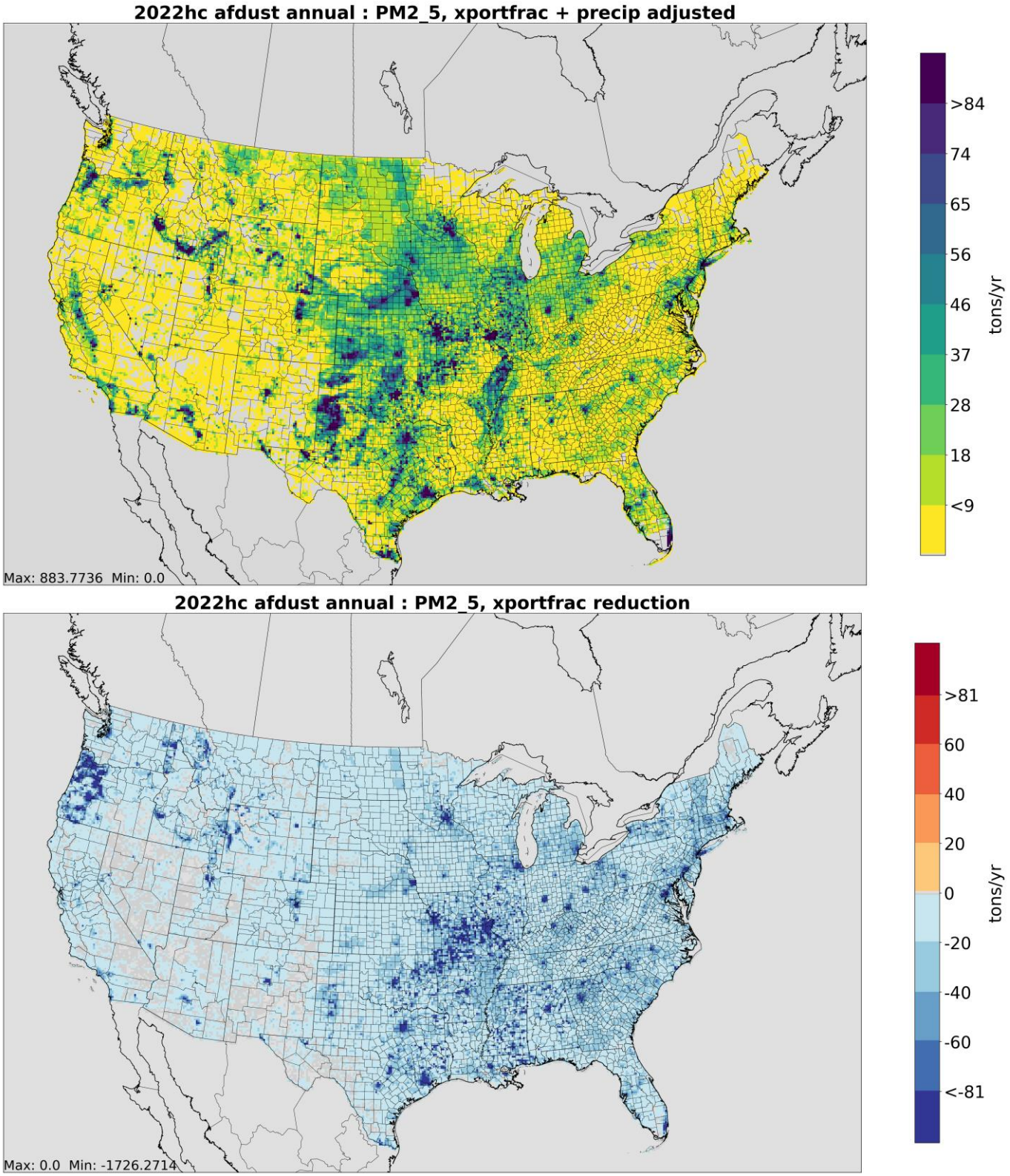
State	Unadjusted PM_{10}	Unadjusted $PM_{2.5}$	Change in PM_{10}	Change in $PM_{2.5}$	PM_{10} Reduction	$PM_{2.5}$ Reduction
District of Columbia	3,494	477	-2,325	-318	65.5%	65.7%
Florida	215,212	34,456	-117,305	-18,353	53.9%	52.7%
Georgia	296,225	41,844	-218,924	-30,614	73.5%	72.8%
Idaho	496,108	58,552	-288,420	-32,354	57.8%	55.0%
Illinois	702,578	90,846	-423,470	-53,837	60.0%	59.0%
Indiana	160,577	29,875	-98,398	-18,297	60.8%	60.8%
Iowa	370,922	54,793	-207,369	-29,999	55.7%	54.6%
Kansas	583,732	79,848	-238,573	-31,989	40.6%	39.9%
Kentucky	179,629	29,151	-127,894	-20,583	70.9%	70.3%
Louisiana	196,181	29,769	-125,867	-18,850	63.8%	63.0%
Maine	41,717	5,878	-33,149	-4,674	79.1%	79.1%
Maryland	60,743	8,821	-39,070	-5,688	63.6%	63.8%
Massachusetts	63,722	8,640	-46,310	-6,151	72.1%	70.6%
Michigan	293,285	38,837	-199,924	-26,154	67.8%	67.0%
Minnesota	537,979	72,776	-331,407	-43,413	61.4%	59.4%
Mississippi	439,287	52,963	-320,342	-37,933	72.6%	71.4%
Missouri	1,439,199	165,014	-960,853	-108,931	66.5%	65.7%
Montana	498,406	66,114	-321,080	-40,509	64.2%	61.1%
Nebraska	507,702	69,197	-194,215	-25,960	38.0%	37.3%
Nevada	125,368	16,303	-43,279	-5,635	33.8%	33.9%
New Hampshire	16,102	3,307	-12,859	-2,634	79.2%	79.0%
New Jersey	36,477	7,100	-23,617	-4,520	64.2%	63.0%
New Mexico	176,997	22,719	-73,934	-9,313	41.4%	40.6%
New York	264,168	37,984	-196,292	-27,753	73.8%	72.6%
North Carolina	257,146	35,016	-183,428	-24,779	70.9%	70.4%
North Dakota	360,358	55,646	-197,013	-29,403	54.5%	52.7%
Ohio	276,882	43,091	-188,841	-29,167	67.7%	67.2%
Oklahoma	562,803	77,603	-279,078	-37,504	49.3%	48.1%
Oregon	731,384	81,811	-548,493	-59,487	74.7%	72.4%
Pennsylvania	149,280	26,152	-106,519	-18,934	70.7%	71.8%
Rhode Island	6,003	1,006	-4,056	-674	66.7%	66.2%
South Carolina	190,577	25,236	-137,314	-18,038	71.7%	71.1%
South Dakota	210,669	37,092	-95,147	-16,442	45.0%	44.2%
Tennessee	141,443	26,022	-98,397	-18,111	69.2%	69.2%
Texas	1,540,940	214,891	-691,078	-94,837	44.5%	43.8%
Utah	142,084	18,020	-80,959	-9,976	56.5%	54.9%
Vermont	58,010	6,495	-50,078	-5,574	86.0%	85.5%
Virginia	138,872	22,095	-106,664	-17,031	76.3%	76.6%

State	Unadjusted PM_{10}	Unadjusted $PM_{2.5}$	Change in PM_{10}	Change in $PM_{2.5}$	PM_{10} Reduction	$PM_{2.5}$ Reduction
Washington	174,558	21,778	-101,076	-12,665	57.3%	57.6%
West Virginia	70,339	9,842	-62,535	-8,718	88.5%	88.2%
Wisconsin	202,901	34,398	-135,251	-22,889	66.2%	66.2%
Wyoming	588,124	62,948	-332,653	-35,219	56.3%	55.7%
Domain Total (12km CONUS)	**14,986,209**	**2,024,623**	**-8,889,472**	**-1,175,604**	**59.0%**	**57.8%**

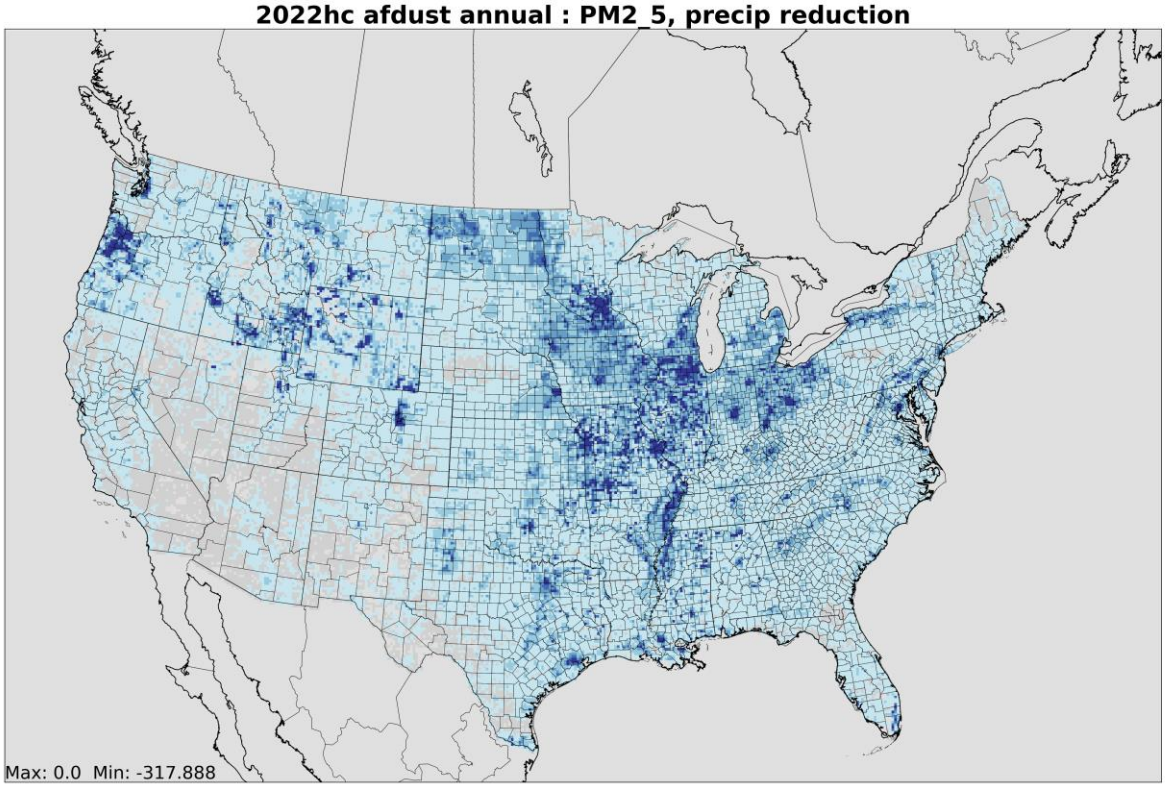
For categories other than paved roads, where states submitted afdust data to the NEI it was assumed that the state-submitted data were not met-adjusted and therefore the meteorological adjustments were applied. Thus, if states submitted data that were met-adjusted for sources other than paved and unpaved roads, these sources would have been adjusted for meteorology twice. Even with that possibility, air quality modeling shows that, in general, dust is frequently overestimated in the air quality modeling results.

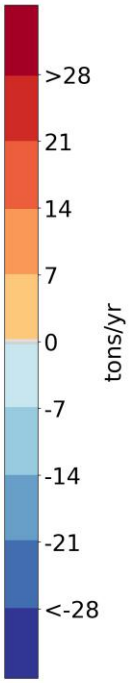
Figure 2-1 illustrates the impact of each step of the adjustment. The reductions due to the transportable fraction adjustments alone are shown at the top of the figure. The reductions due to the precipitation adjustments alone are shown in the middle of the figure. The cumulative emission reductions after both transport fraction and meteorological adjustments are shown at the bottom of the figure. The top plot shows how the transport fraction has a larger reduction effect in the east, where forested areas are more effective at reducing PM transport than in many western areas. The middle plot shows how the meteorological impacts of precipitation, along with snow cover in the north, further reduce the dust emissions.

Figure 2-1. Fugitive dust emissions and impact of adjustments due to transportable fraction, precipitation, and cumulative

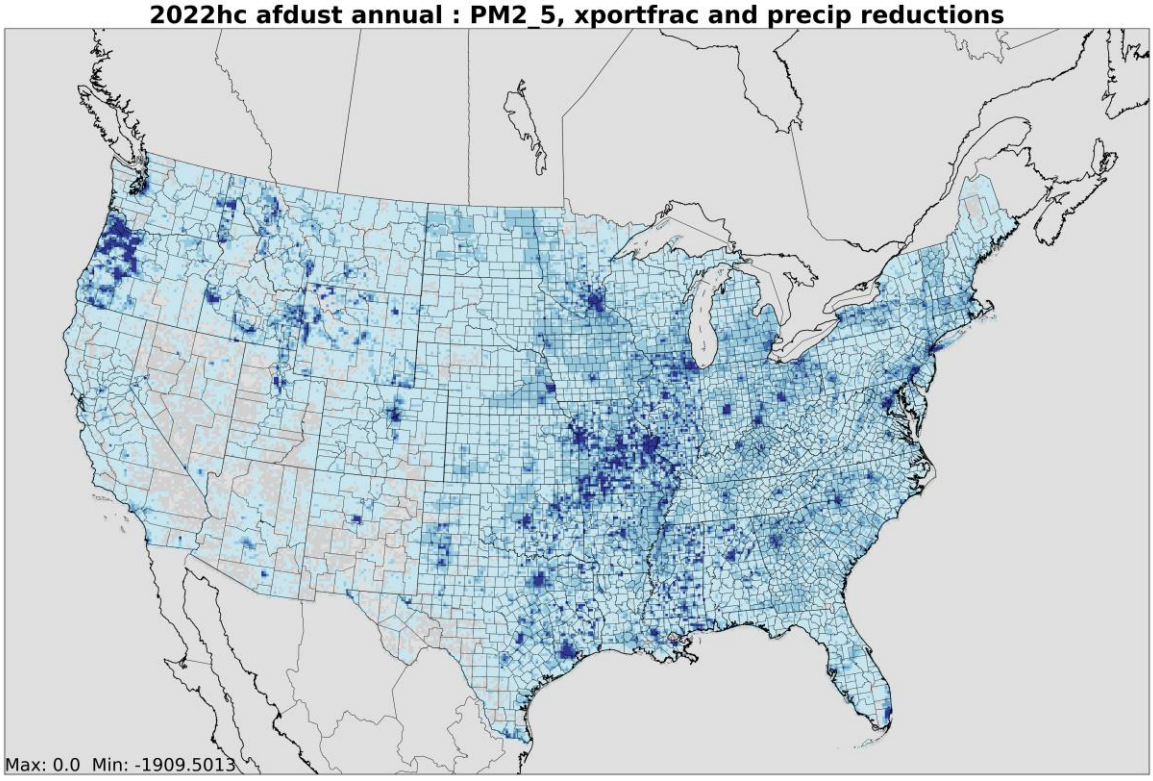


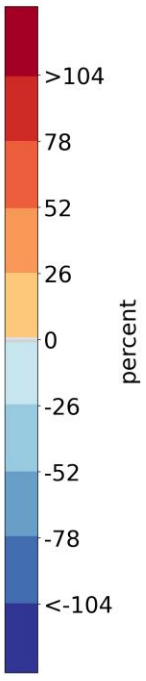
2022hc afdust annual : PM2_5, precip reduction





2022hc afdust annual : PM2_5, xportfrac and precip reductions





2.2.2 Agricultural Livestock (livestock)

The livestock SCCs are shown in Table 2-7. The livestock emissions are related to beef and dairy cattle, poultry production and waste, swine production, waste from horses and ponies, and production and waste for sheep, lambs, and goats. The sector does not include quite all of the livestock NH_3 emissions, as there is a very small amount of NH_3 emissions from livestock in the ptnonipm inventory (as point sources). In addition to NH_3, the sector includes livestock emissions for all pollutants other than $PM_{2.5}$, since $PM_{2.5}$ from dust kicked up from livestock hooves are included in the afdust sector.

Agricultural livestock emissions in the 2022 platform were developed using methods similar to those used to develop the 2020 NEI, which is a mix of state-submitted data and EPA estimates. The 2020 NEI approach for estimating livestock emissions utilizes daily emission factors by animal and county from a model developed by Carnegie Mellon University (CMU) (Pinder, 2004, McQuilling, 2015) and 2020 U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) survey. Details on the approach used to develop livestock emissions for the 2020 NEI are provided in Section 10 of the 2020 NEI TSD. Animal populations used for estimating livestock emissions came from 2022 USDA survey data (see QuickStats at https://quickstats.nass.usda.gov) for the available counties. The FEM model was run for 2022 using the 2022 animal counts and meteorological data for 2022 to create the emission inventories for the livestock sector.

Table 2-7. SCCs for the livestock sector

SCC	Tier 1 description	Tier 2 description	Tier 3 description	Tier 4 description
2805002000	Miscellaneous Area Sources	Ag. Production – Livestock	Beef cattle production composite	Not Elsewhere Classified
2805007100	Miscellaneous Area Sources	Ag. Production – Livestock	Poultry production - layers with dry manure management systems	Confinement
2805009100	Miscellaneous Area Sources	Ag. Production – Livestock	Poultry production - broilers	Confinement
2805010100	Miscellaneous Area Sources	Ag. Production – Livestock	Poultry production - turkeys	Confinement
2805018000	Miscellaneous Area Sources	Ag. Production – Livestock	Dairy cattle composite	Not Elsewhere Classified
2805025000	Miscellaneous Area Sources	Ag. Production – Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)
2805035000	Miscellaneous Area Sources	Ag. Production – Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified
2805040000	Miscellaneous Area Sources	Ag. Production – Livestock	Sheep and Lambs Waste Emissions	Total
2805045000	Miscellaneous Area Sources	Ag. Production – Livestock	Goats Waste Emissions	Not Elsewhere Classified

2.2.3 Agricultural Fertilizer (fertilizer)

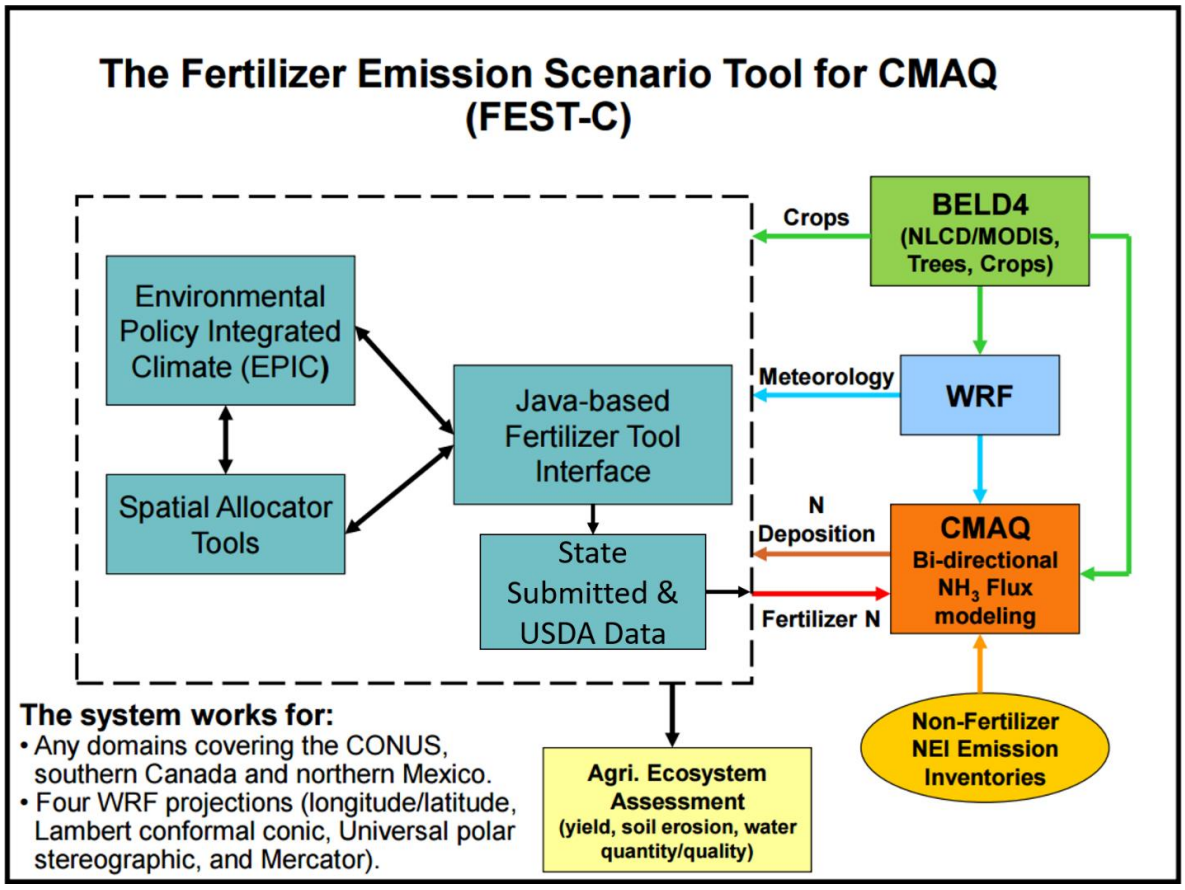
As described in the 2020 NEI TSD, fertilizer emissions were based on the FEST-C model (https://www.cmascenter.org/fest-c/). Unlike most of the other emissions input to the CMAQ model, fertilizer emissions are computed during a run of CMAQ in bi-directional mode and are output during the

model run. The bidirectional version of CMAQ (v5.4) and the Fertilizer Emissions Scenario Tool for CMAQ FEST-C (v1.3) were used to estimate ammonia (NH_3) emissions from agricultural soils. The computed emissions were saved during the CMAQ run so they can be included in emissions summaries and in other model runs that do not use the bidirectional method.

FEST-C is the software program that processes land use and agricultural activity data to develop inputs for the CMAQ model when run with bidirectional exchange. FEST-C reads land use data from the Biogenic Emissions Landuse Dataset (BELD), meteorological variables from the Weather Research and Forecasting (WRF) model for the year to be modeled, and nitrogen deposition data from a previous or historical average CMAQ simulation. FEST-C, then uses the Environmental Policy Integrated Climate (EPIC) modeling system (https://epicapex.tamu.edu/epic/) to simulate the agricultural practices and soil biogeochemistry and provides information regarding fertilizer timing, composition, application method and amount.

An iterative calculation was applied to estimate fertilizer emissions. First, fertilizer application by crop type was estimated using FEST-C modeled data. To develop the emissions for this platform, CMAQ v5.4 was run with the Surface Tiled Aerosol and Gaseous Exchange (STAGE) deposition option along with bidirectional exchange to estimate fertilizer and biogenic NH3 emissions. However, for this study, the M3DRY option was used to develop the fertilizer emissions. Figure 2-2 shows a schematic of the bidirectional modeling system.

Figure 2-2. "Bidi" modeling system used to compute emissions from fertilizer application



Fertilizer Activity Data

The following activity parameters were input into the EPIC model:

- Grid cell meteorological variables from WRF
- Initial soil profiles/soil selection
- Presence of 21 major crops: irrigated and rain fed hay, alfalfa, grass, barley, beans, grain corn, silage corn, cotton, oats, peanuts, potatoes, rice, rye, grain sorghum, silage sorghum, soybeans, spring wheat, winter wheat, canola, and other crops (e.g., lettuce, tomatoes, etc.)
- Fertilizer sales to establish the type/composition of nutrients applied
- Management scenarios for the 10 USDA production regions. These include irrigation, tile drainage, intervals between forage harvest, fertilizer application method (injected versus surface applied), and equipment commonly used in these production regions.

The WRF meteorological model was used to provide grid cell meteorological parameters for the year 2022 using a national 12-km rectangular grid covering the continental U.S. The meteorological parameters in Table 2-8 were used as EPIC model inputs.

Table 2-8. Source of input variables for EPIC

EPIC input variable	Variable Source
Daily Total Radiation (MJ/m^2)	WRF
Daily Maximum 2-m Temperature (C)	WRF
Daily minimum 2-m temperature (C)	WRF
Daily Total Precipitation (mm)	WRF
Daily Average Relative Humidity (unitless)	WRF
Daily Average 10-m Wind Speed ($m\ s^{-1}$)	WRF
Daily Total Wet Deposition Oxidized N (g/ha)	CMAQ
Daily Total Wet Deposition Reduced N (g/ha)	CMAQ
Daily Total Dry Deposition Oxidized N (g/ha)	CMAQ
Daily Total Dry Deposition Reduced N (g/ha)	CMAQ
Daily Total Wet Deposition Organic N (g/ha)	CMAQ

Initial soil nutrient and pH conditions in EPIC were based on the 1992 USDA Soil Conservation Service (CSC) Soils-5 survey. The EPIC model then was run for 25 years using current fertilization and agricultural cropping techniques to estimate soil nutrient content and pH for the 2017 EPIC/WRF/CMAQ simulation.

The presence of crops in each model grid cell was determined using USDA Census of Agriculture data (2012) and USGS National Land Cover data (2011). These two data sources were used to compute the fraction of agricultural land in a model grid cell and the mix of crops grown on that land.

Fertilizer sales data and the 6-month period in which they were sold were extracted from the 2014 Association of American Plant Food Control Officials (AAPFCO, http://www.aapfco.org/publications.html). AAPFCO data were used to identify the composition (e.g., urea, nitrate, organic) of the fertilizer used, and the amount applied was estimated using the modeled crop demand. These data were useful in making a reasonable assignment of what kind of fertilizer was applied to which crops.

Management activity data refers to data used to estimate representative crop management schemes. The USDA Agricultural Resource Management Survey (ARMS, https://www.ers.usda.gov/data-products/arms-farm-financial-and-crop-production-practices /) was used to provide management activity data. These data cover 10 USDA production regions and provide management schemes for irrigated and rain fed hay, alfalfa, grass, barley, beans, grain corn, silage corn, cotton, oats, peanuts, potatoes, rice, rye, grain sorghum, silage sorghum, soybeans, spring wheat, winter wheat, canola, and other crops (e.g., lettuce, tomatoes, etc.).

2.2.4 Nonpoint Oil and Gas Sector (np_oilgas)

The nonpoint oil and gas (np_oilgas) sector includes onshore and offshore oil and gas emissions. The EPA estimated emissions for all counties with 2022 oil and gas activity data using the Oil and Gas Tool. The types of sources covered include drill rigs, workover rigs, artificial lift, hydraulic fracturing engines, pneumatic pumps and other devices, storage tanks, flares, truck loading, compressor engines, and dehydrators. Because of the importance of emissions from this sector, special consideration was given to the speciation, spatial allocation, and monthly temporalization of nonpoint oil and gas emissions, instead of relying on older, more generalized profiles.

The 2020 NEI version of the Nonpoint Oil and Gas Emission Estimation Tool (i.e., the "NEI oil and gas tool") populated with 2022-specific activity data and updated with Subpart W data was used to estimate 2022. Year 2022 oil and gas activity data were obtained from Enverus' activity database (www.enverus.com) and supplied by some state air agencies. The NEI oil and gas tool is an Access database that utilizes county-level activity data (e.g., oil production and well counts), operational characteristics (types and sizes of equipment), and emission factors to estimate emissions. The tool was used to create a CSV-formatted emissions dataset covering all national nonpoint oil and gas emissions. This dataset was converted to the FF10 format for use in SMOKE modeling. More details on the inputs for and running of the tool for 2020 are provided in the 2020 NEI TSD. Table 2-9 shows the nonpoint oil and gas NOx and VOC emissions for 2022 by state. The Colorado emissions in this table include updated emissions for the state developed from the Oil and Gas Tool and state-submitted emissions, along with emissions submitted to the 2020 NEI within the Southern Ute reservation that are still used in this 2022 platform. For spatial allocation purposes, the Southern Ute oil and gas emissions – totaling 11,663 tons/yr of NOx and 879 tons/yr of VOC - were allocated to Colorado counties, with 95% of the emissions in La Plata County (FIPS 08067) and 5% of the emissions in Archuleta County (FIPS 08007).

Table 2-9. Nonpoint oil and gas emissions for 2022

State	2022 NOx	2022 VOC
Alabama	3,914	11,545
Alaska	2,815	9,665
Arizona	12	137

State	2022 NOx	2022 VOC
Arkansas	4,586	8,526
California	1,298	28,206
Colorado	29,542	56,625
Florida	19	1,123
Georgia	0	0
Idaho	12	99
Illinois	13,887	49,502
Indiana	2,741	13,492
Iowa	0	0
Kansas	22,927	62,638
Kentucky	16,116	42,631
Louisiana	17,099	52,799
Maryland	1	2
Michigan	10,435	13,227
Minnesota	0	0
Mississippi	1,807	17,404
Missouri	232	554
Montana	1,815	31,980
Nebraska	247	1,778
Nevada	4	160
New Mexico	99,096	282,137
New York	887	7,131
North Carolina	0	0
North Dakota	43,681	226,680
Ohio	2,996	30,890
Oklahoma	44,446	170,335
Oregon	6	20
Pennsylvania	58,718	139,865
South Dakota	196	1,291
Tennessee	1,057	3,272
Texas	258,865	1,339,498
Utah	8,442	69,862
Virginia	3,826	7,883
Washington	0	3
West Virginia	25,351	77,700
Wyoming	1,943	8,571

A new source was added to the oil and gas sector for the 2020 NEI. Pipeline Blowdowns and Pigging (SCC= 2310021801) emissions were estimated using US EPA Greenhouse Gas Reporting Program (GHGRP) data. These Pipeline Blowdowns and Pigging emissions for year 2022 included county-level estimates of VOC, benzene, toluene, ethylbenzene, and xylene (BTEX). These emissions estimates were calculated outside of the Oil and Gas Tool and submitted to EIS separately from the Oil and Gas Tool emissions. These emissions were considered EPA default emissions and SLTs had the opportunity to

submit their own Pipeline Blowdowns and Pigging (e.g., Utah) emissions and/or accept/omit these emissions using the Nonpoint Survey. Unfortunately, these EPA default Pipeline Blowdowns and Pigging emissions did not get into the 2020 NEI release for the states that accepted these emissions due to EIS tagging issues. These emissions were included in this 2022 Emissions Modeling Platform. Table 2-10 shows the emissions totals by state for Pipeline Blowdowns and Pigging sources.

An additional new source was added to the oil and gas sector for this 2021 and 2022 modeling platforms. This new source was abandoned oil and gas wells in the USA. The term "abandoned wells" encompasses various types of wells:

- Wells with no recent production, and not plugged. Common terms (such as those used in state databases) might include: inactive, temporarily abandoned, shut-in, dormant, and idle.
- Wells with no recent production and no responsible operator. Common terms might include: orphaned, deserted, long-term idle, and abandoned.
- Wells that have been plugged to prevent migration of gas or fluids.

As of year 2022, there were approximately 3.7 million abandoned wells in the U.S., with around 2.3 million abandoned oil wells, 0.6 million abandoned gas wells, and 0.8 million abandoned dry wells (may be oil or gas wells). Abandoned wells may emit CH4, CO2, VOC, and various HAP.

Estimates of greenhouse gas (GHG) emissions (CH4 and CO2) from abandoned wells have been estimated as part of the Inventory of U.S. Greenhouse Gas Emissions and Sinks since 2018. Currently, the inventory from 1990 – 2022 is available[5]. The GHG inventory (GHGI) methodology and estimates of emissions from abandoned wells served as the starting point for development of the VOC and HAP emissions inventory for abandoned wells used in this year 2022 modeling platform. Year 2022 estimates of VOC and BTEX were estimated and used in this 2022 modeling platform. Table 2-11 shows the emissions totals by state for Pipeline Blowdowns and Pigging sources. The inventories for blowdowns and pigging and abandoned wells are separate from the emissions output from the oil and gas tool.

Table 2-10. State emissions totals for year 2022 for Pipeline Blowdowns and Pigging sources

State	VOC (tpy)	Benzene (tpy)	Ethylbenzene (tpy)	Toluene (tpy)	Xylene (tpy)
Alabama	329	1.35	0.074	1.17	0.35
Alaska	14	0.06	0.004	0.06	0.02
Arizona	97	0.44	0.025	0.39	0.11
Arkansas	22	0.01	0.000	0.00	0.00
California	146	0.67	0.038	0.59	0.17
Colorado	2,137	5.47	0.273	6.86	2.14
Florida	2	0.00	0.000	0.00	0.00
Illinois	210	0.77	0.043	0.68	0.19
Indiana	180	0.73	0.042	0.65	0.19
Kansas	1,326	2.34	0.273	1.98	0.86
Kentucky	531	2.40	0.136	2.14	0.61
Louisiana	365	3.01	0.000	0.30	0.51
Maryland	0	0.00	0.000	0.00	0.00

[5] Inventory of U.S. Greenhouse Gas Emissions and Sinks | US EPA

State	VOC (tpy)	Benzene (tpy)	Ethylbenzene (tpy)	Toluene (tpy)	Xylene (tpy)
Michigan	239	1.08	0.061	0.97	0.27
Mississippi	2,183	3.35	0.072	1.29	1.08
Missouri	4	0.00	0.000	0.00	0.00
Montana	147	0.67	0.038	0.59	0.17
Nebraska	57	0.14	0.007	0.17	0.05
New Mexico	1,044	0.00	0.000	0.00	0.00
New York	140	0.63	0.036	0.57	0.16
North Dakota	9	0.04	0.002	0.04	0.01
Ohio	391	1.77	0.100	1.58	0.45
Oklahoma	2,004	1.47	0.090	1.16	0.89
Oregon	8	0.04	0.002	0.03	0.01
Pennsylvania	66	0.30	0.017	0.27	0.08
South Dakota	2	0.01	0.001	0.01	0.00
Tennessee	13	0.06	0.003	0.05	0.01
Texas	9,599	9.05	0.236	3.82	3.23
Utah	18	0.09	0.005	0.08	0.04
Virginia	189	0.86	0.049	0.77	0.22
West Virginia	859	3.89	0.221	3.47	0.99
Wyoming	680	4.19	0.327	2.04	1.34
US Total	**23,010**	**44.92**	**2.172**	**31.77**	**14.15**

Table 2-11. State emissions totals for year 2022 for Abandoned Wells sources

State	2022 VOC (tpy)
Alabama	198
Alaska	64
Arizona	10
Arkansas	794
California	5,357
Colorado	451
Florida	32
Georgia	0
Idaho	0
Illinois	6,738
Indiana	3,326
Iowa	0
Kansas	6,663
Kentucky	12,817
Louisiana	3,195
Maryland	1
Michigan	487
Minnesota	0
Mississippi	749
Missouri	118

State	2022 VOC (tpy)
Montana	740
Nebraska	141
Nevada	34
New Mexico	348
New York	596
North Carolina	0
North Dakota	401
Ohio	22,286
Oklahoma	8,944
Oregon	3
Pennsylvania	69,730
South Dakota	31
Tennessee	1,329
Texas	31,588
Utah	178
Virginia	69
Washington	3
West Virginia	2,723
Wyoming	552
US Total	**180,694**

Lastly, EPA and the state of Oklahoma, New Mexico and Kansas worked together to exercise the point source subtraction step in the Oil and Gas Tool during the 2022 platform development period. This point source subtraction step is a process used to eliminate possible double counting of sources in the Oil and Gas Tool that are already defined in the point source inventory.

2.2.5 Residential Wood Combustion (rwc)

The residential wood combustion (rwc) sector includes residential wood burning devices such as fireplaces, fireplaces with inserts (inserts), free standing woodstoves, pellet stoves, outdoor hydronic heaters (also known as outdoor wood boilers), indoor furnaces, and outdoor burning in firepots and chimeneas. Free standing woodstoves and inserts are further differentiated into three categories: 1) conventional (not EPA certified); 2) EPA certified, catalytic; and 3) EPA certified, noncatalytic. Generally speaking, the conventional units were constructed prior to 1988. Units constructed after 1988 have to meet EPA emission standards and they are either catalytic or non-catalytic. As with the other nonpoint categories, a mix of S/L and EPA estimates were used. The EPA's estimates use updated methodologies for activity data and some changes to emission factors. The source classification codes (SCCs) in the rwc sector are listed in Table 2-12.

The 2022 platform RWC emissions are adjusted from 2020 NEI using SEDS data for 2021. Additionally, Idaho provided new 2022 RWC emissions data, and California (CARB) requested two updates: use EPA estimates for the SCC 2104008700, and remove emissions other than NH3 from the SCCs 2104008210, 2104008200, and 2104008230. Some improvements to RWC emissions estimates were developed as part of the 2020 NEI process. The EPA, along with the Commission on Environmental Cooperation (CEC),

the Northeast States for Coordinated Air Use Management (NESCAUM), and Abt Associates, conducted a national survey of wood-burning activity in 2018. The results of this survey were used to estimate county-level burning activity data. The activity data for RWC processes is the amount of wood burned in each county, which is based on data from the CEC survey on the fraction of homes in each county that use each wood-burning appliance and the average amount of wood burned in each appliance. These assumptions were used with the number of occupied homes in each county to estimate the total amount of wood burned in each county, in cords for cordwood appliances and tons for pellet appliances. Cords of wood were converted to tons using county-level density factors from the U.S. Forest Service. RWC emissions were calculated by multiplying the tons of wood burned by emissions factors. For more information on the development of the residential wood combustion emissions, see Section 27 of the 2020 NEI TSD.

Table 2-12. SCCs for the residential wood combustion sector

SCC	Tier 1 Description	Tier 2 Description	Tier 3 Description	Tier 4 Description
2104008100	Stationary Source Fuel Combustion	Residential	Wood	Fireplace: general
2104008210	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; non-EPA certified
2104008220	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic
2104008230	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; catalytic
2104008300	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, general
2104008310	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, non-EPA certified
2104008320	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, non-catalytic
2104008330	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, catalytic
2104008400	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: pellet-fired, general (freestanding or FP insert)
2104008510	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified
2104008530	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, pellet-fired, general
2104008610	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: outdoor
2104008620	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: indoor
2104008630	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: pellet-fired
2104008700	Stationary Source Fuel Combustion	Residential	Wood	Outdoor wood burning device, NEC (fire-pits, chimeneas, etc)
2104009000	Stationary Source Fuel Combustion	Residential	Firelog	Total: All Combustor Types

2.2.6 Solvents (np_solvents)

The np_solvents sector is a diverse collection of emission sources for which emissions are driven by evaporation. Included in this sector are everyday items, such as cleaners, personal care products, adhesives, architectural and aerosol coatings, printing inks, and pesticides. These sources exclusively emit organic gases and feature origins spanning residential, commercial, institutional, and industrial settings. The organic gases that evaporate from these sources often fulfill other functions than acting as a traditional solvent (e.g., propellants, fragrances, emollients). For this reason, the solvents sector is often referred to as "volatile chemical products." The base methodology used to estimate these emissions are unchanged from the 2020 NEI, which is described in Section 32 of the 2020 NEI TSD, including the SCCs that are included in the sector.

For 2022, all np_solvent emissions, except asphalt paving, are projected using the 2020 NEI as a base year. This includes State, Locality, and Tribal emissions submissions. Here, the model used to estimate a majority of the nonpoint solvent emissions in the NEI (VCPy) was used to estimate 2021 emissions (2022 usage data were not available). From there a SCC-specific ratio (of 2021 / 2020) was applied to the 2020 NEI. This method ensures that state-submitted emissions magnitudes are preserved. In addition, some updates were made based on comments provided by New Jersey, and asphalt-related SCCs featured temporal profile updates using EIA-based monthly profiles for "asphalt and road oil" by PADD region.

2.2.7 Open burning (openburn)

This new sector for 2022v1 platform was split out from the nonpt sector and includes emissions from @yard waste, land clearing, and residential household waste burning (SCCs starting with 261). For 2022v1, these emissions were held constant at 2020 NEI levels.

Table 2-13. SCCs in the openburn sector

SCC	Description
2610000100	Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Yard Waste - Leaf Species Unspecified
2610000400	Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Yard Waste - Brush Species Unspecified
2610000500	Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Land Clearing Debris
2610030000	Waste Disposal, Treatment, and Recovery; Open Burning; Residential; Household Waste
2610000300	Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Yard Waste - Weed Species Unspecified (incl Grass)

2.2.8 Nonpoint (nonpt)

The 2022 platform nonpt sector inventory is based on the April 2023 version of the 2020 NEI but adjusted to better reflect 2022 emissions levels as described below. Stationary nonpoint sources that were not subdivided into the afdust, livestock, fertilizer, np_oilgas, rwc or np_solvents sectors were assigned to the "nonpt" sector. Locomotives and CMV mobile sources from the 2020 NEI nonpoint inventory are described with the mobile sources. The types of sources in the nonpt sector include:

- stationary source fuel combustion, including industrial, commercial, and residential and orchard heaters;

- chemical manufacturing;
- industrial processes such as commercial cooking, metal production, mineral processes, petroleum refining, wood products, fabricated metals, and refrigeration;
- storage and transport of petroleum for uses such as portable gas cans, bulk terminals, gasoline service stations, aviation, and marine vessels;
- storage and transport of chemicals;
- waste disposal, treatment, and recovery via incineration, open burning, landfills, and composting; and
- miscellaneous area sources such as cremation, hospitals, lamp breakage, and automotive repair shops.

The nonpt sector includes emission estimates for Portable Fuel Containers (PFCs), also known as "gas cans." The PFC inventory consists of three distinct sources of PFC emissions, further distinguished by residential or commercial use. The three sources are: (1) displacement of the vapor within the can; (2) emissions due to evaporation (i.e., diurnal emissions); and (3) emissions due to permeation. Note that spillage and vapor displacement associated with using PFCs to refuel nonroad equipment are included in the nonroad inventory.

The factors used to adjust the emissions were developed using the datasets as described in Table 2-14. Emissions for SCC groups other than those listed in this table (e.g., waste disposal, treatment and recovery) were held constant at 2020 NEI levels in the 2022 base year inventory.

Table 2-14. Datasets used to Develop Factors to Adjust Nonpoint Emissions from 2020 to 2022

Source Category Group	2020-2022 Projection Method
All Other Nonpoint Source Fuel Combustion	Apply EIA State Energy Data System energy consumption ratios. Note that 2021 SEDS data are available for all fuels and 2022 data are available for some fuels.
Stage 1 Gasoline Unloading at Service Stations	Apply EIA State Energy Data System Transportation Sector/Motor Gasoline consumption ratios
Stage 1 Gasoline Unloading at Bulk Terminals/Plants	Apply EIA State Energy Data System Total Motor Gasoline consumption ratios
Aviation Gasoline Stage I and II	Apply EIA State Energy Data System Aviation Gasoline consumption ratios
Pipeline Gasoline	Apply EIA State Energy Data System Total Motor Gasoline consumption ratios
Human Cremation	Estimate 2022 county-level number of cremations from 2022 actual county-level deaths from CDC's Wonder Database and 2022 state-level (projected) cremation rates from National Funeral Directors Association's "Cremation and Burial Report" and apply 2022/2020 county-level cremation ratios to 2020 NEI cremation emissions to compute 2022 cremation emissions
Commercial Cooking	Hold constant
Portable Fuel Containers	Hold constant
Asphalt Paving	Hold constant

Source Category Group	2020-2022 Projection Method
Landfills/POTWs	Hold constant
Charcoal Grilling	Hold constant

2.3 Onroad Mobile sources (onroad)

Onroad mobile sources include emissions from motorized vehicles operating on public roadways. These include passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses. The sources are further divided by the fuel they use, including diesel, gasoline, E-85, compressed natural gas (CNG), or electric vehicles. The sector characterizes emissions from parked vehicle processes (e.g., starts, hot soak, and extended idle) as well as from on-network processes (i.e., from vehicles as they move along the roads). For more details on the approach and for a summary of the MOVES inputs submitted by states, see Section 5 of the 2020 NEI TSD (EPA, 2023).

For the 2022 emissions modeling platform activity data (i.e., vehicle miles traveled (VMT) and vehicle population (VPOP)) were based on data submitted by state and local agencies for the 2020 NEI and for the 2022 platform, as well as data from Federal Highway Administration (FHWA) annual VMT at the county level. VMT were based on county-level VM-2 data from FHWA. VPOP was mostly held constant at 2020 levels. A new MOVES run for 2022 was done using MOVES4 to obtain year-specific emission factors.

Except for California, all onroad emissions were generated using the SMOKE-MOVES emissions modeling framework that leverages MOVES-generated emission factors https://www.epa.gov/moves), county and SCC-specific activity data, and hourly 2022 meteorological data. Specifically, EPA used vehicle miles traveled (VMT) and other 2022-specific activity data, along with tools that interface between the MOVES model and SMOKE. In this way, it was possible to take advantage of the gridded hourly temperature data available from meteorological modeling that are also used for air quality modeling. The onroad source classification codes (SCCs) in the emissions modeling platform are more finely resolved than those in the National Emissions Inventory (NEI). The NEI SCCs distinguish vehicles and fuels, while the SCCs used in the model platform also distinguish between emissions processes (i.e., off-network, on-network, and extended idle), and road types. EPA mostly elected to keep 2020 NEI fuel splits (derived from MOVES3) and not upgrade to MOVES4 fuels.

MOVES4 includes the following updates from MOVES3 that impacted the development of the emissions modeling platform:

- Incorporates updates to fuel supply, inspection and maintenance programs, and emission rates.
- Accounts for the emission impacts of the EPA heavy-duty low NOx rule for model years 2027 and later and the light-duty greenhouse gas rule for model years 2023 and later.
- Adds the ability to model heavy-duty battery-electric and fuel-cell vehicles, as well as compressed natural gas (CNG) long-haul combination trucks.
- Improves the modeling of light-duty electric vehicles.

2.3.1 Inventory Development using SMOKE-MOVES

Except for California, onroad emissions were computed with SMOKE-MOVES by multiplying specific types of vehicle activity data by the appropriate emission factors. This section includes discussions of the

activity data and the emission factor development. The vehicles (aka source types) for which MOVES computes emissions are shown in Table 2-15. SMOKE-MOVES was run for specific modeling grids. Emissions for the contiguous U.S. states and Washington, D.C., were computed for a grid covering those areas. Emissions for Alaska, Hawaii, Puerto Rico, and the U.S. Virgin Islands were computed by running SMOKE-MOVES for distinct grids covering each of those regions and are included in the onroad non-Conus sector. In some summary reports these non-CONUS emissions are aggregated with emissions from the onroad sector.

Table 2-15. MOVES vehicle (source) types

MOVES vehicle type	Description	HPMS vehicle type
11	Motorcycle	10
21	Passenger Car	25
31	Passenger Truck	25
32	Light Commercial Truck	25
41	Other Bus	40
42	Transit Bus	40
43	School Bus	40
51	Refuse Truck	50
52	Single Unit Short-haul Truck	50
53	Single Unit Long-haul Truck	50
54	Motor Home	50
61	Combination Short-haul Truck	60
62	Combination Long-haul Truck	60

SMOKE-MOVES makes use of emission rate "lookup" tables generated by MOVES that differentiate emissions by process (i.e., running, start, vapor venting, etc.), vehicle type, road type, temperature, speed, hour of day, etc., to generate the MOVES emission rates that could be applied across the U.S., EPA used an automated process to run MOVES to produce year 2022-specific emission factors by temperature and speed for a series of "representative counties," to which every other county was mapped. The representative counties for which emission factors were generated were selected according to their state, elevation, fuels, age distribution, ramp fraction, and inspection and maintenance programs. Each county was then mapped to a representative county based on its similarity to the representative county with respect to those attributes. For this study, there are 259 representative counties in the continental U.S. and a total of 298 including the non-CONUS areas. The only differences between 2020 and 2022 being a change in Alaska county equivalents which removed one borough (county ID 2261, Valdez-Cordova Census Area) which in 2019 split into two areas (county ID 2063, Chugach Census Area; and county ID 2066, Copper River Census Area), as well as some updates recommended by Texas.

Once representative counties were identified, emission factors were generated with MOVES for each representative county and for two "fuel months" – January to represent winter months, and July to represent summer months – due to the different types of fuels used. SMOKE selected the appropriate MOVES emissions rates for each county, hourly temperature, SCC, and speed bin and then multiplied the emission rate by appropriate activity data. For on-roadway emissions, vehicle miles traveled (VMT) is the activity data; off-network processes use vehicle population (VPOP), vehicle starts, and hours of off-

network idling (ONI); and hoteling hours are used to develop emissions for extended idling of combination long-haul trucks. These calculations were done for every county and grid cell in the continental U.S. for each hour of the year.

The SMOKE-MOVES process for creating the model-ready emissions consists of the following steps:

1) Determine which counties will be used to represent other counties in the MOVES runs.
2) Determine which months will be used to represent other month's fuel characteristics.
3) Create inputs needed only by MOVES. MOVES requires county-specific information on vehicle populations, age distributions, and inspection-maintenance programs for each of the representative counties.
4) Create inputs needed both by MOVES and by SMOKE, including temperatures and activity data.
5) Run MOVES to create emission factor tables for the temperatures found in each county.
6) Run SMOKE to apply the emission factors to activity data (VMT, VPOP, STARTS, off-network idling, and HOTELING) to calculate emissions based on the gridded hourly temperatures in the meteorological data.
7) Aggregate the results to the county-SCC level for summaries and quality assurance.

The onroad emissions were processed in six processing streams that were then merged together into the onroad sector emissions after each of the six streams have been processed:

- rate-per-distance (RPD) uses VMT as the activity data plus speed and speed profile information to compute on-network emissions from exhaust, evaporative, permeation, refueling, and brake and tire wear processes;
- rate-per-vehicle (RPV) uses VPOP activity data to compute off-network emissions from exhaust, evaporative, permeation, and refueling processes;
- rate-per-profile (RPS) uses STARTS activity data to compute off-network emissions from vehicles starts;
- rate-per-profile (RPP) uses VPOP activity data to compute off-network emissions from evaporative fuel vapor venting, including hot soak (immediately after a trip) and diurnal (vehicle parked for a long period) emissions;
- rate-per-hour (RPH) uses hoteling hours activity data to compute off-network emissions for idling of long-haul trucks from extended idling and auxiliary power unit process; and
- rate-per-hour off-network idling (RPHO) uses off network idling hours activity data to compute off-network idling emissions for all types of vehicles.

The onroad emissions inputs to MOVES for the 2022 emissions modeling platform are based on the 2020 NEI, described in more detail in Section 5 of the 2020 NEI TSD. These inputs include:

- Key parameters in the MOVES County databases (CDBs) including Low Emission Vehicle (LEV) table
- Fuel months
- Activity data (e.g., VMT, VPOP, speed, HOTELING)

Fuel months, age distributions, and other inputs were consistent with those used to compute the 2020 NEI. Activity data submitted by states and development of the EPA default activity data sets for VMT, VPOP, hoteling hours, starts, and off-network idling (ONI) hours follows a similar process to the 2020 NEI, but based on 2022-specific VMT. These methods are described in detail in the 2020 NEI TSD and supporting documents. Details specific to 2022 activity data development are described below.

2.3.2 Onroad Activity Data Development

SMOKE-MOVES uses vehicle miles traveled (VMT), vehicle population (VPOP), vehicle starts, hours of off-network idling (ONI), and hours of hoteling, to calculate emissions. These datasets are collectively known as "activity data." For each of these activity datasets, first a national dataset was developed; this national dataset is called the "EPA default" dataset. The default was supplemented with data submitted by state and local agencies. In the EPA default dataset, VMT was derived from FHWA's county-level VM-2 data for 2022. EPA default VPOP was held constant at 2020 levels, as were the starts and fuel splits. Hours of hoteling and off-network idling were computed from 2022 VMT. EPA default activity was used for California, but the emissions were scaled to California-supplied values during the emissions processing.

Vehicle Miles Traveled (VMT) and Vehicle Population (VPOP)

Activity data submitted by states and development of the EPA default activity data sets for VMT, VPOP, and hoteling hours are described in detail in the 2020 NEI TSD (EPA, 2023) and supporting documents. The process for developing VMT for 2022 is similar to the 2020 NEI process, except starting with 2022-specific VMT from the FHWA VM-2 (county-level and by road type) and VM-4 (distributions of VMT by state and HPMS vehicle type). The VM-2 and VM-4 data were combined to create a 2022 VMT dataset by county, HPMS vehicle type, and road type. 2020 NEI VMT was then used to allocate VMT from HPMS vehicle type to MOVES vehicle type, and to different fuel types. New monthly profiles for 2022 VMT were also used, based on FHWA's Travel Monitoring and Analysis System (TMAS) data. See Section 3.3.8 for more information on the use of TMAS data.

The following states submitted VMT for the 2022 platform base year: AK, CO, CT, DE, GA, KS, MA, MI, MD, ME, NC, NH, NJ, NY, OR, PA, SC, TN, TX, UT, VA, WA, WI, WV, and Jefferson Co. KY. In the final base year data, VMT for Colorado are based on EPA default data, and other activity based on VMT was adjusted as a result of this change. VPOP was mostly held constant with the 2020 NEI VPOP except for a few states that supplied VPOP data: DE, GA, NY, and WI.

Speed Activity (SPDIST)

In SMOKE 4.7, SMOKE-MOVES was updated to use speed distributions similarly to how they are used when running MOVES in inventory mode. The speed distribution file, called SPDIST, specifies the amount of time spent in each MOVES speed bin for each county, vehicle (aka source) type, road type, weekday/weekend, and hour of day. This file contains the same information at the same resolution as the Speed Distribution table used by MOVES but is reformatted for SMOKE.

Speeds are based on data for January 2020 as speed data were not available for 2021 or 2022 in time for the 2022v1 platform. Speed data from the StreetLight dataset were used to generate hourly speed profiles by county, SCC, and month. The SPDIST files for the 2022 emissions modeling platform are based

on a combination of the StreetLight project data and 2020 NEI MOVES CDBs. More information can be found in the 2020 NEI TSD (EPA, 2023) and supporting documents.

Hoteling Hours (HOTELING)

Hoteling hours were computed from the 2022 VMT, using a factor of 0.007248 hoteling hours pet VMT for combination long haul trucks on restricted highways. This is the same approach as in 2020 NEI, except based on 2022 VMT. Hoteling hours were capped by county at a theoretical maximum and any excess hours of the maximum were reduced. For calculating reductions, a dataset of truck stop parking space availability was used, which includes a total number of parking spaces per county. This same dataset is used to develop the spatial surrogate for allocating county-total hoteling emissions to model grid cells. The parking space dataset was last updated during the development of the 2016 platforms. There are 8,760 hours in the year 2022; therefore, the maximum number of possible hoteling hours in a particular county is equal to 8,760 * the number of parking spaces in that county. Hoteling hours were capped at that theoretical maximum value for 2022 in all counties, with some exceptions. Also, Texas submitted hoteling activity for 2020 NEI, and their 2020 hoteling activity was projected to 2022 using ratios of 2022 VMT / 2020 VMT for combination long haul trucks.

Because the truck stop parking space dataset may be incomplete in some areas, and trucks may sometimes idle in areas other than designated spaces, it was assumed that every county has at least 12 parking spaces, even if fewer parking spaces are found in the parking space dataset. Therefore, hoteling hours were never reduced below 105,120 hours for the year in any county. If the unreduced hoteling hours were already below that maximum, the hours were left unchanged; in other words, hoteling activity were never increased in this analysis. For recent NEIs, four states requested that no reductions be applied to the hoteling activity based on parking space availability: CO, ME, NJ, and NY. For these states, reductions based on parking space availability were not applied. Reductions were also not applied in Texas, because the hoteling activity in that state are based on state-submitted data.

The final step related to hoteling activity is to split county totals into separate values for extended idling (SCC 2202620153) and Auxiliary Power Units (APUs) (SCC 2202620191). For 2022 modeling with MOVES4, an 9.8% APU split is used nationwide, meaning that during 9.8% of the hoteling hours auxiliary power units are assumed to be running.

Starts

Onroad “start” emissions are the instantaneous exhaust emissions that occur at the engine start (e.g., due to the fuel rich conditions in the cylinder to initiate combustion) as well as the additional running exhaust emissions that occur because the engine and emission control systems have not yet stabilized at the running operating temperature. Operationally, start emissions are defined as the difference in emissions between an exhaust emissions test with an ambient temperature start and the same test with the engine and emission control systems already at operating temperature. As such, the units for start emission rates are instantaneous grams/start.

MOVES4 uses vehicle population information to sort the vehicle population into source bins defined by vehicle source type, fuel type (gas, diesel, etc.), regulatory class, model year and age. The model uses default data from instrumented vehicles (or user-provided values) to estimate the number of starts for

each source bin and to allocate them among eight operating mode bins defined by the amount of time parked ("soak time") prior to the start. Thus, MOVES4 accounts for different amounts of cooling of the engine and emission control systems. Each source bin and operating mode has an associated g/start emission rate. Start emissions are also adjusted to account for fuel characteristics, light duty inspection and maintenance (I/M) programs, and ambient temperatures. Starts were mostly held constant from 2020 to 2022, except where the VPOP changed and thus starts were changed in proportion to the change in VPOP. Additionally, new monthly profiles were applied for 2022.

Off-network Idling Hours

After creating VMT inputs for SMOKE-MOVES, Off-network idle (ONI) activity data were also needed. ONI is defined in MOVES as time during which a vehicle engine is running idle and the vehicle is somewhere other than on the road, such as in a parking lot, a driveway, or at the side of the road. This engine activity contributes to total mobile source emissions but does not take place on the road network. Examples of ONI activity include:

- light duty passenger vehicles idling while waiting to pick up children at school or to pick up passengers at the airport or train station,
- single unit and combination trucks idling while loading or unloading cargo or making deliveries, and
- vehicles idling at drive-through restaurants.

Note that ONI does not include idling that occurs on the road, such as idling at traffic signals, stop signs, and in traffic—these emissions are included as part of the running and crankcase running exhaust processes on the other road types. ONI also does not include long-duration idling by long-haul combination trucks (hoteling/extended idle), as that type of long duration idling is accounted for in other MOVES processes.

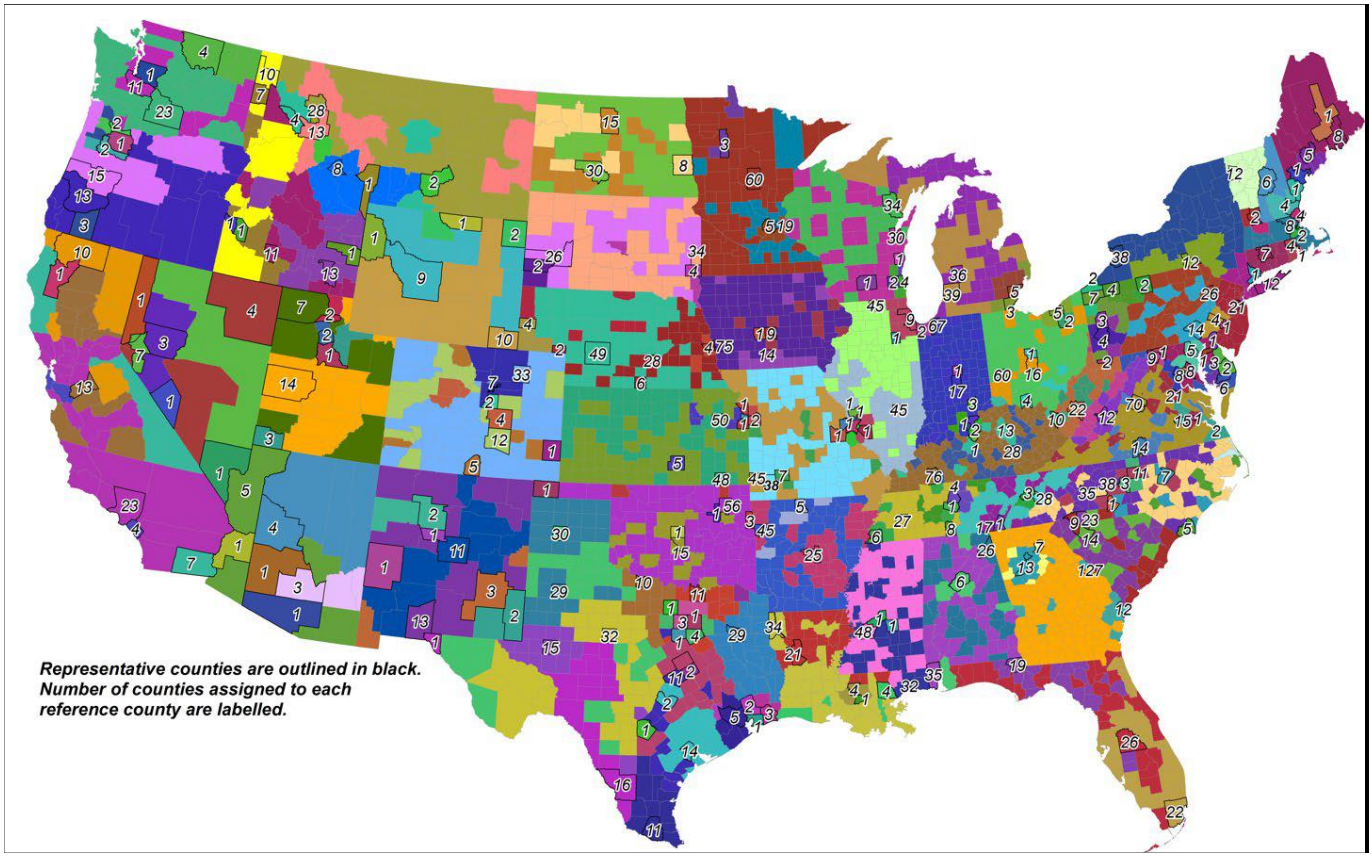
ONI activity hours were calculated based on VMT. For each representative county, the ratio of ONI hours to onroad VMT (on all road types) was calculated using the MOVES ONI Tool by source type, fuel type, and month. These ratios are then multiplied by each county's total VMT (aggregated by source type, fuel type, and month) to get hours of ONI activity.

2.3.3 MOVES Emission Factor Table Development

MOVES4 was run in emission rate mode to create emission factor tables for 2022, for all representative counties and fuel months. The county databases used to run MOVES to develop the emission factor tables included the state-specific control measures such as the California LEV program, and fuels representing the year 2022. The range of temperatures run along with the average humidities used were specific to the year 2022. The remaining settings for the CDBs are documented in the 2020 NEI TSD. To create the emission factors, MOVES was run separately for each representative county and fuel month for each temperature bin needed for the calendar year 2022. The MOVES results were post-processed into CSV-formatted emission factor tables that can be read by SMOKE-MOVES. Additionally, MOVES was run for all counties in Alaska, Hawaii, and Virgin Islands, and for a single representative county in Puerto Rico.

The county databases (CDBs) used to run MOVES to develop the emission factor tables were based on those used for the 2020 NEI. The 2022 emissions modeling platform development included an extensive review of the various tables including speed distributions. Each county in the continental U.S. was classified according to its state, altitude (high or low), fuel region, the presence of I/M programs, and the mean light-duty age. A binning algorithm was executed to identify "like counties." The result was 259 representative counties for the CONUS shown in Figure 2-3 along with 39 for Alaska, Hawaii, Puerto Rico, and the US Virgin Islands. The CONUS representation counties for 2022 are the same as those used for 2020 NEI with the exception of Alaska, which, in 2019, removed one borough (county ID 2261, Valdez-Cordova Census Area) and split that into two areas (county ID 2063, Chugach Census Area; and county ID 2066, Copper River Census Area); as well as some updates recommended by Texas.

Figure 2-3. Map of 2022 Representative Counties



Age distributions are a key input to MOVES in determining emission rates. Age distributions were held constant from 2020 for the 2022 emissions modeling platform; with the exception of Georgia, who supplied their own age distribution. The age distributions for 2020 were updated based on vehicle registration data obtained from IHS Markit, subject to reductions for older vehicles. For more information on how age distributions were developed for the 2020 NEI, please see Section 5 of the 2020 NEI TSD.

EPA calculated the adjustment factors representing the fraction of population remaining in every model year, with two exceptions. Model years from 2011 to 2020 received no adjustment and the model year 1990 received a capped adjustment that equals the adjustment for model year 1991. The adjustment

factors in Table 2-16 were applied to the 2020 IHS data to create the EPA Default set of population and age distributions for the NEI.

Table 2-16. The fraction of IHS vehicle populations retained for 2020 NEI and 2022 emissions modeling platform by model year

Model Year	LDV Adjustment Factor
pre-1991	0.722
1991	0.722
1992	0.728
1993	0.742
1994	0.754
1995	0.766
1996	0.774
1997	0.790
1998	0.787
1999	0.798
2000	0.796
2001	0.806
2002	0.808
2003	0.828
2004	0.844
2005	0.857
2006	0.874
2007	0.892
2008	0.905
2009	0.919
2010	0.929
2011 - 2021	1

EPA also removed the county-specific fractions of antique license plate vehicles present in the registration data from IHS, based on the assumption that antique vehicles are operated significantly less than average. States without any CDB submittals received EPA default populations and age distributions based on the adjusted IHS data, and some states with submittals were overridden, decided on a case-by-case basis.

In addition to removing the older and antique plate vehicles from the IHS data, 28 counties found to be outliers because their fleet age was significantly younger than in typical counties. The outlier review was limited to LDV source types 21, 31, and 32. Many rural counties have outliers for low-population source types such as Transit Bus and Refuse Truck due to small sample sizes, but these do not have much of an impact on the inventory overall and reflect sparse data in low-population areas and therefore do not require correction.

The most extreme examples of LDV outliers were Light Commercial Truck age distributions where over 85 percent of the population in the entire county is 0 and 1 years old. These sorts of young fleets can

happen if the headquarters of a leasing or rental company is the owner/entity of a relatively large number of newer vehicles relative to the county-wide population. While the business owner of thousands of new vehicles may reside in a single county, the vehicles likely operate in broader areas without being registered where they drive.

In areas where submitted vehicle population data were accepted for the 2020 NEI, the relative populations of cars vs. light-duty trucks were reapportioned (while retaining the magnitude of the light-duty vehicles from the submittals) using the county-specific percentages from the IHS data. In this way, the categorization of cars versus light trucks is consistent from state to state. The county total light-duty vehicle populations were preserved through this process.

To create the emission factors, MOVES was run separately for each representative county and fuel month and for each temperature bin needed for calendar year 2022. The CDBs used to run MOVES include the state-specific control measures such as the California low emission vehicle (LEV) program. In addition, the range of temperatures and the average humidities used in the CDBs were specific to the year 2022. The MOVES results were post-processed into CSV-formatted emission factor tables that can be read by SMOKE-MOVES.

2.3.4 Onroad California Inventory Development (onroad_ca_adj)

California uses their own emission model, EMFAC, to develop onroad emissions inventories and provides those inventories to EPA. EMFAC uses emission inventory codes (EICs) to characterize the emission processes instead of SCCs. The EPA and California worked together to develop a code mapping to better match EMFAC's EICs to EPA MOVES' detailed set of SCCs that distinguish between off-network and on-network and brake and tire wear emissions. This detail is needed for modeling but not for the NEI. California submitted onroad emissions for all 2022v1 platform years, including 2022. Since California's 2022 inventory did not contain HAPs, VOC-based speciation factors were used to estimate VOC HAPs for 2022. Other HAPs such as PAHs and metals are not needed for this platform. The EPA added NH_3 to the CARB inventory by using the state total NH_3 from MOVES and allocating it at the county level based on CO. Refueling emissions were taken from MOVES for California.

California onroad mobile source emissions were created through a hybrid approach of combining state-supplied annual emissions with EPA-developed SMOKE-MOVES runs. Through this approach, the platform was able to reflect the California-developed emissions, while leveraging the more detailed SCCs and the highly resolved spatial patterns, temporal patterns, and speciation from SMOKE-MOVES. The basic steps involved in temporally allocating onroad emissions from California based on SMOKE-MOVES results were:

1) Run CA using EPA inputs through SMOKE-MOVES to produce hourly emissions hereafter known as "EPA estimates." These EPA estimates for CA were run in a separate sector called "onroad_ca."
2) Calculate ratios between state-supplied emissions and EPA estimates. The ratios were calculated for each county/SCC/pollutant combination based on the California onroad emissions inventory. The 2020 California data did not separate off and on-network emissions or extended idling, and also did not include information for vehicles fueled by E-85, so these differentiations were obtained using MOVES.

3) Create an adjustment factor file (CFPRO) that includes EPA-to-state estimate ratios.
4) Rerun CA through SMOKE-MOVES using EPA inputs and the new adjustment factor file.

Through this process, adjusted model-ready files were created that sum to annual totals from California, but have the temporal and spatial patterns reflecting the highly resolved meteorology and SMOKE-MOVES. After adjusting the emissions, this sector is called "onroad_ca_adj." Note that in emission summaries, the emissions from the "onroad" and "onroad_ca_adj" sectors were summed and designated as the emissions for the onroad sector.

2.4 Nonroad Mobile sources (cmv, rail, nonroad)

The nonroad mobile source emission modeling sectors consist of nonroad equipment emissions (nonroad), locomotive (rail), and commercial marine CMV emissions (cmv_c1c2 and cmv_c3).

2.4.1 Category 1, Category 2 Commercial Marine Vessels (cmv_c1c2)

The cmv_c1c2 sector contains Category 1 and 2 (C1C2) CMV emissions. Category 1 and 2 vessels use diesel fuel. All emissions in this sector are annual and at county-SCC resolution; however, in the emissions modeling platform they are provided at the sub-county level (i.e., port shape ids) and by SCC and emission type (e.g., hoteling, maneuvering). For the 2021 emissions modeling platform EPA expanded the list of SCCs. SCCs are now further resolved based on ship type than they were for the 2020 NEI. A list of SCCs for the C1C2 sector can be seen in Table 2-17 For more information on the 2022 CMV C1C2 emissions development, see the supplemental documentation (ERG, 2024b). C1C2 emissions that occur outside of state waters are not assigned to states. For this modeling platform, all CMV emissions in the cmv_c1c2 sector are treated as hourly gridded point sources with stack parameters that should result in them being placed in layer 1.

Sulfur dioxide (SO2) emissions reflect rules that reduced sulfur emissions for CMV that took effect in the year 2015. The cmv_c1c2 inventory sector contains small to medium-size engine CMV emissions. Category 1 and Category 2 marine diesel engines typically range in size from about 700 to 11,000 hp. These engines are used to provide propulsion power on many kinds of vessels including tugboats, towboats, supply vessels, fishing vessels, and other commercial vessels in and around ports. They are also used as stand-alone generators for auxiliary electrical power on many types of vessels. Category 1 represents engines up to 7 liters per cylinder displacement. Category 2 includes engines from 7 to 30 liters per cylinder.

The cmv_c1c2 inventory sector contains sources that traverse state and federal waters along with emissions from surrounding areas of Canada, Mexico, and international waters. The cmv_c1c2 sources are modeled as point sources but using plume rise parameters that cause the emissions to be released in the ground layer of the air quality model.

The cmv_c1c2 sources within state waters are identified in the inventory with the Federal Information Processing Standard (FIPS) county code for the state and county in which the vessel is registered. The cmv_c1c2 sources that operate outside of state waters but within the Emissions Control Area (ECA) are encoded with a state FIPS code of 85. The ECA areas include parts of the Gulf of Mexico, and parts of the Atlantic and Pacific coasts. The cmv_c1c2 sources are categorized as operating either in-port or underway and as main and auxiliary engines are encoded using the SCCs listed in Table 2-17. Level 1 and

Level 2 descriptions for all of the entries are “Mobile Sources”, and “Marine Vessels, Commercial”, respectively.

Table 2-17. SCCs for the cmv_c1c2 sector

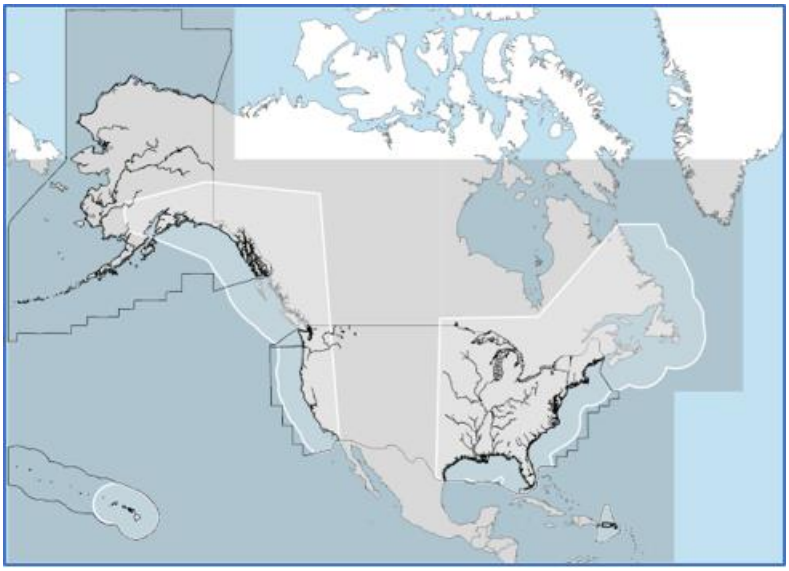
SCC	Level 3 Description	Level 4 Description
2280201113	Diesel Barge	C1C2 Port Emissions: Main Engine
2280202113	Diesel Offshore support	C1C2 Port Emissions: Main Engine
2280203113	Diesel Bulk Carrier	C1C2 Port Emissions: Main Engine
2280204113	Diesel Commercial Fishing	C1C2 Port Emissions: Main Engine
2280205113	Diesel Container Ship	C1C2 Port Emissions: Main Engine
2280206113	Diesel Ferry	C1C2 Port Emissions: Main Engine
2280207113	Diesel General Cargo	C1C2 Port Emissions: Main Engine
2280208113	Diesel Government	C1C2 Port Emissions: Main Engine
2280209113	Diesel Miscellaneous	C1C2 Port Emissions: Main Engine
2280210113	Diesel RollOn RollOff	C1C2 Port Emissions: Main Engine
2280211113	Diesel Tanker	C1C2 Port Emissions: Main Engine
2280212113	Diesel Tour Boat	C1C2 Port Emissions: Main Engine
2280213113	Diesel Tug	C1C2 Port Emissions: Main Engine
2280214113	Diesel Refrigerated	C1C2 Port Emissions: Main Engine
2280215113	Diesel Cruise	C1C2 Port Emissions: Main Engine
2280216113	Diesel Passenger Other	C1C2 Port Emissions: Main Engine
2280201114	Diesel Barge	C1C2 Port Emissions: Auxiliary Engine
2280202114	Diesel Offshore support	C1C2 Port Emissions: Auxiliary Engine
2280203114	Diesel Bulk Carrier	C1C2 Port Emissions: Auxiliary Engine
2280204114	Diesel Commercial Fishing	C1C2 Port Emissions: Auxiliary Engine
2280205114	Diesel Container Ship	C1C2 Port Emissions: Auxiliary Engine
2280206114	Diesel Ferry	C1C2 Port Emissions: Auxiliary Engine
2280207114	Diesel General Cargo	C1C2 Port Emissions: Auxiliary Engine
2280208114	Diesel Government	C1C2 Port Emissions: Auxiliary Engine
2280209114	Diesel Miscellaneous	C1C2 Port Emissions: Auxiliary Engine
2280210114	Diesel RollOn RollOff	C1C2 Port Emissions: Auxiliary Engine
2280211114	Diesel Tanker	C1C2 Port Emissions: Auxiliary Engine
2280212114	Diesel Tour Boat	C1C2 Port Emissions: Auxiliary Engine
2280213114	Diesel Tug	C1C2 Port Emissions: Auxiliary Engine
2280214114	Diesel Refrigerated	C1C2 Port Emissions: Auxiliary Engine
2280215114	Diesel Cruise	C1C2 Port Emissions: Auxiliary Engine
2280216114	Diesel Passenger Other	C1C2 Port Emissions: Auxiliary Engine
2280201123	Diesel Barge	C1C2 Underway emissions: Main Engine
2280202123	Diesel Offshore support	C1C2 Underway emissions: Main Engine
2280203123	Diesel Bulk Carrier	C1C2 Underway emissions: Main Engine
2280204123	Diesel Commercial Fishing	C1C2 Underway emissions: Main Engine
2280205123	Diesel Container Ship	C1C2 Underway emissions: Main Engine
2280206123	Diesel Ferry	C1C2 Underway emissions: Main Engine
2280207123	Diesel General Cargo	C1C2 Underway emissions: Main Engine

SCC	Level 3 Description	Level 4 Description
2280208123	Diesel Government	C1C2 Underway emissions: Main Engine
2280209123	Diesel Miscellaneous	C1C2 Underway emissions: Main Engine
2280210123	Diesel RollOn RollOff	C1C2 Underway emissions: Main Engine
2280211123	Diesel Tanker	C1C2 Underway emissions: Main Engine
2280212123	Diesel Tour Boat	C1C2 Underway emissions: Main Engine
2280213123	Diesel Tug	C1C2 Underway emissions: Main Engine
2280214123	Diesel Refrigerated	C1C2 Underway emissions: Main Engine
2280215123	Diesel Cruise	C1C2 Underway emissions: Main Engine
2280216123	Diesel Passenger Other	C1C2 Underway emissions: Main Engine
2280201124	Diesel Barge	C1C2 Underway emissions: Auxiliary Engine
2280202124	Diesel Offshore support	C1C2 Underway emissions: Auxiliary Engine
2280203124	Diesel Bulk Carrier	C1C2 Underway emissions: Auxiliary Engine
2280204124	Diesel Commercial Fishing	C1C2 Underway emissions: Auxiliary Engine
2280205124	Diesel Container Ship	C1C2 Underway emissions: Auxiliary Engine
2280206124	Diesel Ferry	C1C2 Underway emissions: Auxiliary Engine
2280207124	Diesel General Cargo	C1C2 Underway emissions: Auxiliary Engine
2280208124	Diesel Government	C1C2 Underway emissions: Auxiliary Engine
2280209124	Diesel Miscellaneous	C1C2 Underway emissions: Auxiliary Engine
2280210124	Diesel RollOn RollOff	C1C2 Underway emissions: Auxiliary Engine
2280211124	Diesel Tanker	C1C2 Underway emissions: Auxiliary Engine
2280212124	Diesel Tour Boat	C1C2 Underway emissions: Auxiliary Engine
2280213124	Diesel Tug	C1C2 Underway emissions: Auxiliary Engine
2280214124	Diesel Refrigerated	C1C2 Underway emissions: Auxiliary Engine
2280215124	Diesel Cruise	C1C2 Underway emissions: Auxiliary Engine
2280216124	Diesel Passenger Other	C1C2 Underway emissions: Auxiliary Engine

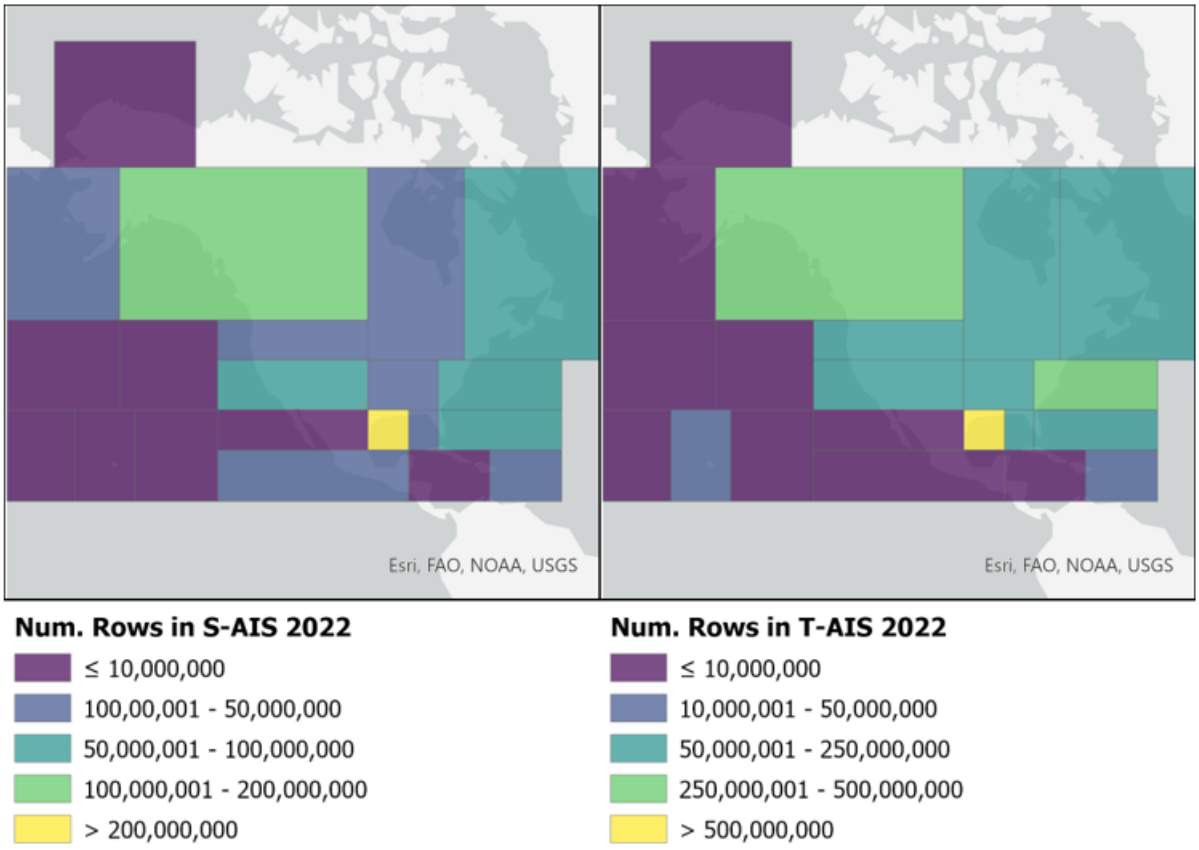
Category 1 and 2 CMV emissions were developed for the 2022 platform and were not based on 2020 NEI although the methods used to develop the emissions were similar. The emissions were developed based on signals from Automated Identification System (AIS) transmitters. AIS is a tracking system used by vessels to enhance navigation and avoid collision with other AIS transmitting vessels. The USEPA Office of Transportation and Air Quality received AIS data from the U.S. Coast Guard (USCG) to quantify all ship activity which occurred between January 1 and December 31, 2022. During the acquisition of the 2022 AIS data from the U.S. Coast Guard, EPA was made aware of a data quality issue that started in late March and continued through late June of 2022. To address this, emissions were substituted in from the 2021 CMV C1C2 inventory for this period. To ensure coverage for all of the areas needed by the NEI, the requested and provided AIS data extend beyond 200 nautical miles from the U.S. coast. The area covered by the AIS Area, 2022 Modeling Platform Geographical Extent, and U.S. ECA is shown in Figure 2-4 (a). This boundary is roughly equivalent to the border of the U.S Exclusive Economic Zone and the North American ECA, although some non-ECA activity are captured as well. Two types of AIS data were received: satellite (S-AIS) and terrestrial (T-AIS). The distribution of terrestrial and satellite AIS data for the 2022 emissions modeling platform are shown in Figure 2-4 (b). An additional enhancement for the 2022 C1C2 CMV inventory was the development and application of a mask that was applied to remove any emissions over land due to stray AIS signals.

Figure 2-4. NEI Commercial Marine Vessel Boundaries and Automatic Identification System Request Boxes for the 2022 Emissions Modeling Platform

a) Entire AIS Area (Transparent Gray), 2022 Modeling Platform Geographical Extent (Black Outline), and U.S. ECA (White Outline)



b) Distribution of Terrestrial and Satellite AIS Data



The AIS data were compiled into five-minute intervals by the USCG, providing a reasonably refined assessment of a vessel's movement. For example, using a five-minute average, a vessel traveling at 25 knots would be captured every two nautical miles that the vessel travels. For slower moving vessels, the distance between transmissions would be less. The ability to track vessel movements through AIS data and link them to attribute data, has allowed for the development of an inventory of very accurate emission estimates. These AIS data were used to define the locations of individual vessel movements, estimate hours of operation, and quantify propulsion engine loads. The compiled AIS data also included the vessel's International Marine Organization (IMO) number and Maritime Mobile Service Identifier (MMSI); which allowed each vessel to be matched to their characteristics obtained from the Clarksons ship registry (Clarksons, 2021).

The engine bore and stroke data were used to calculate cylinder volume. Any vessel that had a calculated cylinder volume greater than 30 liters was incorporated into the USEPA's new Category 3 Commercial Marine Vessel (C3CMV) model. The remaining records were assumed to represent Category 1 and 2 (C1C2) or non-ship activity. The C1C2 AIS data were quality assured including the removal of duplicate messages, signals from pleasure craft, and signals that were not from CMV vessels (e.g., buoys, helicopters, and vessels that are not self-propelled).

The emissions were calculated for each time interval between consecutive AIS messages for each vessel and allocated to the location of the message following to the interval. Emissions were calculated according to Equation 2-1.

$$Emissions_{interval} = Time\ (hr)_{interval} \times\ Power(kW) \times EF(\frac{g}{kWh}) \times LLAF \qquad \textbf{Equation 2-1}$$

Power was calculated for the propulsive (main), auxiliary, and auxiliary boiler engines for each interval and emission factor (EF) reflects the assigned emission factors for each engine, as described below. LLAF represents the low load adjustment factor, a unitless factor which reflects increasing propulsive emissions during low load operations. Time indicates the activity duration time between consecutive intervals.

Next, vessels were identified to determine their vessel type, and thus their vessel group, power rating, and engine tier information which are required for the emissions calculations. See the 2022 C1 C2 CMV development documentation for more details on this process. Following the identification, 236 different vessel types were matched to the C1C2 vessels. Vessel attribute data were not available for all these vessel types, so the vessel types were aggregated into 13 different vessel groups for which surrogate data were available as shown in Table 2-18. 19,322 vessels were directly identified by their ship and cargo number. The remaining group of miscellaneous ships represent 1.6 percent of the AIS vessels (excluding recreational vessels) for which a specific vessel type could not be assigned.

Table 2-18. Vessel groups in the cmv_c1c2 sector

Vessel Group	2017 Entire Area Ship Count	2020 Entire Area Ship Count	2021 Entire Area Ship Count	2022 Entire Area Ship Count
Bulk Carrier	45	44	46	47
Commercial Fishing	1,686	4,262	5,826	5,859
Container Ship	8	16	11	15
Ferry Excursion	482	724	849	997
General Cargo	1,555	3,451	3,190	3,122
Government	1,368	1,192	1,179	1,216
Miscellaneous	1,810	269	291	300
Offshore support	1,203	1,337	1,416	1,377
Pilot	NA	17	15	15
Reefer	15	13	12	28
Ro Ro	27	218	219	212
Tanker	144	555	591	677
Tug	4,203	5,661	5,299	5,289
Work Boat	83	151	162	168
Total in Inventory:	12,629	17,910	19,106	19,322

As shown in Equation 2-1, power is an important component of the emissions computation. Vessel-specific installed propulsive power ratings and service speeds were pulled from Clarksons ship registry and adopted from the Global Fishing Watch (GFW) dataset when available. However, there is limited vessel specific attribute data for most of the C1C2 fleet. This necessitated the use of surrogate engine power and load factors, which were computed for each vessel group. In addition to the power required by propulsive engines, power needs for auxiliary engines were also computed for each vessel group. Emissions from main and auxiliary engines are inventoried with different SCCs as shown in Table 2-17.

The final components of the emissions computation equation are the emission factors and the low load adjustment factor. The emission factors used in this inventory take into consideration the EPA's marine vessel fuel regulations as well as exhaust standards that are based on the year that the vessel was manufactured to determine the appropriate regulatory tier. Emission factors in g/kWhr by tier for NO_x, PM_{10}, $PM_{2.5}$, CO, CO_2, SO_2 and VOC were developed using Tables 3-7 through 3-10 in USEPA's (2008) Regulatory Impact Analysis on engines less than 30 liters per cylinder. To compile these emissions factors, population-weighted average emission factors were calculated per tier based on C1C2 population distributions grouped by engine displacement. Boiler emission factors were obtained from an earlier Swedish Environmental Protection Agency study (Swedish EPA, 2004). If the year of manufacture was unknown then it was assumed that the vessel was Tier 0, such that actual emissions may be less than those estimated in this inventory. Without more specific data, the magnitude of this emissions difference cannot be estimated.

Propulsive emissions from low-load operations were adjusted to account for elevated emission rates associated with activities outside the engines' optimal operating range. The emission factor adjustments were applied by load and pollutant, based on the data compiled for the Port Everglades 2015 Emission

Inventory.[6] Hazardous air pollutants and ammonia were added to the inventory according to multiplicative factors applied either to VOC or $PM_{2.5}$.

The stack parameters used for cmv_c1c2 are a stack height of 1 ft, stack diameter of 1 ft, stack temperature of 70°F, and a stack velocity of 0.1 ft/s. These parameters force emissions into layer 1.

For more information on the emission computations for 2022, see the supporting documentation for the development of the 2022 C1C2 CMV emissions (ERG, 2024). The cmv_c1c2 emissions were aggregated to total hourly values in each grid cell and run through SMOKE as point sources. SMOKE requires an annual inventory file to go along with the hourly data and this file was generated for 2022.

2.4.2 Category 3 Commercial Marine Vessels (cmv_c3)

The cmv_c3 sector contains large engine CMV emissions. Category 3 (C3) marine diesel engines at or above 30 liters per cylinder. Typically, these are the largest CMV engines and are rated at 3,000 to 100,000 hp. C3 engines are typically used for propulsion on ocean-going vessels including container ships, oil tankers, bulk carriers, and cruise ships. Emissions control technologies for C3 CMV sources are limited due to the nature of the residual fuel used by these vessels.[7] The cmv_c3 sector contains sources that traverse state and federal waters; along with sources in waters not covered by the NEI in surrounding areas of Canada, Mexico, and international waters.

The cmv_c3 sources that operate outside of state waters but within the federal Emissions Control Area (ECA) are encoded with a FIPS state code of 85, with the "county code" digits representing broad regions such as the Atlantic, Gulf of Mexico, and Pacific. The ECA areas include parts of the Gulf of Mexico, and parts of the Atlantic and Pacific coasts. CMV C3 sources around Puerto Rico, Hawaii and Alaska, which are outside the ECA areas, are included in the inventory but are in separate files from the emissions around the continental United States (CONUS). The cmv_c3 sources in the inventory are categorized as operating either in-port or underway and are encoded using the SCCs listed in Table 2-19 and distinguish between diesel and residual fuel, in port areas versus underway, and main and auxiliary engines. The Level 1 and Level 2 descriptions for each of the SCCs are "Mobile Sources" and "Marine Vessels, Commercial", respectively.

Table 2-19. SCCs for cmv_c3 sector

SCC	Level 3 Description	Level 4 Description
2280201313	Diesel Barge	C3 Port Emissions: Main Engine
2280202313	Diesel Offshore support	C3 Port Emissions: Main Engine
2280203313	Diesel Bulk Carrier	C3 Port Emissions: Main Engine
2280204313	Diesel Commercial Fishing	C3 Port Emissions: Main Engine
2280205313	Diesel Container Ship	C3 Port Emissions: Main Engine
2280206313	Diesel Ferry	C3 Port Emissions: Main Engine
2280207313	Diesel General Cargo	C3 Port Emissions: Main Engine

[6] USEPA. EPA and Port Everglades Partnership: Emission Inventories and Reduction Strategies. US Environmental Protection Agency, Office of Transportation and Air Quality, June 2018. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100UKV8.pdf.

[7] https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-emissions-marine-vessels.

SCC	Level 3 Description	Level 4 Description
2280208313	Diesel Government	C3 Port Emissions: Main Engine
2280209313	Diesel Miscellaneous	C3 Port Emissions: Main Engine
2280210313	Diesel RollOn RollOff	C3 Port Emissions: Main Engine
2280211313	Diesel Tanker	C3 Port Emissions: Main Engine
2280212313	Diesel Tour Boat	C3 Port Emissions: Main Engine
2280213313	Diesel Tug	C3 Port Emissions: Main Engine
2280214313	Diesel Refrigerated	C3 Port Emissions: Main Engine
2280215313	Diesel Cruise	C3 Port Emissions: Main Engine
2280216313	Diesel Passenger Other	C3 Port Emissions: Main Engine
2280201314	Diesel Barge	C3 Port Emissions: Auxiliary Engine
2280202314	Diesel Offshore support	C3 Port Emissions: Auxiliary Engine
2280203314	Diesel Bulk Carrier	C3 Port Emissions: Auxiliary Engine
2280204314	Diesel Commercial Fishing	C3 Port Emissions: Auxiliary Engine
2280205314	Diesel Container Ship	C3 Port Emissions: Auxiliary Engine
2280206314	Diesel Ferry	C3 Port Emissions: Auxiliary Engine
2280207314	Diesel General Cargo	C3 Port Emissions: Auxiliary Engine
2280208314	Diesel Government	C3 Port Emissions: Auxiliary Engine
2280209314	Diesel Miscellaneous	C3 Port Emissions: Auxiliary Engine
2280210314	Diesel RollOn RollOff	C3 Port Emissions: Auxiliary Engine
2280211314	Diesel Tanker	C3 Port Emissions: Auxiliary Engine
2280212314	Diesel Tour Boat	C3 Port Emissions: Auxiliary Engine
2280213314	Diesel Tug	C3 Port Emissions: Auxiliary Engine
2280214314	Diesel Refrigerated	C3 Port Emissions: Auxiliary Engine
2280215314	Diesel Cruise	C3 Port Emissions: Auxiliary Engine
2280216314	Diesel Passenger Other	C3 Port Emissions: Auxiliary Engine
2280201323	Diesel Barge	C3 Underway emissions: Main Engine
2280202323	Diesel Offshore support	C3 Underway emissions: Main Engine
2280203323	Diesel Bulk Carrier	C3 Underway emissions: Main Engine
2280204323	Diesel Commercial Fishing	C3 Underway emissions: Main Engine
2280205323	Diesel Container Ship	C3 Underway emissions: Main Engine
2280206323	Diesel Ferry	C3 Underway emissions: Main Engine
2280207323	Diesel General Cargo	C3 Underway emissions: Main Engine
2280208323	Diesel Government	C3 Underway emissions: Main Engine
2280209323	Diesel Miscellaneous	C3 Underway emissions: Main Engine
2280210323	Diesel RollOn RollOff	C3 Underway emissions: Main Engine
2280211323	Diesel Tanker	C3 Underway emissions: Main Engine
2280212323	Diesel Tour Boat	C3 Underway emissions: Main Engine
2280213323	Diesel Tug	C3 Underway emissions: Main Engine
2280214323	Diesel Refrigerated	C3 Underway emissions: Main Engine

SCC	Level 3 Description	Level 4 Description
2280215323	Diesel Cruise	C3 Underway emissions: Main Engine
2280216323	Diesel Passenger Other	C3 Underway emissions: Main Engine
2280201324	Diesel Barge	C3 Underway emissions: Auxiliary Engine
2280202324	Diesel Offshore support	C3 Underway emissions: Auxiliary Engine
2280203324	Diesel Bulk Carrier	C3 Underway emissions: Auxiliary Engine
2280204324	Diesel Commercial Fishing	C3 Underway emissions: Auxiliary Engine
2280205324	Diesel Container Ship	C3 Underway emissions: Auxiliary Engine
2280206324	Diesel Ferry	C3 Underway emissions: Auxiliary Engine
2280207324	Diesel General Cargo	C3 Underway emissions: Auxiliary Engine
2280208324	Diesel Government	C3 Underway emissions: Auxiliary Engine
2280209324	Diesel Miscellaneous	C3 Underway emissions: Auxiliary Engine
2280210324	Diesel RollOn RollOff	C3 Underway emissions: Auxiliary Engine
2280211324	Diesel Tanker	C3 Underway emissions: Auxiliary Engine
2280212324	Diesel Tour Boat	C3 Underway emissions: Auxiliary Engine
2280213324	Diesel Tug	C3 Underway emissions: Auxiliary Engine
2280214324	Diesel Refrigerated	C3 Underway emissions: Auxiliary Engine
2280215324	Diesel Cruise	C3 Underway emissions: Auxiliary Engine
2280216324	Diesel Passenger Other	C3 Underway emissions: Auxiliary Engine
2280301313	Residual Barge	C3 Port Emissions: Main Engine
2280302313	Residual Offshore support	C3 Port Emissions: Main Engine
2280303313	Residual Bulk Carrier	C3 Port Emissions: Main Engine
2280304313	Residual Commercial Fishing	C3 Port Emissions: Main Engine
2280305313	Residual Container Ship	C3 Port Emissions: Main Engine
2280306313	Residual Ferry	C3 Port Emissions: Main Engine
2280307313	Residual General Cargo	C3 Port Emissions: Main Engine
2280308313	Residual Government	C3 Port Emissions: Main Engine
2280309313	Residual Miscellaneous	C3 Port Emissions: Main Engine
2280310313	Residual RollOn RollOff	C3 Port Emissions: Main Engine
2280311313	Residual Tanker	C3 Port Emissions: Main Engine
2280312313	Residual Tour Boat	C3 Port Emissions: Main Engine
2280313313	Residual Tug	C3 Port Emissions: Main Engine
2280314313	Residual Refrigerated	C3 Port Emissions: Main Engine
2280315313	Residual Cruise	C3 Port Emissions: Main Engine
2280316313	Residual Passenger Other	C3 Port Emissions: Main Engine
2280301314	Residual Barge	C3 Port Emissions: Auxiliary Engine
2280302314	Residual Offshore support	C3 Port Emissions: Auxiliary Engine
2280303314	Residual Bulk Carrier	C3 Port Emissions: Auxiliary Engine
2280304314	Residual Commercial Fishing	C3 Port Emissions: Auxiliary Engine
2280305314	Residual Container Ship	C3 Port Emissions: Auxiliary Engine

SCC	Level 3 Description	Level 4 Description
2280306314	Residual Ferry	C3 Port Emissions: Auxiliary Engine
2280307314	Residual General Cargo	C3 Port Emissions: Auxiliary Engine
2280308314	Residual Government	C3 Port Emissions: Auxiliary Engine
2280309314	Residual Miscellaneous	C3 Port Emissions: Auxiliary Engine
2280310314	Residual RollOn RollOff	C3 Port Emissions: Auxiliary Engine
2280311314	Residual Tanker	C3 Port Emissions: Auxiliary Engine
2280312314	Residual Tour Boat	C3 Port Emissions: Auxiliary Engine
2280313314	Residual Tug	C3 Port Emissions: Auxiliary Engine
2280314314	Residual Refrigerated	C3 Port Emissions: Auxiliary Engine
2280315314	Residual Cruise	C3 Port Emissions: Auxiliary Engine
2280316314	Residual Passenger Other	C3 Port Emissions: Auxiliary Engine
2280301323	Residual Barge	C3 Underway emissions: Main Engine
2280302323	Residual Offshore support	C3 Underway emissions: Main Engine
2280303323	Residual Bulk Carrier	C3 Underway emissions: Main Engine
2280304323	Residual Commercial Fishing	C3 Underway emissions: Main Engine
2280305323	Residual Container Ship	C3 Underway emissions: Main Engine
2280306323	Residual Ferry	C3 Underway emissions: Main Engine
2280307323	Residual General Cargo	C3 Underway emissions: Main Engine
2280308323	Residual Government	C3 Underway emissions: Main Engine
2280309323	Residual Miscellaneous	C3 Underway emissions: Main Engine
2280310323	Residual RollOn RollOff	C3 Underway emissions: Main Engine
2280311323	Residual Tanker	C3 Underway emissions: Main Engine
2280312323	Residual Tour Boat	C3 Underway emissions: Main Engine
2280313323	Residual Tug	C3 Underway emissions: Main Engine
2280314323	Residual Refrigerated	C3 Underway emissions: Main Engine
2280315323	Residual Cruise	C3 Underway emissions: Main Engine
2280316323	Residual Passenger Other	C3 Underway emissions: Main Engine
2280301324	Residual Barge	C3 Underway emissions: Auxiliary Engine
2280302324	Residual Offshore support	C3 Underway emissions: Auxiliary Engine
2280303324	Residual Bulk Carrier	C3 Underway emissions: Auxiliary Engine
2280304324	Residual Commercial Fishing	C3 Underway emissions: Auxiliary Engine
2280305324	Residual Container Ship	C3 Underway emissions: Auxiliary Engine
2280306324	Residual Ferry	C3 Underway emissions: Auxiliary Engine
2280307324	Residual General Cargo	C3 Underway emissions: Auxiliary Engine
2280308324	Residual Government	C3 Underway emissions: Auxiliary Engine
2280309324	Residual Miscellaneous	C3 Underway emissions: Auxiliary Engine
2280310324	Residual RollOn RollOff	C3 Underway emissions: Auxiliary Engine
2280311324	Residual Tanker	C3 Underway emissions: Auxiliary Engine
2280312324	Residual Tour Boat	C3 Underway emissions: Auxiliary Engine

SCC	Level 3 Description	Level 4 Description
2280313324	Residual Tug	C3 Underway emissions: Auxiliary Engine
2280314324	Residual Refrigerated	C3 Underway emissions: Auxiliary Engine
2280315324	Residual Cruise	C3 Underway emissions: Auxiliary Engine
2280316324	Residual Passenger Other	C3 Underway emissions: Auxiliary Engine

The EPA received Automated Identification System (AIS) data from United States Coast Guard (USCG) to quantify all ship activity which occurred between January 1 and December 31, 2022. The International Maritime Organization's (IMO's) International Convention for the Safety of Life at Sea (SOLAS) requires AIS to be fitted aboard all international voyaging ships with gross tonnage of 300 or more, and all passenger ships regardless of size.[8] In addition, the USCG has mandated that all commercial marine vessels continuously transmit AIS signals while transiting U.S. navigable waters. As the vast majority of C3 vessels meet these requirements, any omitted from the inventory due to lack of AIS adoption are deemed to have a negligible impact on national C3 emissions estimates. The activity data incorporated into this inventory reflect ship operations within 200 nautical miles of the official U.S. baseline and beyond. Activity data within the border of the U.S Exclusive Economic Zone and the North American ECA are included as well as some activity data outside of the ECA.

The 2022 CMV emissions modeling platform data were computed based on the AIS data from the USGS for the year of 2022. This process is described in more detail in the Category 3 Commercial Marine Vessel 2022 Emissions Inventory (EPA, 2024a). During the acquisition of the 2022 AIS data from the U.S. Coast Guard, EPA was made aware of a data quality issue that started in late March and continued through late June of 2022. To address this, emissions were substituted in from the 2021 CMV C3 inventory for this period. The AIS data were coupled with ship registry data that contained engine parameters, vessel power parameters, and other factors such as tonnage and year of manufacture which helped to separate the C3 vessels from the C1C2 vessels. Where specific ship parameters were not available, they were gap-filled. The types of vessels that remain in the C3 data set include bulk carrier, chemical tanker, liquified gas tanker, oil tanker, other tanker, container ship, cruise, ferry, general cargo, fishing, refrigerated vessel, roll-on/roll-off, tug, and yacht.

Prior to use, the AIS data were reviewed - data deemed to be erroneous were removed, and data found to be at intervals greater than 5 minutes were interpolated to ensure that each ship had data every five minutes. The five-minute average data provide a reasonably refined assessment of a vessel's movement. For example, using a five-minute average, a vessel traveling at 25 knots would be captured every two nautical miles that the vessel travels. For slower moving vessels, the distance between transmissions would be less. An additional enhancement for the 2022 C3 CMV inventory was the development and application of a mask that was applied to remove any emissions over land due to stray AIS signals and interpolated values.

[8] International Maritime Organization (IMO) Resolution MSC.99(73) adopted December 12th. 2000 and entered into force July 1st, 2002; as amended by SOLAS Resolution CONF.5/32 adopted December 13th, 2002.

The emissions were calculated for each C3 vessel in the dataset for each 5-minute time range and allocated to the location of the message following to the interval. Emissions were calculated according to Equation 2-2.

$$Emissions_{interval} = Time\ (hr)_{interval} \times\ Power(kW) \times EF(\frac{g}{kWh}) \times LLAF \qquad \textbf{Equation 2-2}$$

Power is calculated for the propulsive (main), auxiliary, and auxiliary boiler engines for each interval and emission factor (EF) reflects the assigned emission factors for each engine, as described below. LLAF represents the low load adjustment factor, a unitless factor which reflects increasing propulsive emissions during low load operations. Time indicates the activity duration time between consecutive intervals.

Emissions were computed according to a computed power need (kW) multiplied by the time (hr) and by an engine-specific emission factor (g/kWh) and finally by a low load adjustment factor that reflects increasing propulsive emissions during low load operations.

The resulting emissions were available at 5-minute intervals. Code was developed to aggregate these emissions to modeling grid cells and up to hourly levels so that the emissions data could be input to SMOKE for emissions modeling with SMOKE. Within SMOKE, the data were speciated into the pollutants needed by the air quality model,[9] but since the data were already in the form of point sources at the center of each grid cell, and they were already hourly, no other processing was needed within SMOKE. SMOKE requires an annual inventory file to go along with the hourly data, so this annual file was generated for 2022.

On January 1st, 2015, the ECA initiated a fuel sulfur standard which regulated large marine vessels to use fuel with 1,000 ppm sulfur or less. These standards are reflected in the cmv_c3 inventories.

The resulting point emissions centered on each grid cell were converted to an annual point 2010 flat file format (FF10). A set of standard stack parameters were assigned to each release point in the cmv_c3 inventory. The assigned stack height was 65.62 ft, the stack diameter was 2.625 ft, the stack temperature was 539.6 °F, and the velocity was 82.02 ft/s. Emissions were computed for each grid cell needed for modeling.

2.4.3 Railway Locomotives (rail)

The rail sector includes all locomotives in the NEI nonpoint data category including line haul locomotives on Class 1, 2, and 3 railroads along with emissions from commuter rail lines and Amtrak. The rail sector excludes railway maintenance locomotives and point source yard locomotives. Railway maintenance emissions are included in the nonroad sector. The point source yard locomotives are included in the ptnonipm sector. The development of the 2022 rail inventory is summarized here but is described in more detail in the 2022 National Emissions Inventory Locomotive Methodology documentation (ERG, 2024c).

International Maritime Organization (IMO) Resolution MSC.99(73).

The rail sector emissions for the 2022 emissions modeling platform are based on the 2020 NEI. Projection factors were applied based on fuel use data for Class I locomotives and rail yards. For Class II/III locomotives, activity data for the years 2012, 2017, 2020, and 2022 from the U.S. Energy Information Administration's Annual Energy Outlook was examined. Based on these data, the fuel data used in 2020 was increased across the rail system by 11.6% for the 2022 effort. The 2020 NEI is based on methods developed during the development of the 2017 NEI rail inventory by the Lake Michigan Air Directors Consortium (LADCO) and the State of Illinois with support from various other states. Class I railroad emissions are based on confidential link-level line-haul activity GIS data layer maintained by the Federal Railroad Administration (FRA). In addition, the Association of American Railroads (AAR) provided preliminary 2023 national emission tier fleet mix information for Class I railroads. Class II and III railroad emissions are based on a comprehensive nationwide GIS database of locations where short line and regional railroads operate. Passenger rail (Amtrak) emissions follow a similar procedure as Class II and III, except using a database of Amtrak rail lines. Yard locomotive emissions are based on a combination of yard data provided by individual rail companies, and by using Google Earth and other tools to identify rail yard locations for rail companies which did not provide yard data. Information on specific yards were combined with fuel use data and emission factors to create an emissions inventory for rail yards. Pollutant-specific factors were applied on top of the activity-based changes for the Class I rail. The inventory SCCs are shown in Table 2-20. More detailed information on the development of the 2022 emission modeling platform rail inventory is available in the 2020 NEI TSD and in the Rail 2020 National Emissions Inventory Supplementary Document on the 2020 NEI supporting data FTP site.

Table 2-20. SCCs for the Rail Sector

SCC	Sector	Description: Mobile Sources prefix for all
2285002006	Rail	Railroad Equipment; Diesel; Line Haul Locomotives: Class I Operations
2285002007	Rail	Railroad Equipment; Diesel; Line Haul Locomotives: Class II / III Operations
2285002008	Rail	Railroad Equipment; Diesel; Line Haul Locomotives: Passenger Trains (Amtrak)
2285002009	Rail	Railroad Equipment; Diesel; Line Haul Locomotives: Commuter Lines
2285002010	Rail	Railroad Equipment; Diesel; Yard Locomotives (nonpoint)
28500201	Rail	Railroad Equipment; Diesel; Yard Locomotives (point)

Class I Line-haul Methodology

For the 2020 inventory, the Class I railroads granted EPA permission to use the confidential link-level line haul activity geographic information system (GIS) data layer maintained and updated annually by the Federal Railroad Administration (FRA). At the time of inventory development, 2019 million gross ton (MGT) data was the most recent and complete data available. A map of the Class I railroad lines is shown in Figure 2-5. The dataset contains three columns indicating railroad ownership and nine columns indicating trackage rights for each rail segment. While most rail links have a single owner, some links have up to six different Class 1 railroad companies operating on it. To prepare the FRA data for use in the Class I line haul calculations, all segments associated with a railroad company were extracted to identify the full network for each company. This involved iterating through each of those twelve columns to identify all segments within each railroad company's network. This process was conducted seven

times, one for each Class I railroad company. This resulted in a complete inventory of rail links trafficked by each Class I railroads with a record for each link/railroad company combination.

Figure 2-5. 2019 Class I Railroad Line Haul Activity



EPA collected 2020 and 2022 Class I line haul fuel use data from the most recent R-1 submittals from the Surface Transportation Board.[10] Consistent with previous inventory efforts, EPA summed line haul and work train fuel usage, Table 2-21. Projection factors were developed based on the increased fuel use in 2022 and applied to the 2020 emissions.

Table 2-21. 2020 and 2022 R-1 Reported Locomotive Fuel Use for Class I Railroads

Class I Railroad	2020 Line Haul Fuel Use (gal)*	2022 Line Haul Fuel Use (gal)*
BNSF	1,137,598,007	1,175,184,806
Canadian National (CN)	96,337,392	107,012,486
Canadian Pacific (CPRS)	57,664,407	64,138,533
CSX Transportation (CSXT)	327,917,859	356,002,171
Kansas City Southern (KCS)	55,763,748	64,185,774
Norfolk Southern (NS)	342,470,779	354,139,306

[10] Surface Transportation Board. Available at https://www.stb.gov/reports-data/economic-data/annual-report-financial-data/ Retrieved 22 June 2021.

Class I Railroad	2020 Line Haul Fuel Use (gal)*	2022 Line Haul Fuel Use (gal)*
Union Pacific (UP)	773,476,896	839,457,293

* Includes work train fuel usage

The Association of American Railroads (AAR) provided national Class I locomotive tier fleet mix information that reflects engine turnover in the nation. Given the impact of the pandemic in 2020, AAR provided a fleet mix that reflected active locomotives and excluded those that were held in storage. A locomotive's Tier level determines its allowable emission rates based on the year when it was built and/or re-manufactured. More accurate emission factors for each pollutant were calculated based on the percentage of the operating Class I line haul locomotives for each USEPA Tier-level category.

Class II and III Methodology

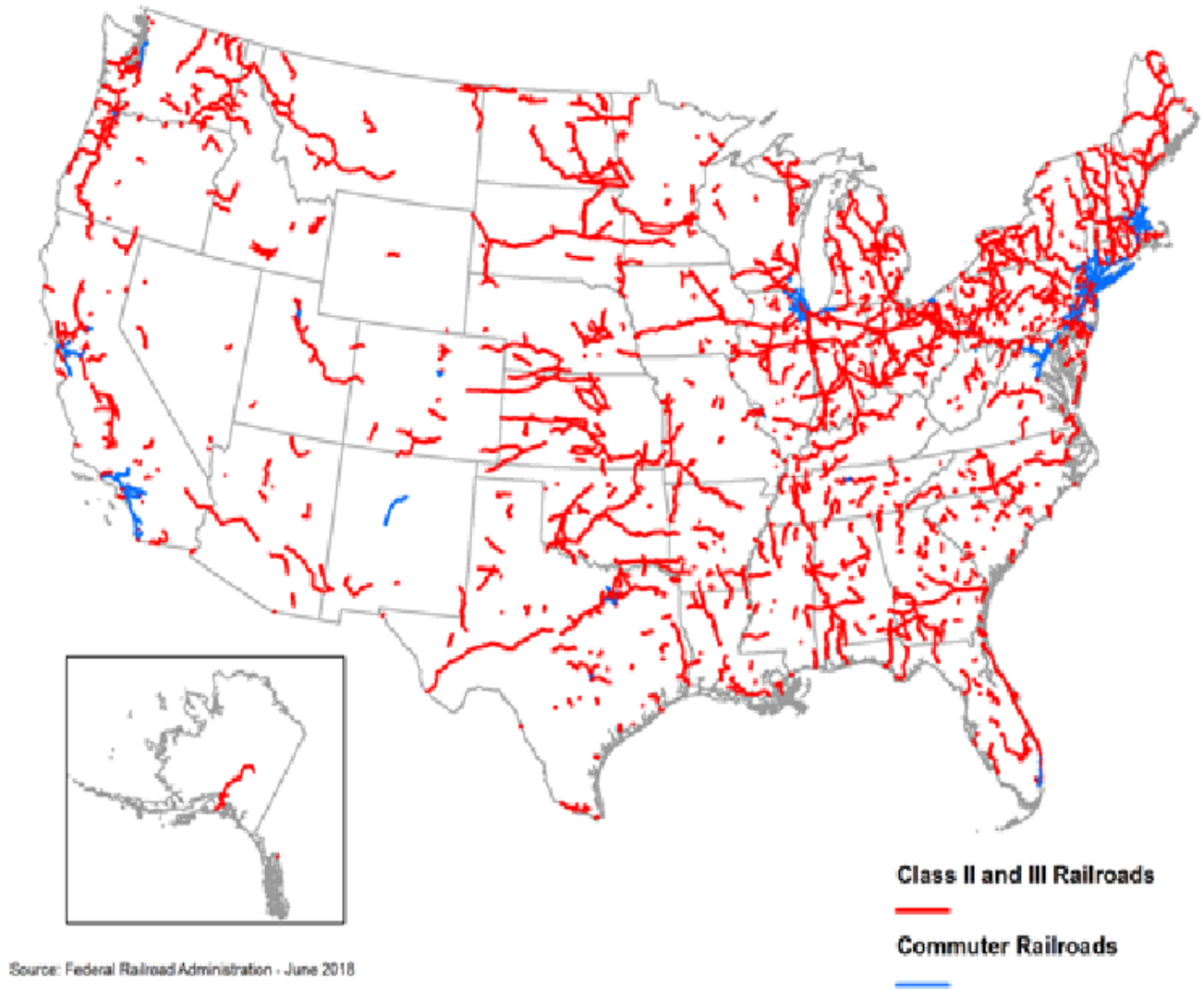
There are approximately 630 Class II and III Railroads operating in the United States, most of which are members of the American Short Line and Regional Railroad Association (ASLRRA). Data on Class II and III locomotive operations is publicly available from Bureau of Transportation Statistics' National Transportation Atlas Database (NTAD), along with related data including reporting mark, railroad name, route miles owned or operated, and total route miles of links.

Class II and III railroads are widely dispersed across the country (see Figure 2-6), often utilizing older, higher emitting locomotives than their Class I counterparts. AAR provided a national line-haul tier fleet mix profile for 2020 which reflects the trend toward older engines in this sector as shown in Table 2-22. These data continue to be used for the 2022 platform. The national fleet mix data was then used to calculate weighted average in-use emissions factors for the locomotives operated by the Class II and III railroads. Note that to be consistent with the 2020 inventory, the unweighted emission factors were the same as the Class I line haul due to the conservative use of the EPA's large locomotive conversion factor of 20.8 bhp-hr/gal. Emission factors for PM2.5, SO2, NH3, VOC, and GHGs were calculated in the same manner as those used for Class I line-haul inventory described above.

Table 2-22. 2020 Class II/III Line Haul Fleet by Tier Level

Tier	2020 Class II/III Locomotive Count	Percent of Total Fleet
0	1,664	48%
1	31	1%
2	169	5%
3	160	5%
4	64	2%
Not Classified	1,359	39%
Total	**3,447**	**100%**

Figure 2-6. Class II and III Railroads in the United States



For the 2022 inventory, EPA considered activity data for the years 2012, 2017, 2020, and 2022 from the U.S. Energy Information Administration's Annual Energy Outlook, shown in Table 2-23 below.[11] Based on these data, the fuel data used in 2020 was increased across the rail system by 11.6% for the 2022 effort.

Table 2-23. Rail Freight Values by year (quadrillion BTU)

2012	2017	2020	2022
0.43	0.52	0.44	0.48

Commuter Rail Methodology

[11] USEIA, Annual Energy Outlook 2021. Accessed 3 Apr 2024. Available at https://www.eia.gov/outlooks/aeo/data/browser/#/?id=7-AEO2021&cases=ref2021&sourcekey=0

Commuter rail emissions were calculated in the same way as the Class II and III railroads. The primary difference is that the fuel use estimates for 2020 and 2022 were based on data collected by the Federal Transit Administration (FTA) for the National Transit Database and projection factors calculated. These fuel use estimates were replaced with reported fuel use statistics for MBTA (Massachusetts) and Metra (Illinois). The commuter railroads were separated from the Class II and III railroads so that the appropriate SCC codes could be entered into the emissions calculation sheet.

Intercity Passenger Methodology (Amtrak)

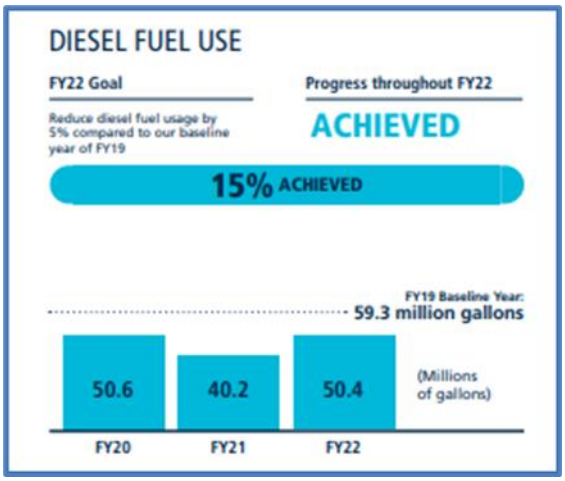
The calculation methodology mimics that used for the Class II and III and commuter railroads with a few modifications. Since link-level activity data for Amtrak was unavailable, the default assumption was made to evenly distribute Amtrak's 2020 reported fuel use across all of it diesel-powered route-miles shown in Figure 2-7.

Figure 2-7. Amtrak National Rail Network



For 2022 platform, the 2020 fuel use and emissions were adjusted down based on the fuel use reported in Amtrak's FY22 AMTRAK Sustainability Report as shown in Figure 2-8. The adjustment was applied uniformly, so the spatial representation of the emissions did not change.

Figure 2-8 Amtrak Diesel Fuel Use 2020-2022



Upon receipt of state-provided comments, two adjustments were made to Amtrak emissions. First, Delaware verified that all Amtrak passenger service in/through the state utilize electric locomotives only, so fuel usage and emissions for Delaware SCC 2285002008 were removed. Second, Connecticut confirmed that AMTRAK trains operating on electrified lines do not have diesel emissions. The state provided emissions estimates which were used to replace the previously calculated emissions.

Other Data Sources

The 2020 NEI locomotives sector includes data from SLT agency-provided emissions data, and an EPA dataset of locomotive emissions. The following agencies also submitted emissions to locomotive SCCs: Alaska Department of Environmental Conservation; California; Connecticut; District of Columbia; Maricopa County, AZ; Minnesota; North Carolina; Texas; Virginia; Washington; and Washoe County, NV.

2.4.4 Nonroad Mobile Equipment (nonroad)

The mobile nonroad equipment sector includes all mobile source emissions that do not operate on roads, excluding commercial marine vehicles, railways, and aircraft. Types of nonroad equipment include recreational vehicles, pleasure craft, and construction, agricultural, mining, and lawn and garden equipment. Nonroad equipment emissions for 2022 were computed by running MOVES4 which incorporates the NONROAD model. MOVES3 incorporated updated nonroad engine population growth rates, nonroad Tier 4 engine emission rates, and sulfur levels of nonroad diesel fuels. The only change made for nonroad from MOVES3 to MOVES4 was a change to fuel properties. Additionally, MOVES4 was run using 2022 meteorological data. MOVES provides a complete set of HAPs and incorporates updated nonroad emission factors for HAPs. MOVES4 was used for all states other than California, which uses their own model. California nonroad emissions were provided by the California Air Resources Board (CARB) for the 2020 NEI, as well as 2023. For the 2022 emissions modeling platform CARB nonroad emissions were interpolated between 2020 and 2023. CARB emissions were used in California for all pollutants except PAHs and CO2, which were taken from MOVES.

MOVES creates a monthly emissions inventory for criteria air pollutants (CAPs) and a full set of HAPs, plus additional pollutants such as NONHAPTOG and ETHANOL, which are not included in the NEI but are

used for speciation. MOVES provides estimates of NONHAPTOG along with the speciation profile code for the NONHAPTOG emission source. This was accomplished by using NHTOG#### as the pollutant code in the flat file 2010 (FF10) inventory file that can be read into SMOKE, where #### is a speciation profile code. For California, NHTOG####-VOC and HAP-VOC ratios from MOVES-based emissions were applied to VOC emissions so that VOC emissions can be speciated consistently with other states.

MOVES also provides estimates of PM2.5 by speciation profile code for the PM2.5 emission source, using PM25_#### as the pollutant code in the FF10 inventory file, where #### is a speciation profile code. To facilitate calculation of PMC within SMOKE, and to help create emissions summaries, an additional pollutant representing total PM2.5 called PM25TOTAL was added to the inventory. As with VOC, PM25_####-PM25TOTAL ratios were calculated and applied to PM2.5 emissions in California so that PM2.5 emissions in California can be speciated consistently with other states.

MOVES4 outputs emissions data in county-specific databases, and a post-processing script converts the data into FF10 format. Additional post-processing steps were performed as follows:

- County-specific FF10s were combined into a single FF10 file.
- Emissions were aggregated from the more detailed SCCs modeled in MOVES to the SCCs modeled in SMOKE. A list of the aggregated SMOKE SCCs is in Appendix A of the 2016v1 platform nonroad specification sheet (NEIC, 2019).
- To reduce the size of the inventory, HAPs not needed for air quality modeling, such as dioxins and furans, were removed from the inventory.
- To reduce the size of the inventory further, all emissions for sources (identified by county/SCC) for which CAP emissions totaling less than $1*10^{-10}$ were removed from the inventory. The MOVES model attributes a very tiny amount of emissions to sources that are actually zero, for example, snowmobile emissions in Florida. Removing these sources from the inventory reduces the total size of the inventory by about 7%.
- Gas and particulate components of HAPs that come out of MOVES separately, such as naphthalene, were combined.
- VOC was renamed VOC_INV so that SMOKE does not speciate both VOC and NONHAPTOG, which would result in a double count.
- PM25TOTAL, referenced above, was also created at this stage of the process.
- Emissions for airport ground support vehicles (SCCs ending in -8005), and oil field equipment (SCCs ending in -10010), were removed from the inventory at this stage, to prevent a double count with the airports and np_oilgas sectors, respectively.
- California emissions from MOVES were deleted and replaced with the CARB-supplied emissions.

National Updates: Agricultural and Construction Equipment Allocation

The modified MOVES default database for that included the refinements made to construction and agricultural sectors in the 2016 platform process (movesdb20220105_nrupdates) and state-submitted inputs in CDBs from the most recent NEI were used to run MOVES-Nonroad to produce emissions for all states other than California. California-submitted emissions were used. Updated *nrsurrogate*, *nrstatesurrogate*, and *nrbaseyearequippopulation* tables, along with instructions for utilizing these tables in MOVES runs, are available for download from EPA's ftp site: https://gaftp.epa.gov/air/emismod/2016/v1/reports/nonroad/).

Emissions Inside California

California nonroad emissions were provided by CARB for the 2020 NEI and 2023. The 2022 emissions were interpolated between 2020 and 2023 where pollutants were available in both data sets. All California nonroad inventories are annual, with monthly temporalization applied in SMOKE. Emissions for oil field equipment (SCCs ending in -10010) were removed from the California inventory in order to prevent a double count with the np_oilgas sector. VOC HAPs from California were incorporated into speciation similarly to VOC HAPs from MOVES elsewhere, e.g., model species BENZ is equal to HAP emissions for benzene as submitted by CARB. VOC and $PM_{2.5}$ emissions were allocated to speciation profiles. Ratios of VOC ($PM_{2.5}$) by speciation profile to total VOC ($PM_{2.5}$) were calculated by county and SCC from the MOVES run in California, and then applied CARB-provided VOC ($PM_{2.5}$) in the inventory so that California nonroad emissions could be speciated consistently with the rest of the country.

State Submitted Data

The CDBs used to run MOVES-Nonroad to produce emissions for all states other than California were consistent with those used to develop the 2020 NEI. The following states submitted CDBs for the 2020 NEI: Arizona - Maricopa Co.; Connecticut; Georgia; Illinois; Indiana; Michigan; Minnesota; Ohio; Oregon; Texas; Utah; Washington; and Wisconsin.

Following the completion of the MOVES runs, railway maintenance emissions were removed from specific counties / census areas in Alaska because Alaska DEC specified that this type of activity does not happen in those areas. Specifically, emissions from SCCs 2285002015, 2285004015, and 2285006015 were removed from the following counties / census areas: 02013, 02016, 02050, 02060, 02063, 02066, 02070, 02100, 02105, 02110, 02130, 02150, 02158, 02164, 02180, 02185, 02188, 02195, 02198, 02220, 02240, 02275, and 02282. Alaska DEC also specified some counties / census areas in which logging and agricultural emissions do not happen, but the emissions for the specified SCCs were already zero in the specified areas.

For more information on the development of the nonroad emissions inputs for the 2020 NEI see Section 4 of the 2020 NEI TSD.

2.5 Fires (ptfire-rx, ptfire-wild, ptagfire)

Multiple types of fires are represented in the modeling platform. These include wild and prescribed fires that are grouped into the ptfire-wild and ptfire-rx sectors, respectively, and agricultural fires that comprise the ptagfire sector. All ptfire and ptagfire fires are in the United States. Fires outside of the United States are described in the ptfire_othna sector later in this document.

2.5.1 Wild and Prescribed Fires (ptfire-rx, ptfire-wild)

Wildfire and prescribed burning emissions are contained in the ptfire-wild and ptfire-rx sectors, respectively. The ptfire sector has emissions provided at geographic coordinates (point locations) and has daily emissions values. The ptfire-rx sector excludes agricultural burning and other open burning sources that are included in the ptagfire and nonpt sectors. The ptfire-rx sector includes a new methodology for calculating pile burn emissions with this year 2022 emissions modeling platform. Emissions are day-specific and include satellite-derived latitude/longitude of the fire's origin and other parameters associated with the emissions such as acres burned and fuel load, which allow estimation of plume rise. The SCCs used for the ptfire-rx and ptfire-wild sources are shown in Table 2-24. The ptfire-rx and ptfire-wild inventories include separate SCCs for the flaming and smoldering combustion phases for wildfire and prescribed burns. Note that prescribed grassland fires or Flint Hills, Kansas has their own SCC (2801500171) in the inventory. Any wild grassland fires were assigned the standard wildfire SCCs shown in Table 2-24. A new source was added to wildland fires for the 2022 platform. This new source was Pile Burns with a SCC = 2810005001. Pile burns has been a burn method used for prescribed burns for many years, but no methodology for estimating the emissions from these burns had been used in previous NEIs or Emissions Modeling Platforms.

Table 2-24. SCCs included in the ptfire sector for the 2022 platform

SCC	Description
2801500171	Agricultural Field Burning - whole field set on fire; Fallow
2810001001	Forest Wildfires; Smoldering; Residual smoldering only (includes grassland wildfires)
2810001002	Forest Wildfires; Flaming (includes grassland wildfires)
2810005001	Prescribed burning; pile burns
2811015001	Prescribed Forest Burning; Smoldering; Residual smoldering only
2811015002	Prescribed Forest Burning; Flaming
2811020002	Prescribed Rangeland Burning

Fire Information Data

Inputs to SMARTFIRE2 for 2022 include:

- The National Oceanic and Atmospheric Administration's (NOAA's) Hazard Mapping System (HMS) fire location information
- Wildland Fire Interagency Geospatial Services (WFIGS) wildland fire perimeter polygons
- The Incident Status Summary, also known as the "ICS-209", used for reporting specific information on fire incidents of significance
- Hazardous fuel treatment reduction polygons for prescribed burns from the Forest Service Activity Tracking System (FACTS)
- Fire activity on federal lands from the United States Department of Interior agencies

The Hazard Mapping System (HMS) was developed in 2001 by the National Oceanic and Atmospheric Administration's (NOAA) National Environmental Satellite and Data Information

Service (NESDIS) as a tool to identify fires over North America in an operational environment. The system utilizes geostationary and polar orbiting environmental satellites. Automated fire detection algorithms are employed for each of the sensors. When possible, HMS data analysts apply quality control procedures for the automated fire detections by eliminating those that are deemed to be false and adding hotspots that the algorithms have not detected via a thorough examination of the satellite imagery.

The HMS product used for the 2022 inventory consisted of daily comma-delimited files containing fire detect information including latitude-longitude, satellite used, time detected, and other information. These detects were processed through a modified, python-based, Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation version 2 SmartFire2/BlueSky Pipeline (SF2/BSP).

Wildland Fire Interagency Geospatial Services (WFIGS) is an online wildfire mapping application designed for fire managers to access maps of current U.S. fire locations and perimeters. The wildfire perimeter data are based upon input data from incident intelligence sources from multiple agencies, GPS data, and infrared (IR) imagery from fixed wing and satellite platforms.

The Incident Status Summary, also known as the "ICS-209" is used for reporting specific information on significant fire incidents. The ICS-209 report is a critical interagency incident reporting tool giving daily 'snapshots' of the wildland fire management situation and individual incident information which include fire behavior, size, location, cost, and other information. Data from two tables in the ICS-209 database were merged and used for the 2022 ptfire inventory: the SIT209_HISTORY_INCIDENT_209_REPORTS table contained daily 209 data records for large fires, and the SIT209_HISTORY_INCIDENTS table contained summary data for additional smaller fires.

The US Forest Service (USFS) compiles a variety of fire information every year. Year 2022 data from the USFS Natural Resource Manager (NRM) Forest Activity Tracking System (FACTS) were acquired and used for emissions inventory development. This database includes information about activities related to fire/fuels, silviculture, and invasive species. The FACTS database consists of shapefiles for prescribed burns that provide acres burned and start and ending time information.

The Department of Interior (DOI) also compiles wildfire and prescribed burn activity on their federal lands every year. Year 2022 DOI data were acquired from National Fire Plan Operations and Reporting System (NFPORS) and through direct communication with DOI staff and were used for 2022 platform development. The DOI fire information provided fire type, acres burned, latitude-longitude, and start and ending times.

About 30 different states provided fire activity that was used in developing the wildland fire inventory. Table 2-25 below gives a listing of the type of fire activity data provided by each state that participated.

Table 2-25. Types of State-provided Fire Activity Data

SLT	Wildfire	Prescribed burns	RX includes pile burns	Ag burns
Arizona	No	Yes	Yes	No
Arkansas	Yes	Yes	Yes	Yes
California	Yes	Yes	Yes	No
Colorado	No	Yes	Yes	No
Connecticut	Yes	Yes	No	No

SLT	Wildfire	Prescribed burns	RX includes pile burns	Ag burns
Delaware	No	Yes	No	Few
Florida	Yes	Yes	Yes	Yes
Georgia	Yes	Yes	No	Yes
Idaho	No	No	No	Yes
Iowa	Yes	Yes	Yes	No
Kansas	No	Yes	No	No
Maine	Yes	Few	No	No
Maryland	Yes	Yes	Yes	No
Minnesota	No	Yes	No	No
Missouri	No	Yes	No	Yes
Montana	No	Yes	Yes	No
Nevada	No	Yes	Yes	No
New Jersey	Yes	Yes	No	No
New Mexico	Yes	Yes	No	No
Nez Perce Tribe	No	Yes	Yes	Yes
North Carolina	Yes	Yes	No	No
North Dakota	No	Yes	No	No
Oklahoma	No	Yes	No	No
Oregon	Yes	Yes	Yes	No
Pennsylvania	Yes	Yes	No	No
South Carolina	Yes	Yes	Yes	Yes
Texas	Yes	Yes	No	No
Utah	No	Yes	Yes	No
Virginia	Yes	Yes	No	No
Washington	No	Yes	Yes	Yes
Wyoming	Yes	Yes	Yes	No

Fire Emissions Estimation Methodology

The national and S/L/T data mentioned earlier were used to estimate daily wildfire and prescribed burn emissions from flaming combustion and smoldering combustion phases for the 2022 inventory. Flaming combustion is more complete combustion than smoldering and is more prevalent with fuels that have a high surface-to-volume ratio, a low bulk density, and low moisture content. Smoldering combustion occurs without a flame, is a less complete burn, and produces some pollutants, such as PM2.5, VOCs, and CO, at higher rates than flaming combustion. Smoldering combustion is more prevalent with fuels that have low surface-to-volume ratios, high bulk density, and high moisture content. Models sometimes differentiate between smoldering emissions that are lofted with a smoke plume and those that remain near the ground (residual emissions), but for the purposes of the inventory the residual smoldering emissions were allocated to the smoldering SCCs listed in Table 2-24. The lofted smoldering emissions were assigned to the flaming emissions SCCs in Table 2-24.

Figure 2-9 is a schematic of the data processing stream for the inventory of wildfire and prescribed burn sources. The ptfire-rx and ptfire-wild inventory sources were estimated using Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation version 2 (SMARTFIRE2) and BlueSky Pipeline.

SMARTFIRE2 is an algorithm and database system that is within a geographic information system (GIS). SMARTFIRE2 combines multiple sources of fire information and reconciles them into a unified GIS database. It reconciles fire data from space-borne sensors and ground-based reports, thus drawing on the strengths of both data types while avoiding double-counting of fire events. At its core, SMARTFIRE2 is an association engine that links reports covering the same fire in any number of multiple databases. In this process, all input information is preserved, and no attempt is made to reconcile conflicting or potentially contradictory information (for example, the existence of a fire in one database but not another).

For the 2022 platform, the national and S/L/T fire information was input into SMARTFIRE2 and then merged and associated based on user-defined weights for each fire information dataset. The output from SMARTFIRE2 was daily acres burned by fire type, and latitude-longitude coordinates for each fire. The fire type assignments were made using the fire information datasets. If the only information for a fire was a satellite detect for fire activity, then the flow described in Figure 2-9 was used to make fire type assignment by state and by month in conjunction with the default fire type assignments shown in Figure 2-10.

Figure 2-9. Processing flow for fire emission estimates in the 2022 inventory

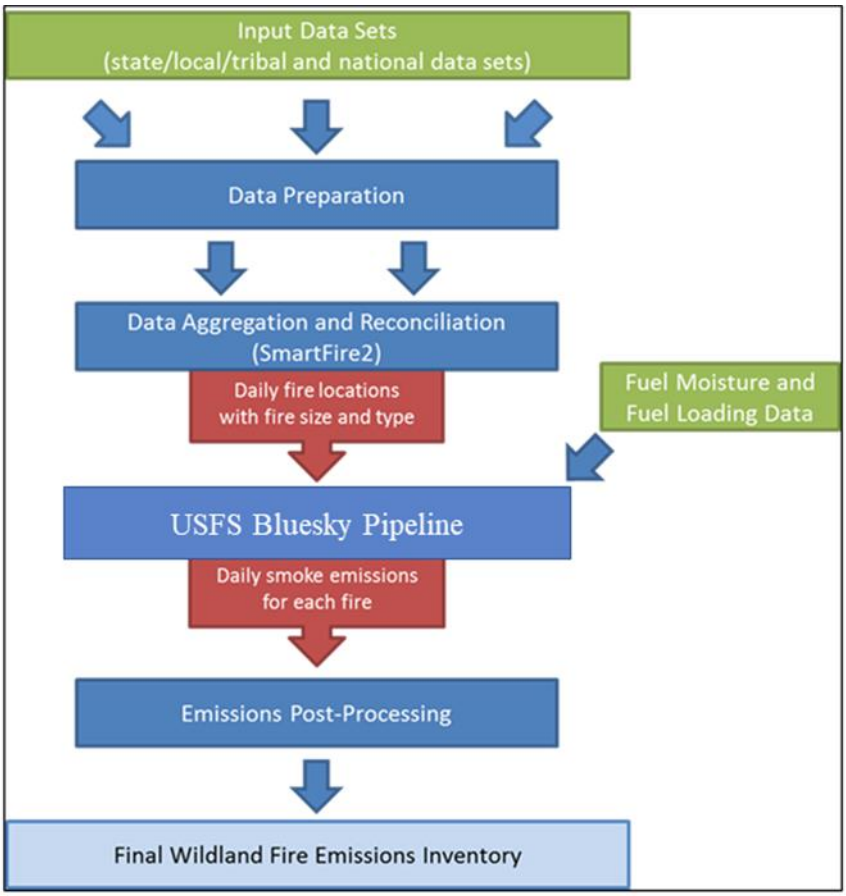
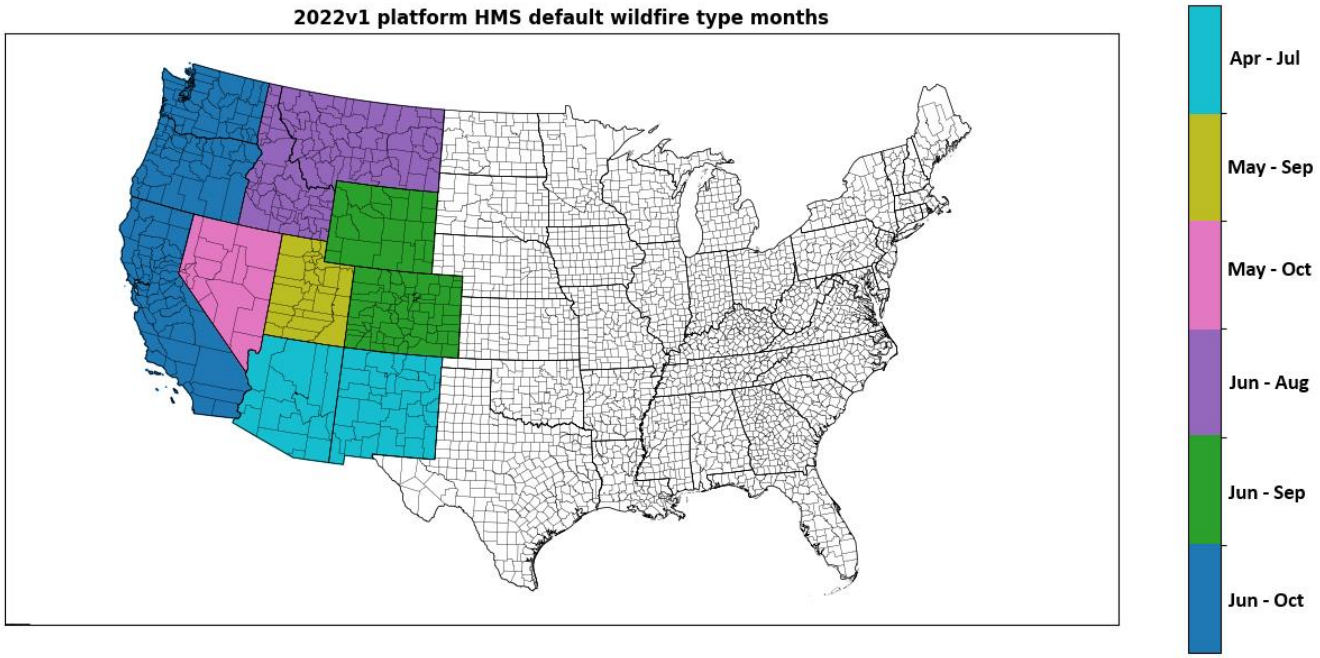
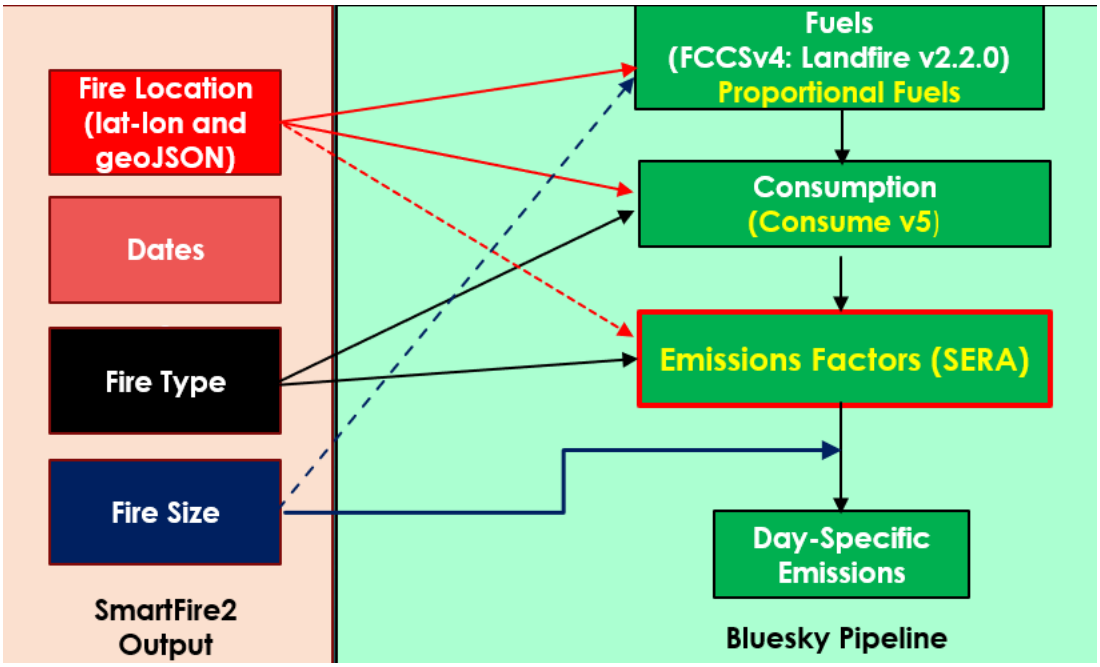


Figure 2-10. Default fire type assignment by state and month where data are only from satellites



The second system used to estimate emissions is the BlueSky Modeling Pipeline (BSP). The framework supports the calculation of fuel loading and consumption, and emissions using various models depending on the available inputs as well as the desired results. The contiguous United States and Alaska, where Fuel Characteristic Classification System (FCCS) fuel loading data are available, were processed using the modeling chain described in Figure 2-11. The Smoke Emissions Reference Application (SERA) in the BSP generates all the CAP emission factors for wildland fires used in the 2022 study. SERA factors can vary by phase, fire type, region, fuel type and more pollutants. SERA emission factors are available here: https://depts.washington.edu/nwfire/sera/index.php. SERA consists of existing peer-reviewed emission factors (EFs) of 276 known air pollutants. The SERA database enables the analysis and summaries of existing EFs, and creation of average EFs to be used in decision support tools for smoke management, including BSP. HAP emission factors were obtained from Urbanski's (2014) work and applied by region and by fire type.

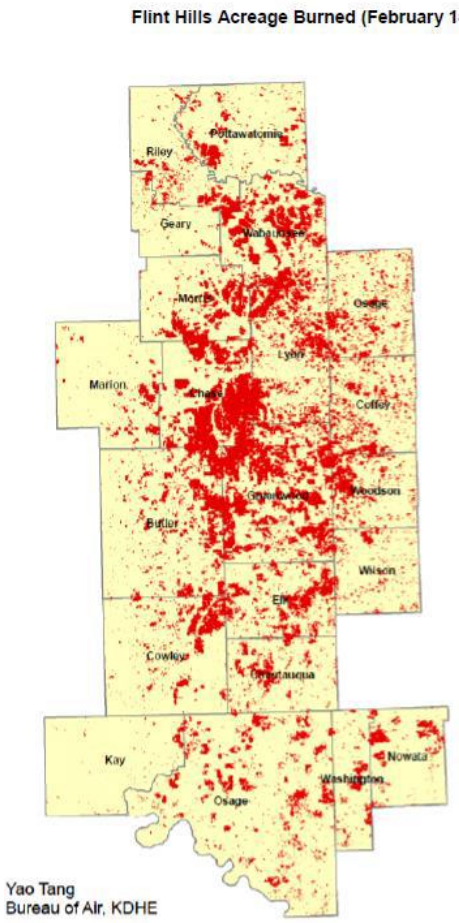
Figure 2-11. Blue Sky Modeling Pipeline



The FCCSv4 cross-reference was implemented along with the LANDFIREv2 (at 120 meter resolution) to provide better fuel bed information for the BlueSky Pipeline (BSP). The LANDFIREv2 was aggregated from the native resolution and projection to 120 meter using a nearest-neighbor methodology. Aggregation and reprojection were required for the proper function on BSP.

The Flint Hills grasslands typically have 1 to 2 million acres of prescribed burns each year usually between late February to early May. Kansas provided county acres burned information for these prescribed burns for 2022 that cover most of eastern Kansas and 4 additional counties in eastern Oklahoma. As shown in Figure 2-12. Flint Hills Acreage Burned in 2022below, between February 15-April 30 about 2.1M acres were burned in the Flint Hills. The HMS detects for this time period and for these counties (about 21000 detects) were used to temporally and spatially allocate these prescribed burns and the associated estimated emissions. The emissions estimation process is done outside of BSP using SERA emissions factors except for PM2.5 where a factor of 12.68 g/kg was used based on EPA ORD test results. The Flint Hills emissions are assigned the SCC 2801500171.

Figure 2-12. Flint Hills Acreage Burned in 2022



County	Acres Burned
Butler	163,895
Chase	237,442
Chautauqua	57,901
Coffey	85,902
Cowley	88,095
Elk	109,933
Geary	17,035
Greenwood	315,605
Lyon	180,190
Marion	37,483
Morris	96,126
Osage (KS)	83,894
Pottawatomie	59,106
Riley	53,700
Wabaunsee	182,259
Wilson	33,592
Woodson	69,422
Nowata (OK)	43,507
Osage (OK)	156,297
Washington (OK)	30,842
Kay (OK)	10,533
Total	2,112,759

In 2022v1 and in the 2020NEI, HMS detects on or near corn and soybean fields in the Midwest were assumed to be nearby irrigation ditch or other type of ditch burns. These emissions were also estimated outside of BSP using the assumption of fuels being similar to grasses. These ditch burns were put into the prescribed burn sector (ptfire-rx) and assigned a Rangeland burning SCC 2811020002.

The final products from this process were annual and daily FF10-formatted emissions inventories. These SMOKE-ready inventory files contain both CAPs and HAPs. The BAFM HAP emissions from the inventory were used directly in modeling and were not overwritten with VOC speciation profiles (i.e., an "integrate HAP" use case).

For the 2022 platform, pile burn (PB) emissions were estimated using a combination of federal, state, local, and tribal activity data. This activity data was supplied in the form of daily estimates of area treated, pile volume, pile dimensions, or mass piled by location, varying by data source. As with the RX and WF S/L/T data, the pile burn data was imported into SF2 so that it could be reconciled with other data sources to avoid duplication of activity and emissions. HMS satellite detects that reconciled only with the location of the PB activity were removed from the BSP workflow as pile burns. The PB activity data was then directly imported into a calculator script that estimates the amount of biomass consumed at each location and the resulting emissions. The consumption calculations made are consistent with

those used in the University of Washington pile burn calculator (https://depts.washington.edu/nwfire/piles/). For activity data where only a treated area is provided a default fuel loading of 4.5 tons per acre is used based on an analysis of California and Washington historical pile burn permits. A consumption efficiency of 90% is assumed unless otherwise specified in the activity data. Emissions factors averaged over pile burn studies in the SERA database were applied to estimate CAPs from the consumed piled biomass.

The 2022 wildfire season was slightly below average with about 4.6M acres burned in the CONUS. The 2022v1 EMP includes emissions from the 4.6M acres of wildfires plus an estimated 13.5M acres in prescribed burns. The prescribed burns include the 829K acres estimated for the Midwest ditch burns. It is important to note that using the activity data available mentioned early from federal and state agencies about 8M prescribed burn acres were reconciled with or without HMS detects. The remaining 5.5M prescribed burn acres were estimated using a default acre burn assumption were not reconciled with any federal or state agency fire activity data. The default acre burn assumption was applied to any HMS detects that did not reconcile with any federal or state agency activity data.

2.5.2 Point source Agriculture Fires (ptagfire)

In the NEI, agricultural fires are stored as county-annual emissions and are part of the nonpoint data category. For this 2022 platform, agricultural fires are modeled as day specific fires derived from satellite data for the year 2022 in a similar way to the emissions in ptfire.

Daily year-specific agricultural burning emissions are derived from HMS fire activity data, which contains the date and location of remote-sensed anomalies. The activity is filtered using the 2022 USDA cropland data layer (CDL). Satellite fire detects over agricultural lands are assumed to be agricultural burns and assigned a crop type. Detects that are not over agricultural lands are output to a separate file for use in the ptfire sector. Each detect is assigned an average size of between 40 and 120 acres varying by state. Grassland/pasture fires were moved to the ptfire sectors for this 2022 modeling platform. Depending on their origin, grassland fires are in both ptfire-rx and ptfire-wild sectors because both fire types do involve grassy fuels.

The point source agricultural fire (ptagfire) inventory sector contains daily agricultural burning emissions. Daily fire activity was derived from the NOAA Hazard Mapping System (HMS) fire activity data. The agricultural fires sector includes SCCs starting with '28015'. The first three levels of descriptions for these SCCs are: 1) Fires - Agricultural Field Burning; Miscellaneous Area Sources; 2) Agriculture Production - Crops - as nonpoint; and 3) Agricultural Field Burning - whole field set on fire. The SCC 2801500000 does not specify the crop type or burn method, while the more specific SCCs specify field or orchard crops and, in some cases, the specific crop being grown. The SCCs for this sector listed are in Table 2-26.

Table 2-26. SCCs included in the ptagfire sector

SCC	Description
2801500000	Miscellaneous Area Sources; Agriculture Production - Crops - as nonpoint; Agricultural Field Burning - whole field set on fire; Unspecified crop type and Burn Method
2801500141	Miscellaneous Area Sources; Agriculture Production - Crops - as nonpoint; Agricultural Field Burning - whole field set on fire; Field Crop is Bean (red): Headfire Burning

SCC	Description
2801500150	Miscellaneous Area Sources; Agriculture Production - Crops - as nonpoint; Agricultural Field Burning - whole field set on fire; Field Crop is Corn: Burning Techniques Not Important
2801500160	Miscellaneous Area Sources; Agriculture Production - Crops - as nonpoint; Agricultural Field Burning - whole field set on fire; Field Crop is Cotton: Burning Techniques Not Important
2801500220	Miscellaneous Area Sources; Agriculture Production - Crops - as nonpoint; Agricultural Field Burning - whole field set on fire; Field Crop is Rice: Burning Techniques Not Significant
2801500250	Miscellaneous Area Sources; Agriculture Production - Crops - as nonpoint; Agricultural Field Burning - whole field set on fire; Field Crop is Sugar Cane: Burning Techniques Not Significant
2801500262	Miscellaneous Area Sources; Agriculture Production - Crops - as nonpoint; Agricultural Field Burning - whole field set on fire; Field Crop is Wheat: Backfire Burning
2801500264	Miscellaneous Area Sources; Agriculture Production - Crops - as nonpoint; Agricultural Field Burning - whole field set on fire; DoubleCrop Winter Wheat and Soybeans
2811020002	Miscellaneous Area Sources; Other Combustion - as Event; Prescribed Rangeland Burning; Flaming

Another feature of the ptagfire database is that the satellite detections for 2022 were filtered out to exclude areas covered by snow during the winter months. To do this, the daily snow cover fraction per grid cell was extracted from a 2022 meteorological Weather Research Forecast (WRF) model simulation. The locations of fire detections were then compared with this daily snow cover file. For any day in which a grid cell had snow cover, the fire detections in that grid cell on that day were excluded from the inventory. Due to the inconsistent reporting of fire detections from the Visible Infrared Imaging Radiometer Suite (VIIRS) platform, any fire detections in the HMS dataset that were flagged as VIIRS or Suomi National Polar-orbiting Partnership satellite were excluded. In addition, certain crop types (corn and soybeans) have been excluded from these specific midwestern states: Iowa, Kansas, Indiana, Illinois, Michigan, Missouri, Minnesota, Wisconsin, and Ohio. The reason for these crop types being excluded is because states have indicated that these crop types are not burned.

Heat flux for plume rise was calculated using the size and assumed fuel loading of each daily agricultural fire. This information is needed for a plume rise calculation within a chemical transport modeling system.

The daily agricultural emissions were converted from a tabular format into the SMOKE-ready daily point flat file format. The daily emissions were also aggregated into annual values by location and converted into the annual point flat file format.

For this modeling platform, a SMOKE update allows the use of HAP integration for speciation for PTDAY inventories. The 2022 agricultural fire inventories include emissions for HAPs, so HAP integration was used for this study.

2.6 Biogenic Sources (beis)

Biogenic emissions were computed based on the 2022 meteorology data used for the 2022 platform and were developed using the Biogenic Emission Inventory System version 4 (BEIS4) within CMAQ. BEIS4 creates gridded, hourly, model-species emissions from vegetation and soils. It estimates CO, VOC (most

notably isoprene, terpene, and sesquiterpene), and NO emissions for the contiguous U.S. and for portions of Mexico and Canada. In the BEIS4 two-layer canopy model, the layer structure varies with light intensity and solar zenith angle (Pouliot and Bash, 2015). Both layers include estimates of sunlit and shaded leaf area based on solar zenith angle and light intensity, direct and diffuse solar radiation, and leaf temperature (Bash et al., 2015). BEIS4 computes the seasonality of emissions using the 1-meter soil temperature (SOIT2) instead of the BIOSEASON file, and canopy temperature and radiation environments are now modeled using the driving meteorological model's (WRF) representation of leaf-area index (LAI) rather than the estimated LAI values from BELD data alone. See these CMAQ Release Notes for technical information on BEIS4: https://github.com/USEPA/CMAQ/wiki/CMAQ-Release-Notes:-Emissions-Updates:-BEIS-Biogenic-Emissions. The variables output from the Meteorology-Chemistry Interface Processor (MCIP) that are used to convert WRF outputs to CMAQ inputs are shown in Table 2-27.

Table 2-27. Meteorological variables required by BEIS4

Variable	Description
LAI	leaf-area index
PRSFC	surface pressure
Q2	mixing ratio at 2 m
RC	convective precipitation per met TSTEP
RGRND	solar rad reaching surface
RN	nonconvective precipitation per met TSTEP
RSTOMI	inverse of bulk stomatal resistance
SLYTP	soil texture type by USDA category
SOIM1	volumetric soil moisture in top cm
SOIT1	soil temperature in top cm
TEMPG	skin temperature at ground
USTAR	cell averaged friction velocity
RADYNI	inverse of aerodynamic resistance
TEMP2	temperature at 2 m
WSAT_PX	soil saturation from (Pleim-Xiu Land Surface Model) PX-LSM

The Biogenic Emissions Landcover Database version 6 (BELD6) was used as the input gridded land use information in generating the biogenic emissions estimates. There are now two different BELD6 datasets that are input into BEIS4. The gridded landuse and the other is the gridded dry leaf biomass (grams/m^2) values for various vegetation types. The BELD6 includes the following datasets:

- High resolution tree species and biomass data from Wilson et al. 2013a, and Wilson et al. 2013b for which species names were changed from non-specific common names to scientific names
- Tree species biogenic volatile organic carbon (BVOC) emission factors for tree species were taken from the NCAR Enclosure database (Wiedinmyer, 2001)
    - https://www.sciencedirect.com/science/article/pii/S1352231001004290
- Agricultural land use from US Department of Agriculture (USDA) crop data layer

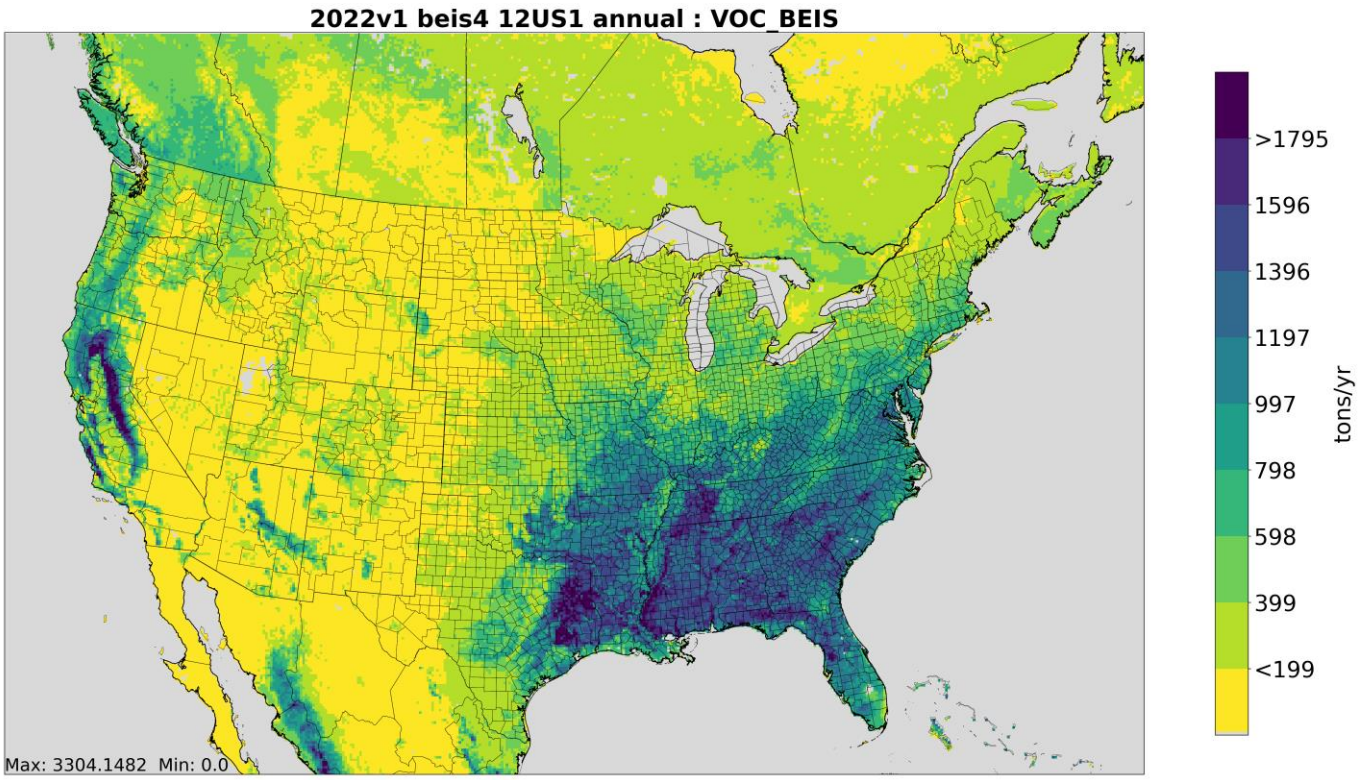
- Global Moderate Resolution Imaging Spectroradiometer (MODIS) 20 category data with enhanced lakes and Fraction of Photosynthetically Active Radiation (FPAR) for vegetation coverage from National Center for Atmospheric Research (NCAR)
- Canadian BELD land use, updates to Version 4 of the Biogenic Emissions Landuse Database (BELD4) for Canada and Impacts on Biogenic VOC Emissions (https://www.epa.gov/sites/default/files/2019-08/documents/800am_zhang_2_0.pdf).

Bug fixes included in BEIS4 included the following:

- Solar radiation attenuation in the shaded portion of the canopy was using the direct beam photosynthetically active radiation (PAR) when the diffuse beam PAR attenuation coefficient should have been used.
    - This update had little impact on the total emissions but did result in slightly higher emissions in the morning and evening transition periods for isoprene, methanol and Methylbutenol (MBO).
- The fraction of solar radiation in the sunlit and shaded canopy layers, SOLSUN and SOLSHADE respectively were estimated using a planar surface. These should have been estimated based on the PAR intercepted by a hemispheric surface rather than a plane.
    - This update can result in an earlier peak in leaf temperature, approximately up to an hour.
- The quantum yield for isoprene emissions (ALPHA) was updated to the mean value in Niinemets et al. 2010a and the integration coefficient (CL) was updated to yield 1 when PAR = 1000 following Niinemets et al 2010b.
    - This updated resulted in a slight reduction in isoprene, methanol, and MBO emissions.

Biogenic emissions computed with BEIS were used to review and prepare summaries but were left out of the CMAQ-ready merged emissions in favor of inline biogenic emissions produced during the CMAQ model run itself using the same algorithm described above but with finer time steps within the air quality model. Figure 2-13 provides an annual estimate of the biogenic VOC emissions in year 2022 from BEIS4.

Figure 2-13. Annual biogenic VOC BEIS4 emissions for the 12US1 domain



2.7 Sources Outside of the United States

The emissions from Canada and Mexico are included as part of the emissions modeling sectors: canmex_point, canmex_area, canada_afdust, canada_ptdust, canada_onroad, mexico_onroad, canmex_ag, and canada_og2D. The canmex_ag sector is processed as a separate sector for reporting and tracking purposes, and unlike in other recent emissions platforms, the Canada ag sources are area sources in this platform rather than pre-gridded point sources. As in prior platforms, Fugitive dust emissions in Canada are represented as both area sources (canada_afdust sector, formerly “othafdust”) and point sources (canada_ptdust sector, formerly “othptdust”). Due to the large number of individual points, low-level oil and gas emissions in Canada are processed separately from the canmex_point sector to reduce the number of individual points to track within CMAQ, and also to reduce the size of the model-ready emissions files.

Canadian emissions in these sectors were generally taken from 2020 and 2023 inventories provided by Environment and Climate Change Canada (ECCC), interpolated to 2022. ECCC provided the following inventories, the sectors in which they were incorporated are listed and the inventories are described in more detail below:

- Agricultural livestock and fertilizer, area source format (canmex_ag sector)
- Surface-level oil and gas emissions in Canada (canada_og2D sector)
- Agricultural fugitive dust, point source format (canada_ptdust sector)
- Other area source dust (canada_afdust sector)
- Onroad (canada_onroad sector)
- Nonroad and rail (canmex_area sector)

- Airports (canmex_point sector)
- Other area sources (canmex_area sector)
- Other point sources (canmex_point sector)

The 2022 CMV data included coastal waters of Canada and Mexico with emissions derived from AIS data. These emissions were used for all areas of Canada and Mexico and are included in the cmv_c1c2 and cmv_c3 sectors. Both the C1C2 and C3 emissions were developed in a point source format with point locations at the center of the 12km grid cells.

Other than the CB6 species present in the speciated point source data, there are no explicit HAP emissions in these Canadian inventories. In addition to emissions inventories, the ECCC 2020 dataset also included shapefiles for creating spatial surrogates. These surrogates were used for this study.

While emissions in the 2020 platform were adjusted at the monthly level to reflect COVID pandemic effects, no such adjustments were made for 2022 modeling.

2.7.1 Point Sources in Canada and Mexico (canmex_point)

Canadian point source inventories provided by ECCC include emissions for airports and other point sources. The Canadian industrial point source inventory is pre-speciated for the CB6 chemical mechanism. All Canada point source emissions were interpolated from 2020 and 2023 inventories to 2022 except for the point EGU inventory, for which the 2023 inventory was used directly. This is because for point EGUs, the ECCC inventories contain different facilities in different years, making an interpolation difficult.

Point sources in Mexico were compiled in two parts. New emissions inventories representing 2018 developed through a collaboration between EPA and SEMARNAT were used for the six Mexico border states: Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas. Mexico inventories for other states were based on inventories projected from the Inventario Nacional de Emisiones de Mexico, 2016 (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT)), projected to 2019 as part of the 2019 emissions modeling platform. For the emissions carried forward from the 2019 platform, the point source emissions were converted to English units and into the FF10 format that could be read by SMOKE, missing stack parameters were gapfilled using SCC-based defaults, latitude and longitude coordinates were verified and adjusted if they were not consistent with the reported municipality. Only CAPs are covered in the Mexico point source inventory.

2.7.2 Fugitive Dust Sources in Canada (canada_afdust, canada_ptdust)

Fugitive dust sources of particulate matter emissions excluding land tilling from agricultural activities, were provided by Environment and Climate Change Canada (ECCC) for 2020 and 2023, and were interpolated to 2022 for this study. Dust emissions resulting from land tilling due to agricultural activities and livestock were provided as part of the ECCC area source dust inventory. The provided wind erosion emissions were removed. The ECCC point source dust inventory includes emissions from road dust. A transport fraction adjustment that reduces dust emissions based on land cover types was applied to both point and nonpoint dust emissions, along with a meteorology-based (precipitation and snow/ice cover) zero-out of emissions when the ground is snow covered or wet.

2.7.3 Agricultural Sources in Canada and Mexico (canmex_ag)

Agricultural emissions from Canada and Mexico, excluding fugitive dust, are included in the canmex_ag sector. Canadian agricultural emissions were provided by Environment and Climate Change Canada (ECCC) as part of their 2020 and 2023 emission inventories (interpolated to 2022). Unlike in recent platforms, Canadian agricultural were not represented as point sources, instead they were represented as area sources and gridded using spatial surrogates. In Mexico, agricultural sources were based on new emissions inventories representing 2018 for the six Mexico border states (Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas), and emissions from the 2019 emissions platform (SEMARNAT-provided 2016, projected to 2019) were carried forward for all other states.

2.7.4 Surface-level Oil and Gas Sources in Canada (canada_og2D)

Canadian point source inventories provided by ECCC included oil and gas emissions, and were interpolated from 2020 and 2023 to 2022. A very large number of these oil and gas point sources are surface level emissions, appropriate to be modeled in layer 1. Reducing the size of the canmex_point sector improves air quality model run time because plume rise calculations are needed for fewer sources, so these surface level oil and gas sources were placed into the canada_og2D sector for layer 1 modeling.

2.7.5 Nonpoint and Nonroad Sources in Canada and Mexico (canmex_area)

ECCC provided year 2020 and 2023 at the Canada province, and in some cases sub-province, resolution emissions from for nonpoint and nonroad sources (canmex_area). 2022 was interpolated from the 2020 and 2023 emissions. The nonroad sources were monthly while the nonpoint and rail emissions were annual.

In Mexico, nonroad and nonpoint sources were based on new emissions inventories representing 2018 for the six Mexico border states (Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas), and emissions from the 2019 emissions platform (SEMARNAT-provided 2016, projected to 2019) were carried forward for all other states.

2.7.6 Onroad Sources in Canada and Mexico (canada_onroad, mexico_onroad)

The onroad emissions for Canada and Mexico are in the canada_onroad and mexico_onroad sectors, respectively. ECCC provided year 2020 and 2023 at the Canada province, and in some cases sub-province resolution. 2022 was interpolated from the 2020 and 2023 emissions.

For Mexico onroad emissions, a version of the MOVES model for Mexico was run for 2020 and 2023. 2022 was then interpolated. This provided the same VOC HAPs and speciated VOCs as for the U.S. MOVES model (ERG, 2016a). This includes NBAFM plus several other VOC HAPs such as toluene, xylene, ethylbenzene and others. Except for VOC HAPs that are part of the speciation, no other HAPs are included in the Mexico onroad inventory (such as particulate HAPs nor diesel particulate matter).

2.7.7 Fires in Canada and Mexico (*ptfire_othna*)

Annual 2022 wildland fire emissions for Mexico, Canada, Central America, and Caribbean nations are included in the ptfire_othna sector. Canadian fire activity was developed by processing the Canadian Wildland Fire Information System's National Burned Area Composite (NBAC) and NOAA's Hazard

Mapping System (HMS) through SMARTFIRE 2.[12] Emissions were estimated from the wildland fire activity using BlueSky pipeline with Canadian Fire Behavior Prediction (FBP) fuel beds mapped to Fuel Characteristic Classification System (FCCS) fuel beds. Fires in Mexico, Central America, and the Caribbean, were developed from the Fire Inventory from NCAR (FINN) v2.5 daily fire emissions for 2022 (Wiedenmyer, 2023). For FINN fires, listed vegetation type codes of 1 and 9 are defined as agricultural burning, all other fire detections and assumed to be wildfires. All wildland fires that are not defined as agricultural are assumed to be wildfires rather than prescribed. FINN fire detects of less than 50 square meters (0.012 acres) are removed from the inventory. The locations of FINN fires are geocoded from latitude and longitude to FIPS code.

2.7.8 Ocean Chlorine, Ocean Sea Salt, and Volcanic Mercury

The ocean chlorine gas emission estimates are based on the build-up of molecular chlorine (Cl_2) concentrations in oceanic air masses (Bullock and Brehme, 2002). Data at 36 km and 12 km resolution were available and were not modified other than the model-species name "CHLORINE" was changed to "CL2" to support CMAQ modeling.

For mercury, the volcanic mercury emissions that were used in the recent modeling platforms were not included in this 2022v1 platform because no HAP+CAP modeling was performed. The emissions were originally developed for a 2002 multipollutant modeling platform with coordination and data from Christian Seigneur and Jerry Lin for 2001 (Seigneur et. al, 2004 and Seigneur et. al, 2001). The volcanic emissions from the most recent eruption were not included in the because they have diminished by the year 2019. Thus, no volcanic emissions were included.

Because of mercury bidirectional flux within the latest version of CMAQ, no natural mercury emissions are included in the emissions merge step for HAP+CAP platforms.

[12] See https://www.cmascenter.org/conference/2023/slides/2023-10-18-1350-2021-Canada-WF-Updates-CMAS.pptx.

3 Emissions Modeling

The CMAQ and CAMx air quality models require hourly emissions of specific gas and particle species for the horizontal and vertical grid cells contained within the modeled region (i.e., modeling domain). To provide emissions in the form and format required by the model, it is necessary to "pre-process" the "raw" emissions (i.e., emissions input to SMOKE) for the sectors described above in Section 2. In brief, the process of emissions modeling transforms the emissions inventories from their original temporal resolution, pollutant resolution, and spatial resolution into the hourly, speciated, gridded and vertical resolution required by the air quality model. Emissions modeling includes temporal allocation, spatial allocation, and pollutant speciation. Emissions modeling sometimes includes the vertical allocation (i.e., plume rise) of point sources, but many air quality models also perform this task because it greatly reduces the size of the input emissions files if the vertical layers of the sources are not included.

As seen in Section 2, the temporal resolutions of the emissions inventories input to SMOKE vary across sectors and may be hourly, daily, monthly, or annual total emissions. The spatial resolution may be individual point sources; totals by county (U.S.), province (Canada), or municipio (Mexico); or gridded emissions. This section provides some basic information about the tools and data files used for emissions modeling as part of the modeling platform.

3.1 Emissions Modeling Overview

SMOKE version 5.1 was used to process the raw emissions inventories into emissions inputs for each modeling sector into a format compatible with CMAQ. SMOKE executables and source code are available from the Community Multiscale Analysis System (CMAS) Center at http://www.cmascenter.org. Additional information about SMOKE is available from http://www.smoke-model.org. For sectors that have plume rise, the in-line plume rise capability allows for the use of emissions files that are much smaller than full three-dimensional gridded emissions files. For quality assurance of the emissions modeling steps, emissions totals by specie for the entire model domain are output as reports that are then compared to reports generated by SMOKE on the input inventories to ensure that mass is not lost or gained during the emissions modeling process.

When preparing emissions for the air quality model, emissions for each sector are processed separately through SMOKE, and then the final merge program (Mrggrid) is run to combine the model-ready, sector-specific 2-D gridded emissions across sectors. The SMOKE settings in the run scripts and the data in the SMOKE ancillary files control the approaches used by the individual SMOKE programs for each sector. Table 3-1 summarizes the major processing steps of each platform sector with the columns as follows.

The "Spatial" column shows the spatial approach used: "point" indicates that SMOKE maps the source from a point location (i.e., latitude and longitude) to a grid cell; "surrogates" indicates that some or all of the sources use spatial surrogates to allocate county emissions to grid cells; and "area-to-point" indicates that some of the sources use the SMOKE area-to-point feature to grid the emissions (further described in Section 3.4.2). The "Speciation" column indicates that all sectors use the SMOKE speciation step, though biogenics speciation is done within the Tmpbeis3 program and not as a separate SMOKE step. The "Inventory resolution" column shows the inventory temporal resolution from which SMOKE needs to calculate hourly emissions. Note that for some sectors (e.g., onroad, beis), there is no input

inventory; instead, activity data and emission factors are used in combination with meteorological data to compute hourly emissions.

Table 3-1. Key emissions modeling steps by sector.

Platform sector	Spatial	Speciation	Inventory resolution	Plume rise
afdust_adj	Surrogates	Yes	Annual	
airports	Point	Yes	Annual	None
beis	Pre-gridded land use	in BEIS4	computed hourly in CMAQ	
fertilizer	EPIC	No	computed hourly in CMAQ	
livestock	Surrogates	Yes	Daily	
cmv_c1c2	Point	Yes	hourly	in-line
cmv_c3	Point	Yes	hourly	in-line
nonpt	Surrogates & area-to-point	Yes	Annual	
nonroad	Surrogates	Yes	monthly	
np_oilgas	Surrogates	Yes	Annual	
onroad	Surrogates	Yes	monthly activity, computed hourly	
onroad_ca_adj	Surrogates	Yes	monthly activity, computed hourly	
canada_onroad	Surrogates	Yes	monthly	
mexico_onroad	Surrogates	Yes	monthly	
canada_afdust	Surrogates	Yes	annual & monthly	
canmex_area	Surrogates	Yes	monthly	
canmex_point	Point	Yes	monthly	in-line
canada_ptdust	Point	Yes	annual	None
canada_og2D	Point	Yes	monthly	None
canmex_ag	Surrogates	Yes	annual	
ptagfire	Point	Yes	daily	in-line
pt_oilgas	Point	Yes	annual	in-line
ptegu	Point	Yes	daily & hourly	in-line
ptfire-rx	Point	Yes	daily	in-line
ptfire-wild	Point	Yes	daily	in-line
ptfire_othna	Point	Yes	daily	in-line
ptnonipm	Point	Yes	annual	in-line
rail	Surrogates	Yes	annual	
rwc	Surrogates	Yes	annual	
np_solvents	Surrogates	Yes	annual	

The “plume rise” column in indicates the sectors for which the “in-line” approach is used. These sectors are the only ones with emissions in aloft layers based on plume rise. The term “in-line” means that the plume rise calculations are done inside of the air quality model instead of being computed by SMOKE. In all of the “in-line” sectors, all sources are output by SMOKE into point source files which are subject to plume rise calculations in the air quality model. In other words, no emissions are output to layer 1 gridded emissions files from those sectors as has been done in past platforms. The air quality model computes the plume rise using stack parameters, the Briggs algorithm, and the hourly emissions in the SMOKE output files for each emissions sector. The height of the plume rise determines the model layers into which the emissions are placed. The plume top and bottom are computed, along with the plumes' distributions into the vertical layers that the plumes intersect. The pressure difference across each layer divided by the pressure difference across the entire plume is used as a weighting factor to assign the emissions to layers. This approach gives plume fractions by layer and source. Day-specific point fire emissions are treated differently in CMAQ. After plume rise is applied, there are emissions in every layer from the ground up to the top of the plume.

Note that SMOKE has the option of grouping sources so that they are treated as a single stack when computing plume rise. For the modeling cases discussed in this document, no grouping was performed because grouping combined with “in-line” processing will not give identical results as “offline” processing (i.e., when SMOKE creates 3-dimensional files). This occurs when stacks with different stack parameters or latitude and longitudes are grouped, thereby changing the parameters of one or more sources. The most straightforward way to get the same results between in-line and offline is to avoid the use of stack grouping.

Biogenic emissions can be modeled two different ways in the CMAQ model. The BEIS model in SMOKE can produce gridded biogenic emissions that are then included in the gridded CMAQ-ready emissions inputs, or alternatively, CMAQ can be configured to create “in-line” biogenic emissions within CMAQ itself. For this study, the in-line biogenic emissions option was used, and so biogenic emissions from BEIS were not included in the gridded CMAQ-ready emissions.

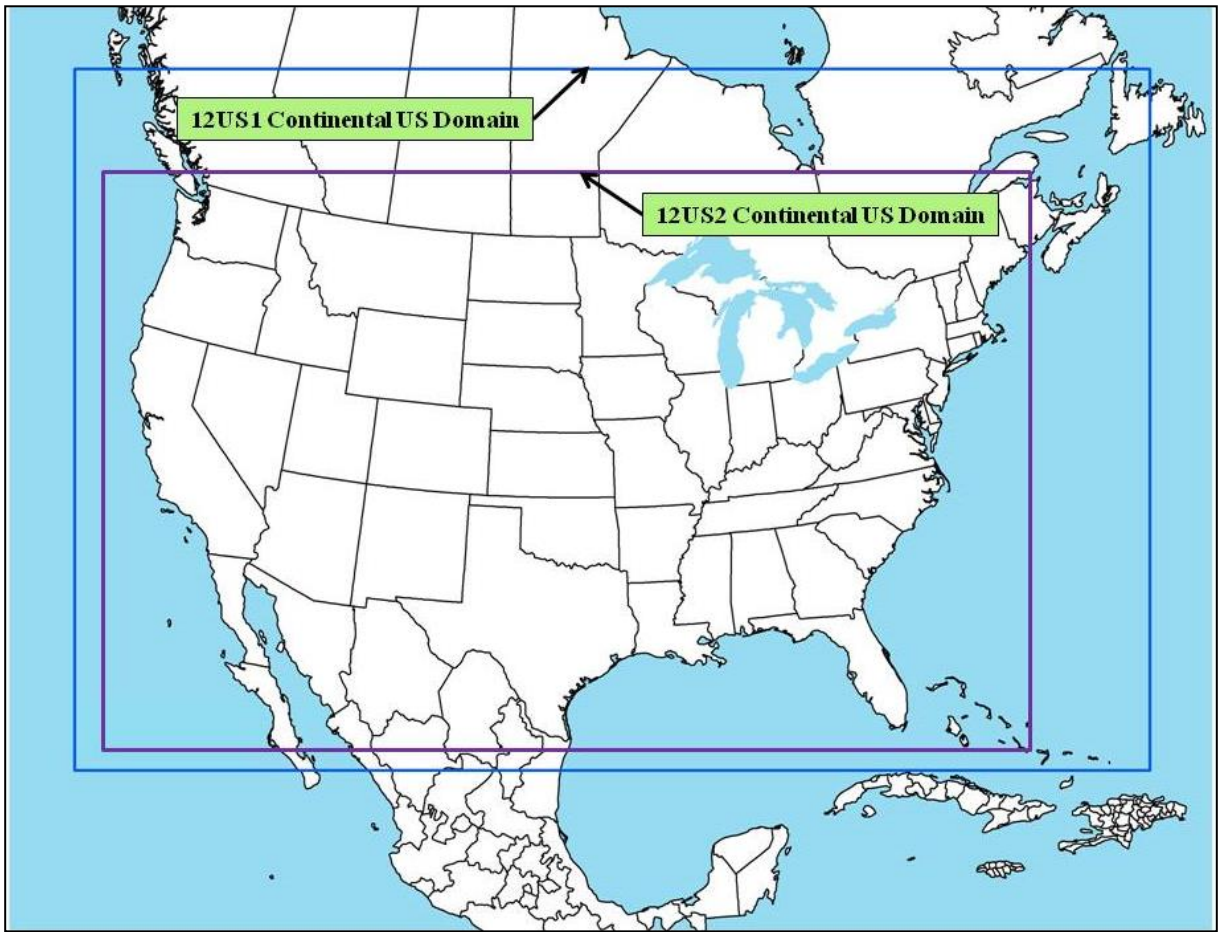
For this study, SMOKE was run for the larger 12-km CONtinental United States “CONUS” modeling domain (12US1) shown in Figure 3-1, but the air quality model was run on the smaller 12-km domain (12US2). More specifically, SMOKE was run on the 12US1 domain and emissions were extracted from 12US1 data files to create 12US2 emissions. The grids used a Lambert-Conformal projection, with Alpha = 33, Beta = 45 and Gamma = -97, with a center of X = -97 and Y = 40. In addition, SMOKE was run for grids over Alaska, Hawaii, and Puerto Rico plus the Virgin Islands. Later sections provide details on the spatial surrogates and area-to-point data used to accomplish spatial allocation with SMOKE. Table 3-2 describes the grids. WRF, SMOKE, and CMAQ all presume the Earth is a sphere with a radius of 6370000 m.

Table 3-2. Descriptions of the platform grids

Common Name	Grid Cell Size	Description	Grid name	Parameters listed in SMOKE grid description (GRIDDESC) file: projection name, xorig, yorig, xcell, ycell, ncols, nrows, nthik
Continental 12km grid	12 km	Entire conterminous US plus some of Mexico/Canada	12US1_459X299	'LAM_40N97W', -2556000, -1728000, 12.D3, 12.D3, 459, 299, 1
US 12 km or "smaller" CONUS-12	12 km	Smaller 12km CONUS plus some of Mexico/Canada	12US2	'LAM_40N97W', -2412000, -1620000, 12.D3, 12.D3, 396, 246, 1
Alaska 9km	9 km	Small 9 km Alaska with parts of Canada	9AK1	LAM_36N_155W', -1107000, -1134000, 9000, 9000, 312, 252, 1
Hawaii 3km	3 km	Small 3 km Hawaii	3HI1	LAM_21N_157W', -391500, -346500, 3000, 3000, 225, 201, 1
Puerto Rico & Virgin Islands 3km	3 km	Small 3 km covering Puerto Rico and the Virgin Islands	3PR1	LAM_18N_66W', -274500, -202500, 3000, 3000, 150, 150, 1

Figure 3-1. Air quality modeling domains

a) 12US1 and 12US2



3.2 Chemical Speciation

Chemical speciation involves the process of translating emissions from the inventory into the chemical mechanism-specific "model species" needed by an air quality model. Using the CB6R5_AE7 chemical mechanism as an example, these model species either represent explicit chemical compounds (e.g., acetone, benzene, ethanol) or groups of species (i.e., "lumped species;" e.g., PAR, OLE, KET). Table 3-3 lists the model species generated by SMOKE for this mechanism. Table 3-4 and Table 3-5 list additional model species that are generated when performing toxics modeling, and Table 3-6 lists the mapping between individual polycyclic aromatic hydrocarbons (PAHs) to the PAH groups used in toxics modeling.

Table 3-3. Emission model species produced for CB6R5_AE7 for CMAQ

Inventory Pollutant	Model Species	Model species description
Cl_2	CL2	Atomic gas-phase chlorine
HCl	HCL	Hydrogen Chloride (hydrochloric acid) gas
CO	CO	Carbon monoxide
NO_X	NO	Nitrogen oxide
NO_X	NO2	Nitrogen dioxide
NO_X	HONO	Nitrous acid
SO_2	SO2	Sulfur dioxide
SO_2	SULF	Sulfuric acid vapor
NH_3	NH3	Ammonia
NH_3	NH3_FERT	Ammonia from fertilizer
VOC	AACD	Acetic acid
VOC	ACET	Acetone
VOC	ALD2	Acetaldehyde
VOC	ALDX	Propionaldehyde and higher aldehydes
VOC	APIN	Alpha pinene
VOC	BENZ	Benzene
VOC	CAT1	Methyl-catechols
VOC	CH4	Methane
VOC	CRES	Cresols
VOC	CRON	Nitro-cresols
VOC	ETH	Ethene
VOC	ETHA	Ethane
VOC	ETHY	Ethyne
VOC	ETOH	Ethanol
VOC	FACD	Formic acid
VOC	FORM	Formaldehyde
VOC	GLY	Glyoxal
VOC	GLYD	Glycolaldehyde
VOC	IOLE	Internal olefin carbon bond (R-C=C-R)
VOC	ISOP	Isoprene
VOC	ISPD	Isoprene Product
VOC	IVOC	Intermediate volatility organic compounds
VOC	KET	Ketone Groups
VOC	MEOH	Methanol

Inventory Pollutant	Model Species	Model species description
VOC	MGLY	Methylglyoxal
VOC	NAPH	Naphthalene
VOC	NVOL	Non-volatile compounds
VOC	OLE	Terminal olefin carbon bond (R-C=C)
VOC	PACD	Peroxyacetic and higher peroxycarboxylic acids
VOC	PAR	Paraffin carbon bond
VOC	PRPA	Propane
VOC	SESQ	Sesquiterpenes (from biogenics only)
VOC	SOAALK	Secondary Organic Aerosol (SOA) tracer
VOC	TERP	Terpenes (from biogenics only)
VOC	TOL	Toluene and other monoalkyl aromatics
VOC	UNR	Unreactive
VOC	XYLMN	Xylene and other polyalkyl aromatics, minus naphthalene
Naphthalene	NAPH	Naphthalene from inventory
Benzene	BENZ	Benzene from the inventory
Acetaldehyde	ALD2	Acetaldehyde from inventory
Formaldehyde	FORM	Formaldehyde from inventory
Methanol	MEOH	Methanol from inventory
PM_{10}	PMC	Coarse PM > 2.5 microns and □ 10 microns
$PM_{2.5}$	PEC	Particulate elemental carbon □ 2.5 microns
$PM_{2.5}$	PNO3	Particulate nitrate □ 2.5 microns
$PM_{2.5}$	POC	Particulate organic carbon (carbon only) □ 2.5 microns
$PM_{2.5}$	PSO4	Particulate Sulfate □ 2.5 microns
$PM_{2.5}$	PAL	Aluminum
$PM_{2.5}$	PCA	Calcium
$PM_{2.5}$	PCL	Chloride
$PM_{2.5}$	PFE	Iron
$PM_{2.5}$	PK	Potassium
$PM_{2.5}$	PH2O	Water
$PM_{2.5}$	PMG	Magnesium
$PM_{2.5}$	PMN	Manganese
$PM_{2.5}$	PMOTHR	$PM_{2.5}$ not in other AE6 species
$PM_{2.5}$	PNA	Sodium
$PM_{2.5}$	PNCOM	Non-carbon organic matter
$PM_{2.5}$	PNH4	Ammonium
$PM_{2.5}$	PSI	Silica
$PM_{2.5}$	PTI	Titanium

Table 3-4. Additional HAP gaseous model species generated for toxics modeling

Inventory Pollutant	Model Species
Acetaldehyde	ALD2_PRIMARY
Formaldehyde	FORM_PRIMARY
Acetonitrile	ACETONITRILE
Acrolein	ACROLEIN
Acrylic acid	ACRYLICACID
Acrylonitrile	ACRYLONITRILE
Benzo[a]Pyrene	BENZOAPYRNE
1,3-Butadiene	BUTADIENE13
Carbon tetrachloride	CARBONTET
Carbonyl Sulfide	CARBSULFIDE
Chloroform	CHCL3
Chloroprene	CHLOROPRENE
1,4-Dichlorobenzene(p)	DICHLOROBENZENE
1,3-Dichloropropene	DICHLOROPROPENE
Ethylbenzene	ETHYLBENZ
Ethylene dibromide (Dibromoethane)	BR2_C2_12
Ethylene dichloride (1,2-Dichloroethane)	CL2_C2_12
Ethylene oxide	ETOX
Hexamethylene-1,6-diisocyanate	HEXAMETH_DIIS
Hexane	HEXANE
Hydrazine	HYDRAZINE
Maleic Anyhydride	MAL_ANYHYDRIDE
Methyl Chloride	METHCLORIDE
Methylene chloride (Dichloromethane)	CL2_ME
Specific PAHs assigned with URE =0	PAH_000E0
Specific PAHs assigned with URE =9.6E-06 (previously 1.76E-5)	PAH_176E5
Specific PAHs assigned with URE =4.8E-05 (previously 8.8E-5)	PAH_880E5
Specific PAHs assigned with URE =9.6E-05 (previously 1.76E-4)	PAH_176E4
Specific PAHs assigned with URE =9.6E-04 (previously 1.76E-3)	PAH_176E3
Specific PAHs assigned with URE =9.6E-03 (previously 1.76E-2)	PAH_176E2
Specific PAHs assigned with URE =0.01 (previously 1.01E-2)	PAH_101E2
Specific PAHs assigned with URE =1.14E-1	PAH_114E1
Specific PAHs assigned with URE =9.9E-04 (previously 1.92E-3)	PAH_192E3
Propylene dichloride (1,2-Dichloropropane)	PROPDICHLORIDE
Quinoline	QUINOLINE
Styrene	STYRENE
1,1,2,2-Tetrachloroethane	CL4_ETHANE1122
Tetrachloroethylene (Perchloroethylene)	CL4_ETHE
Toluene	TOLU
2,4-Toluene diisocyanate	TOL_DIIS
Trichloroethylene	CL3_ETHE
Triethylamine	TRIETHYLAMINE
m-xylene, o-xylene, p-xylene, xylenes (mixed isomers)	XYLENES
Vinyl chloride	CL_ETHE

Table 3-5. Additional HAP particulate model species generated for toxics modeling

Inventory Pollutant	Model Species
Arsenic	ARSENIC_C, ARSENIC_F
Beryllium	BERYLLIUM_C, BERYLLIUM_F
Cadmium	CADMIUM_C, CADMIUM_F
Chromium VI, Chromic Acid (VI), Chromium Trioxide	CHROMHEX_C, CHROMHEX_F
Chromium III	CHROMTRI_C, CHROMTRI_F
Lead	LEAD_C, LEAD_F
Manganese	MANGANESE_C, MANGANESE_F
Mercury[1]	HGIIGAS, HGNRVA, PHGI
Nickel, Nickel Oxide, Nickel Refinery Dust	NICKEL_C, NICKEL_F
Diesel-PM10, Diesel-PM25	DIESEL_PMC , DIESEL_PMFINE, DIESEL_PMEC, DIESEL_PMOC, DIESEL_PMNO3, DIESEL_PMSO4

[1]Mercury is multi-phase

Table 3-6. PAH/POM pollutant groups

PAH Group	NEI Pollutant Code	NEI Pollutant Description	URE 1/(µg/m^3)
PAH_000E0	120127	Anthracene	0
PAH_000E0	129000	Pyrene	0
PAH_000E0	85018	Phenanthrene	0
PAH_101E2	56495	3-Methylcholanthrene	0.01
PAH_114E1	57976	7,12-Dimethylbenz[a]Anthracene	0.114
PAH_176E2	189559	Dibenzo[a,i]Pyrene	9.6E-03
PAH_176E2	189640	Dibenzo[a,h]Pyrene	9.6E-03
PAH_176E2	191300	Dibenzo[a,l]Pyrene	9.6E-03
PAH_176E2	7496028	6-Nitrochrysene	9.6E-03
PAH_176E3	192654	Dibenzo[a,e]Pyrene	9.6E-04
PAH_176E3	194592	7H-Dibenzo[c,g]carbazole	9.6E-04
PAH_176E3	3697243	5-Methylchrysene	9.6E-04
PAH_176E3	41637905	Methylchrysene	9.6E-04
PAH_176E3	53703	Dibenzo[a,h]Anthracene	9.6E-04
PAH_176E4	193395	Indeno[1,2,3-c,d]Pyrene	9.6E-05
PAH_176E4	205823	Benzo[j]Fluoranthene	9.6E-05
PAH_176E4	205992	Benzo[b]Fluoranthene	9.6E-05
PAH_176E4	224420	Dibenzo[a,j]Acridine	9.6E-05
PAH_176E4	226368	Dibenz[a,h]acridine	9.6E-05
PAH_176E4	5522430	1-Nitropyrene	9.6E-05
PAH_176E4	56553	Benz[a]Anthracene	9.6E-05
PAH_176E5	207089	Benzo[k]Fluoranthene	9.6E-06
PAH_176E5	218019	Chrysene	9.6E-06
PAH_176E5	86748	Carbazole	9.6E-06
PAH_192E3	8007452	Coal Tar	9.9E-04
PAH_880E5	130498292	PAH, total	4.8E-05
PAH_880E5	191242	Benzo[g,h,i,]Perylene	4.8E-05
PAH_880E5	192972	Benzo[e]Pyrene	4.8E-05

PAH Group	NEI Pollutant Code	NEI Pollutant Description	URE 1/(µg/m^3)
PAH_880E5	195197	Benzo(c)phenanthrene	4.8E-05
PAH_880E5	198550	Perylene	4.8E-05
PAH_880E5	203123	Benzo(g,h,i)Fluoranthene	4.8E-05
PAH_880E5	203338	Benzo(a)fluoranthene	4.8E-05
PAH_880E5	206440	Fluoranthene	4.8E-05
PAH_880E5	208968	Acenaphthylene	4.8E-05
PAH_880E5	2381217	1-Methylpyrene	4.8E-05
PAH_880E5	2422799	12-Methylbenz(a)Anthracene	4.8E-05
PAH_880E5	250	PAH/POM - Unspecified	4.8E-05
PAH_880E5	2531842	2-Methylphenanthrene	4.8E-05
PAH_880E5	26914181	Methylanthracene	4.8E-05
PAH_880E5	284	Extractable Organic Matter (EOM)	4.8E-05
PAH_880E5	56832736	Benzofluoranthenes	4.8E-05
PAH_880E5	65357699	Methylbenzopyrene	4.8E-05
PAH_880E5	779022	9-Methyl Anthracene	4.8E-05
PAH_880E5	832699	1-Methylphenanthrene	4.8E-05
PAH_880E5	83329	Acenaphthene	4.8E-05
PAH_880E5	86737	Fluorene	4.8E-05
PAH_880E5	90120	1-Methylnaphthalene	4.8E-05
PAH_880E5	91576	2-Methylnaphthalene	4.8E-05
PAH_880E5	91587	2-Chloronaphthalene	4.8E-05
PAH_880E5	N590	Polycyclic aromatic compounds (includes PAH/POM)	4.8E-05

The TOG and $PM_{2.5}$ profiles used to speciate emissions are part of the SPECIATE v5.2 database (https://www.epa.gov/air-emissions-modeling/speciate). The SPECIATE database is developed and maintained by the EPA's Office of Research and Development (ORD), Office of Transportation and Air Quality (OTAQ), and the Office of Air Quality Planning and Standards (OAQPS), in cooperation with Environment Canada (EPA, 2016). These profiles are processed using the EPA's S2S-Tool (https://github.com/USEPA/S2S-Tool) to generate the GSPRO and GSCNV files needed by SMOKE. As with previous platforms, some Canadian point source inventories are provided from Environment Canada as pre-speciated emissions.

Speciation profiles (GSPRO files) and cross-references (GSREF files) for this platform are available in the SMOKE input files for the platform. Emissions of VOC and $PM_{2.5}$ emissions by county, sector, and profile for all sectors other than onroad mobile can be found in the sector summaries. Total emissions for each model species by state and sector can be found in the state-sector totals workbook.

The following updates to profile assignments were made to this modeling platform and vary from prior years:

- For PM2.5:
  - All GSPRO files were generated by the S2S-Tool, dated 09-11-2023, and utilized SPECIATE v5.3.
  - Update of the CMV speciation cross-reference files to utilize the SCC updates for this sector and use the new CROC profiles introduced in SPECIATE v5.3.

    - Update onroad and nonroad mobile cross-reference files to utilize the CROC profiles introduced in SPECIATE v5.3.
- For VOC:
    - All GSPRO and GSCNV files were generated by the S2S-Tool, dated 09-11-2023, and utilized SPECIATE v5.3.
    - All oil and gas well completion and abandoned wells emissions were updated (or added in the case of abandoned wells) from 1101 and 8949, respectively, to 95404 and 95403, respectively. However, this update was not performed for basin-specific profiles that were output by the O&G Tool.
    - Update of the CMV speciation cross-reference files to utilize the SCC updates for this sector and use the new GROC profiles introduced in SPECIATE v5.3.
    - Update usage of 95120a to 95120c.
    - Update onroad and nonroad mobile cross-reference files to utilize the GROC profiles introduced in SPECIATE v5.3.

3.2.1 VOC speciation

The base emissions inventory for this modeling platform includes total VOC and individual HAP emissions. Often, individual HAPs are components of VOC (HAP-VOC), and these HAP-VOCs are included ("integrated") in the speciation process. This HAP integration is performed in a way to ensure double counting of emitted mass does not occur and requires specific data processing by the S2S-Tool and user input in SMOKE.

To incorporate HAP emissions from the base inventory into the modeling platform, one of two methods are performed. (1) Integrate, HAP-use is a method where the mass of integrated HAP-VOCs is summed and subtracted from VOC, and the residual mass (NONHAPVOC) is speciated using a renormalized speciation profile that does not include the integrated HAP-VOCs (they are subtracted from the profile and then the profile is renormalized to 100%). (2) No-Integrate, HAP-use is a method where the mass of VOC is speciated using a speciation profile that does not include the integrated HAP-VOCs (they are subtracted from the profile and the profile is not renormalized to 100%). In this scenario, the HAP-VOC and VOC portions of the inventory are difficult to harmonize, and it is assumed that the proportions of HAPs from these sources are adequately captured in the speciation profile used to speciate the VOC emissions (which is why there is no renormalization). In addition, HAPs can be introduced into a modeling platform using speciation profiles. In this scenario, HAP-VOC emissions are "generated" through VOC speciation and are not incorporated from the base inventory. This method is called "Criteria" speciation. An illustration of these methods is shown in Figure 3-2 and the integration methods used for this platform for each sector are shown in Table 3-7.

Figure 3-2. Process of integrating HAPs and speciating VOC in a modeling platform

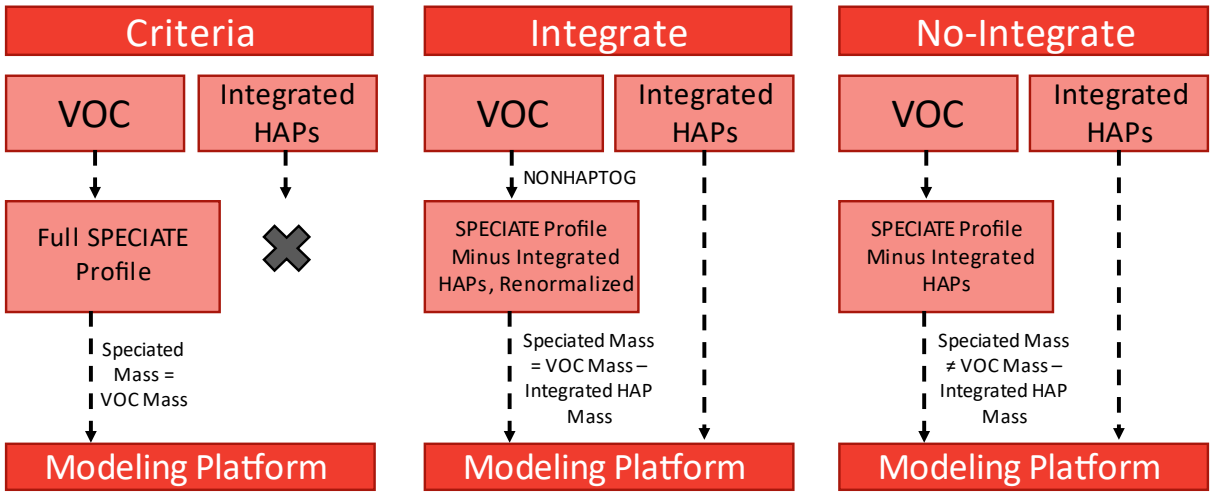


Table 3-7. Integration status for each platform sector

Platform Sector	Approach for Integrating NEI emissions of Naphthalene (N), Benzene (B), Acetaldehyde (A), Formaldehyde (F) and Methanol (M)
afdust	N/A – sector contains no VOC
airports	No integration, use NBAFM in inventory
beis	N/A – sector contains no inventory pollutant "VOC"; but rather specific VOC species
cmv_c1c2	No integration, no NBAFM in inventory, create NBAFM from VOC speciation
cmv_c3	No integration, no NBAFM in inventory, create NBAFM from VOC speciation
fertilizer	N/A – sector contains no VOC
livestock	Full integration (NBAFM)
nonpt	Partial integration (NBAFM)
nonroad	Full integration (internal to MOVES)
np_oilgas	Partial integration (NBAFM)
onroad	Full integration (internal to MOVES)
canada_onroad	No integration, no NBAFM in inventory, create NBAFM from VOC speciation
mexico_onroad	Full integration (internal to MOVES-Mexico); however, MOVES-MEXICO speciation was older CB6, so post-SMOKE emissions were converted to CB6R3AE6
canada_afdust	N/A – sector contains no VOC
canmex_area	No integration, no NBAFM in inventory, create NBAFM from VOC speciation
canmex_point	No integration, no NBAFM in inventory, create NBAFM from VOC speciation
canada_ptdust	N/A – sector contains no VOC
canada_og2D	No integration, no NBAFM in inventory, create NBAFM from VOC speciation
canmex_ag	No integration, no NBAFM in inventory, create NBAFM from VOC speciation
pt_oilgas	No integration, use NBAFM in inventory
ptagfire	Full integration (NBAFM)
ptegu	No integration, use NBAFM in inventory
ptfire-rx	Full integration (NBAFM)
ptfire-wild	Partial integration (NBAFM)
ptfire_othna	No integration, no NBAFM in inventory, create NBAFM from VOC speciation
ptnonipm	No integration, use NBAFM in inventory
rail	Full integration (NBAFM)

Platform Sector	Approach for Integrating NEI emissions of Naphthalene (N), Benzene (B), Acetaldehyde (A), Formaldehyde (F) and Methanol (M)
rwc	Full integration (NBAFM)
np_solvents	Partial integration (NBAFM)

The HAPs integrated from the base inventory into the modeling platform are sector and chemical mechanism specific. In recent years, CB6R3_AE7 has been the primary chemical mechanism used at the EPA. Within that mechanism, naphthalene (NAPH), benzene (BENZ), acetaldehyde (ALD2), formaldehyde (FORM), and methanol (MEOH) are explicit HAP-VOCs, and these compounds are collectively referred to as NBAFM. Since NBAFM are explicitly modeled in CB6R3_AE7, these species have become the default collection of integrated HAP species at the EPA. MOVES, the EPA's mobile emissions model, features additional species that are explicitly modeled (e.g., ethanol). These species (Table 3-8) are also incorporated directly into modeling platforms. To incorporate these species, additional files from the S2S-Tool are required. For California, speciation of NONHAPTOG is performed on CARB's VOC submissions using the county-specific speciation profile assignments generated by MOVES in California.

Table 3-8. Integrated species from MOVES sources

MOVES ID	Pollutant Name
5	Methane (CH4)
20	Benzene
21	Ethanol
22	MTBE
24	1,3-Butadiene
25	Formaldehyde
26	Acetaldehyde
27	Acrolein
40	2,2,4-Trimethylpentane
41	Ethyl Benzene
42	Hexane
43	Propionaldehyde
44	Styrene
45	Toluene
46	Xylene
185	Naphthalene gas

Several sectors require VOC speciation to occur at the county-level and consistent speciation profiles cannot be applied across the nation. To accomplish this, the GSREF is setup to provide profiles that are "blended" at the county/SCC-level using proportions included in the input file. These variable VOC speciation methods are year-specific and applied in the oil and gas sector and for various mobile emissions sources. In both the np_oilgas and pt_oilgas sector, VOC speciation profiles are weighted to reflect region-specific application of controls, differences in gas composition, and variable sources of emissions (e.g., varying proportions of emissions from associated gas, condensate tanks, crude oil tanks, dehydrators, liquids unloading and well completions). The Nonpoint Oil and Gas Emissions Estimation

Tool generates an intermediate file that provides SCC and county-specific emissions proportions, which are subsequently incorporated into the modeling platform.

For onroad and nonroad mobile sources, the speciation of total organic gas and particulate matter emissions has historically been performed within MOVES. However, this is now performed outside of MOVES as a post-processing step. This has the advantages of making MOVES simpler, faster to run, and making it easier to change or update chemical mechanisms and speciation profiles used in the emissions modeling process. Some speciation is still performed inside MOVES (i.e., for "integrated species"). In many cases, these integrated species have effects like temperature or fuel effects which are not always well captured by external speciation profiles. For total organic gases, MOVES calculates 15 integrated species, such as methane and benzene, and the remainder is called NONHAPTOG and speciated outside MOVES.

In MOVES, speciation profiles are assigned by emission process, fuel subtype, regulatory class, and model year. Each of these dimensions are available in MOVES output except for fuel subtype, which is aggregated as part of each fuel type. To apply speciation outside of MOVES and make it compatible with the needs of SMOKE, we need to determine the speciation profile mapping by SMOKE process (aggregation of MOVES emission processes) and SMOKE Source Classification Code (SCC), which are defined by fuel type, source type, and road type. To support use of new ROC-based speciation profiles for mobile sources, during nonroad inventory post-MOVES processing, speciation profile assignments were updated to both NONHAPTOG and PM2.5 in a one-to-one manner. As well, to support use of these new profiles, PM2.5 was split into four parts: PEC and PSO4 (based on the new speciation profiles); total organic matter, or TOM (PNCOM plus PEC); and residual_PM, is RESID_PM (all other PM species). These profile updates are included in the tables below.

Table 3-9. Mobile Speciation Profile Updates

Pollutant	Old profile	New profile
PM2.5	8992	100CROC
PM2.5	8993	101CROC
PM2.5	8994	103CROC (starts) 102CROC (other)
PM2.5	8995	103CROC
PM2.5	8996	104CROC
PM2.5	95219a	105CROC
PM2.5	95220a	106CROC
NONHAPTOG	1001	107GROC
NONHAPTOG	8757	101GROC (starts) 103GROC (other)
NONHAPTOG	8774	104GROC
NONHAPTOG	8775	105GROC
NONHAPTOG	8855	108GROC (starts) 109GROC (other)
NONHAPTOG	8751a	100GROC (starts) 102GROC (other)
NONHAPTOG	95335a	106GROC

NONHAPTOG	95335a	106GROC
NONHAPTOG	95327	110GROC
NONHAPTOG	95328	111GROC
NONHAPTOG	95329	112GROC
NONHAPTOG	95330	113GROC
NONHAPTOG	95331	114GROC
NONHAPTOG	95332	115GROC
NONHAPTOG	95333	116GROC
NONHAPTOG	8775	105GROC
NONHAPTOG	1001	107GROC
NONHAPTOG	8860	117GROC
PM2_5	8996	109CROC
PM2_5	91106	108CROC
PM2_5	91113	107CROC
PM2_5	95219	105CROC

For this platform, MOVES runs were performed in inventory mode[13] for each representative county and season (i.e., winter and summer) to compute NONHAPTOG output by emission process, fuel type, regulatory class, and model year. Emissions were then disaggregated by fuel subtype using the market share of each fuel blend in each county. Then, emissions were normalized and aggregated to calculate the percentage of total NONHAPTOG emissions that should be speciated by each profile for each SMOKE SCC and process. Finally, these percentages were applied in SMOKE-MOVES to all counties based on their representative county. A MOVES post-processing tool was used to generate the speciation cross-references (GSREFs) for SMOKE from the outputs of the inventory mode runs.

To generate onroad emissions and to perform the subsequent speciation, SMOKE-MOVES was first run to estimate emissions and both the MEPROC and INVTABLE files were used to control which pollutants are processed and eventually integrated. From there, the NONHAPTOG emission factor tables produced by MOVES were speciated within SMOKE using the GSREF files and the NONHAPTOG GSPRO files generated by the S2S-Tool. Further details on speciation methods involving MOVES can be found in Table 3-10 and in the associated technical reports (EPA-420-R-22-017, EPA-420-R-23-006).

Table 3-10. Mobile NOx and HONO fractions

Fuel	Model Years	Process	NO	NOx	HONO
Gasoline	1960-1980	Running Exhaust	0.975	0.017	0.008
Gasoline	1981-1990	Running Exhaust	0.932	0.06	0.008
Gasoline	1991-1995	Running Exhaust	0.954	0.038	0.008
Gasoline	1996-2050	Running Exhaust	0.836	0.156	0.008
Gasoline	1960-1980	Start Exhaust	0.975	0.017	0.008

[13] Inventory mode was run rather than rates mode because: 1) MOVES inventory mode is faster than rates mode, 2) there are several dimensions of rates mode output which are not relevant to the assigning of speciation profiles, such as speed bin and temperature profile and 3) weighting speciation profiles by their emissions inventory is both easier and more accurate than by MOVES output activity or emission rates.

Fuel	Model Years	Process	NO	NOx	HONO
Gasoline	1981-1990	Start Exhaust	0.961	0.031	0.008
Gasoline	1991-1995	Start Exhaust	0.987	0.005	0.008
Gasoline	1996-2050	Start Exhaust	0.951	0.041	0.008
Diesel	1960-2003	Exhaust	0.9622	0.0298	0.008
Diesel	2004-2006	Exhaust	0.9325	0.0595	0.008
Diesel	2007-2009	Exhaust	0.7529	0.2381	0.008
Diesel	2010-2060	Exhaust	0.8035	0.1885	0.008

In Canada, a GSPRO_COMBO file is used to generate speciated gasoline emissions that account for various ethanol mixes. In Mexico, onroad emissions are pre-speciated from the MOVES-Mexico model, thus eliminating the need for a GSPRO_COMBO file. For both Canada and Mexico, nonroad VOC emissions are not defined by mode (e.g., exhaust versus evaporative), which necessitates the need for a GSPRO_COMBO file that splits total VOC into exhaust and evaporative components. In addition, MOVES-Mexico uses an older version of MOVES that is hardcoded for an older version of the CB6 chemical mechanism ("CB6-CAMx"). This version does not generate the model species XYLMN or SOAALK, so additional post-processing is performed to generate those emissions:

- XYLMN = XYL[1]-0.966*NAPHTHALENE[1]
- PAR = PAR[1]-0.00001*NAPHTHALENE[1]
- SOAALK = 0.108*PAR[1]

3.2.2 PM speciation

Like VOC speciation, $PM_{2.5}$ speciation does feature integrated species from the base inventory, though there are far fewer (only BC and SO_4). The remaining mass is either TOM (total organic matter) or RESID_PM (residual PM = $PM_{2.5}$ – BC – SO_4 – TOM), which is speciated using SPECIATE profiles that were post-processed using the S2S-Tool. Small adjustments to the methods were needed to accommodate the reporting by California. Since California does not provide speciated $PM_{2.5}$ emissions, total $PM_{2.5}$ emissions for onroad and nonroad sources in California were speciated using the profile proportions estimated by MOVES in California. Finally, onroad brake and tire wear $PM_{2.5}$ emissions were speciated in the *moves2smk* postprocessor using the SPECIATE profiles 95462 and 95460, respectively.

3.2.2.1 Diesel PM

Diesel PM emissions are explicitly included in the NEI using the pollutant names DIESEL-PM10 and DIESEL-PM25 for select mobile sources whose engines burn diesel or residual oil fuels. This includes sources in onroad, nonroad, point airport ground support equipment, point locomotives, nonpoint locomotives, and all PM from diesel or residual oil fueled nonpoint CMV. These emissions are equal to their primary PM10-PRI and PM25-PRI counterparts, are exclusively from exhaust (i.e., do not include brake/tire wear), and are exclusively used in toxics modeling. Diesel PM is then speciated in SMOKE using the same speciation profiles and methods as primary PM, except that diesel PM is mapped to model species that feature "DIESEL_PM" in their species name.

3.2.3 NO_X speciation

In the NEI, NO_x emissions are inventoried on a NO_2 weighted basis, but must be speciated into NO, NO_2, and HONO. Table 3-11 provides the NO_x speciation profiles used in EPA's modeling platforms. The only difference between the two profiles is the allocation of some NO_2 mass to HONO in the "HONO" profile.

HONO emissions from mobile sources have been identified in tunnel studies and its inclusion in emissions inventories is important for urban chemistry. Here, a HONO to NO_x ratio of 0.008 was selected (Sarwar, 2008). In this modeling platform, all non-mobile sources use the "NHONO" profile, all non-onroad mobile sources (including nonroad, cmv, and rail) use the "HONO" profile, and all onroad NO_x speciation occurs within MOVES. For further details on NO_x speciation within MOVES, please see the associated technical report.

Table 3-11. NO_X speciation profiles

Profile	Pollutant	Species	Mass Split Factor
HONO	NOX	NO2	0.092
HONO	NOX	NO	0.9
HONO	NOX	HONO	0.008
NHONO	NOX	NO2	0.1
NHONO	NOX	NO	0.9

3.2.4 Sulfuric Acid Vapor (SULF)

Sulfuric acid vapor (SULF) is added for coal and distillate oil fuel combustion sources to the emissions files using SO_2 emissions from the base inventory. This process utilizes profiles assignments in the GSREF file and the profiles were derived using data from AP-42 (EPA, 1998). The weight fraction of added sulfuric acid vapor is fuel specific, assumes that gaseous sulfate is primarily H_2SO_4, and is calculated as follows:

$$SULF\ emissions\ = SO_2\ emissions\ \times \frac{fraction\ of\ S\ emitted\ as\ sulfate}{fraction\ of\ S\ emitted\ as\ SO_2} \times \frac{MW\ H_2SO_4}{MW\ SO_2}$$

In the above, the molecular weight (*MW*) of sulfate and sulfur dioxide are 98 g/mol and 64 g/mol, respectively. The fractions of sulfur emissions emitted as sulfate and sulfur dioxide, as well as the resulting sulfuric acid vapor split factors, by fuel, are summarized in Table 3-12 and Table 3-13 below.

Table 3-12. Sulfate Split Factor Computation

Fuel	SCCs	Profile Code	Fraction as SO2	Fraction as Sulfate	Split Factor (Mass Fraction)
Bituminous	**1-0X-002-YY** X is 1, 2, or 3 YY is 01-19 **21-0Z-002-000** Z is 2, 3, or 4	95014	0.95	0.014	.014/.95 * 98/64 = 0.0226
Subbituminous	**1-0X-002-YY** X is 1, 2, or 3 YY is 21-38	87514	0.875	0.014	.014/.875 * 98/64 = 0.0245
Lignite	**1-0X-003-YY** X is 1, 2, or 3 YY is 01-18	75014	0.75	0.014	.014/.75 * 98/64 = 0.0286

Fuel	SCCs	Profile Code	Fraction as SO2	Fraction as Sulfate	Split Factor (Mass Fraction)
Residual oil	**1-0X-004-YY** X is 1, 2, or 3 YY is 01-06 **21-0Z-005-000** Z is 2, 3, or 4	99010	0.99	0.01	.01/.99 * 98/64 = 0.0155
Distillate oil	**1-0X-005-YY** X is 1, 2, or 3 YY is 01-06 **21-0Z-004-000** Z is 2, 3, or 4	99010	0.99	0.01	Same as residual oil

Table 3-13. SO_2 speciation profiles

Profile	pollutant	species	split factor
95014	SO2	SULF	0.0226
95014	SO2	SO2	1
87514	SO2	SULF	0.0245
87514	SO2	SO2	1
75014	SO2	SULF	0.0286
75014	SO2	SO2	1
99010	SO2	SULF	0.0155
99010	SO2	SO2	1

3.2.5 Speciation of Metals and Mercury

Metals and mercury emissions from the base inventory require speciation for use in modeling. Non-mercury metals must be speciated into coarse and fine size ranges for use in CMAQ, and Table 3-14, summarizes the particle size profiles used for each data category.

Table 3-14. Particle Size Speciation of Metals

Source Type	Profile	Pollutant	Fine	Coarse
Onroad	OARS	Arsenic	0.95	0.05
Onroad	ONMN	Manganese	0.4375	0.5625
Onroad	ONNI	Nickel	0.83	0.17
Onroad	CRON	Chromhex	0.86	0.14
Nonroad	NOARS	Arsenic	0.83	0.17
Nonroad	NONMN	Manganese	0.67	0.33
Nonroad	NONNI	Nickel	0.49	0.51
Nonroad	CRNR	Chromhex	0.80	0.20
Stationary	STANI	Nickel	0.59	0.41
Stationary	STACD	Cadmium	0.76	0.24
Stationary	STAMN	Manganese	0.67	0.33
Stationary	STAPB	Lead	0.74	0.26
Stationary	STABE	Beryllium	0.68	0.32

Source Type	Profile	Pollutant	Fine	Coarse
Stationary	CRSTA	Chromhex	0.71	0.29
Stationary	STARS	Arsenic	0.59	0.41

Mercury is speciated into one of the three forms used by CMAQ; elemental, divalent gaseous, and divalent particulate. Table 3-15 provides the mercury speciation profiles used in the modeling platform. All relevant SCCs were mapped to these profiles within the GSREF. A caveat is the onroad and nonroad sectors, where mercury emissions are pre-speciated in MOVES, nonroad emissions from California, which use the appropriate profiles below, and onroad emissions from California, where MOVES-based speciation is applied.

Table 3-15. Mercury Speciation Profiles

Profile Code	Description	Elemental	Divalent Gas	Particulate
HGCEM	Cement kiln exhaust	0.66	0.34	0
HGCLI	Cement clinker cooler	0	0	1
HBCMB	Fuel combustion	0.5	0.4	0.1
HGCRE	Human cremation	0.8	0.15	0.05
HGELE	Elemental only (used?)	1	0	0
HGGEO	Geothermal power plants	0.87	0.13	0
HGGLD	Gold mining	0.8	0.15	0.05
HGHCL	Chlor-Alkali plants	0.972	0.028	0
HGINC	Waste incineration	0.2	0.6	0.2
HGIND	Industrial average	0.73	0.22	0.05
HGMD	Mobile diesel	0.56	0.29	0.15
HGMG	Mobile gas	0.915	0.082	0.003
HGMET	Metal production	0.8	0.15	0.005
HGMWI	Medical waste incineration	0.2	0.6	0.2
HGPETCOKE	Petroleum coke	0.6	0.3	0.1

3.3 Temporal Allocation

Temporal allocation is the process of distributing aggregated emissions to a finer temporal resolution, thereby converting annual emissions to hourly emissions as is required by CMAQ. While the total emissions are important, the timing of the occurrence of emissions is also essential for accurately simulating ozone, PM, and other pollutant concentrations in the atmosphere. Many emissions inventories are annual or monthly in nature. Temporal allocation takes these aggregated emissions and distributes the emissions to the hours of each day. This process is typically done by applying temporal profiles to the inventories in this order: monthly, day of the week, and diurnal, with monthly and day-of-week profiles applied only if the inventory is not already at that level of detail.

The temporal factors applied to the inventory were selected using some combination of country, state, county, SCC, and pollutant. Table 3-16 summarizes the temporal aspects of emissions modeling by comparing the key approaches used for temporal processing across the sectors. In the table, “Daily temporal approach” refers to the temporal approach for getting daily emissions from the inventory

using the SMOKE Temporal program. The values given are the values of the SMOKE L_TYPE setting. The "Merge processing approach" refers to the days used to represent other days in the month for the merge step. If this is not "all," then the SMOKE merge step runs only for representative days, which could include holidays as indicated by the right-most column. The values given are those used for the SMOKE M_TYPE setting (see below for more information).

Table 3-16. Temporal settings used for the platform sectors in SMOKE

Platform sector short name	Inventory resolutions	Monthly profiles used?	Daily temporal approach	Merge processing approach	Process holidays as separate days
afdust_adj	Annual	Yes	week	all	Yes
airports	Annual	Yes	all	all	No
beis	Hourly		n/a	all	No
cmv_c1c2	Annual & hourly		All	all	No
cmv_c3	Annual & hourly		All	all	No
fertilizer	Monthly		met-based	All	Yes
livestock	Daily	No	met-based	All	No
nonpt	Annual	Yes	week	week	Yes
nonroad	Monthly		mwdss	mwdss	Yes
np_oilgas	Annual	Yes	aveday	aveday	No
onroad	Annual & monthly[1]		all	all	Yes
onroad_ca_adj	Annual & monthly[1]		all	all	Yes
canada_afdust	Annual & monthly	Yes	week	all	No
canmex_area	Monthly		week	week	No
canada_onroad	Monthly		week	week	No
mexico_onroad	Monthly		week	week	No
canmex_point	Monthly	Yes	mwdss	mwdss	No
canada_ptdust	Annual	Yes	week	all	No
canmex_ag	Annual	Yes	mwdss	mwdss	No
canada_og2D	Monthly		mwdss	mwdss	No
pt_oilgas	Annual	Yes	mwdss	mwdss	Yes
Ptegu	Annual & hourly	Yes[2]	all	All	No
ptnonipm	Annual	Yes	mwdss	mwdss	Yes
ptagfire	Daily		all	all	No
ptfire-rx	Daily		all	all	No
ptfire-wild	Daily		all	all	No
ptfire_othna	Daily		all	all	No
rail	Annual	Yes	aveday	aveday	No
rwc	Annual	No[3]	met-based[3]	all	No[3]
np_solvents	Annual	Yes	aveday	aveday	No

[1]Note the annual and monthly "inventory" actually refers to the activity data (VMT, hoteling, and VPOP) for onroad. VMT and hoteling is monthly and VPOP is annual. The actual emissions are computed on an hourly basis.

[2]Only units that do not have matching hourly CEMS data use monthly temporal profiles.

[3]Except for 3 SCCs that do not use met-based speciation.

The following values are used in the table. The value "all" means that hourly emissions were computed for every day of the year and that emissions potentially have day-of-year variation. The value "week" means that hourly emissions were computed for all days in one "representative" week, representing all weeks for each month. This means emissions have day-of-week variation, but not week-to-week variation within the month. The value "mwdss" means hourly emissions for one representative Monday, representative weekday (Tuesday through Friday), representative Saturday, and representative Sunday for each month. This means emissions have variation between Mondays, other weekdays, Saturdays and Sundays within the month, but not week-to-week variation within the month. The value "aveday" means hourly emissions computed for one representative day of each month, meaning emissions for all days within a month are the same. Special situations with respect to temporal allocation are described in the following subsections.

In addition to the resolution, temporal processing includes a ramp-up period for several days prior to January 1, 2022, which is intended to mitigate the effects of initial condition concentrations. The ramp-up period was 10 days (December 22-31, 2021). For all anthropogenic sectors, emissions from December 2022 were used to fill in surrogate emissions for the end of December 2021. For biogenic emissions, December 2021 emissions were computed using year meteorology.

3.3.1 Use of FF10 format for finer than annual emissions

The FF10 inventory format for SMOKE provides a consolidated format for monthly, daily, and hourly emissions inventories. With the FF10 format, a single inventory file can contain emissions for all 12 months and the annual emissions in a single record. This helps simplify the management of numerous inventories. Similarly, daily and hourly FF10 inventories contain individual records with data for all days in a month and all hours in a day, respectively.

SMOKE prevents the application of temporal profiles on top of the "native" resolution of the inventory. For example, a monthly inventory should not have annual-to-month temporal allocation applied to it; rather, it should only have month-to-day and diurnal temporal allocation. This becomes particularly important when specific sectors have a mix of annual, monthly, daily, and/or hourly inventories. The flags that control temporal allocation for a mixed set of inventories are discussed in the SMOKE documentation. The modeling platform sectors that make use of monthly values in the FF10 files are nonroad, onroad (for activity data), and all Canada and Mexico inventories except for agriculture. Commercial marine vessels in cmv_c3 and cmv_c1c2 use hourly data in the FF10 files.

3.3.2 Temporal allocation for non-EGU sources (ptnonipm)

Most temporal profiles in ptnonipm result in primarily constant emissions for each day of the year, although some have lower emissions on Sundays. An update in the 2018 platform was an analysis of monthly temporal profiles for non-EGU point sources in the ptnonipm sector. A number of profiles were found to be not quite flat over the months but were so close to flat that the difference was not meaningful. These profiles were replaced in the cross reference to point instead to the flat monthly profile. The codes for the profiles that were replaced were: 202, 214, 220, 221, 222, 223, 227, 257, 263, 264, 265, 266, 267, 269, 271, 272, 279, 280, 295, 302, 303, 304, 305, 306, 309, 310, 327, 329, 332, and 333. For the 2022v1 platform, temporal profiles for SCC 40202501 emissions for which are related to

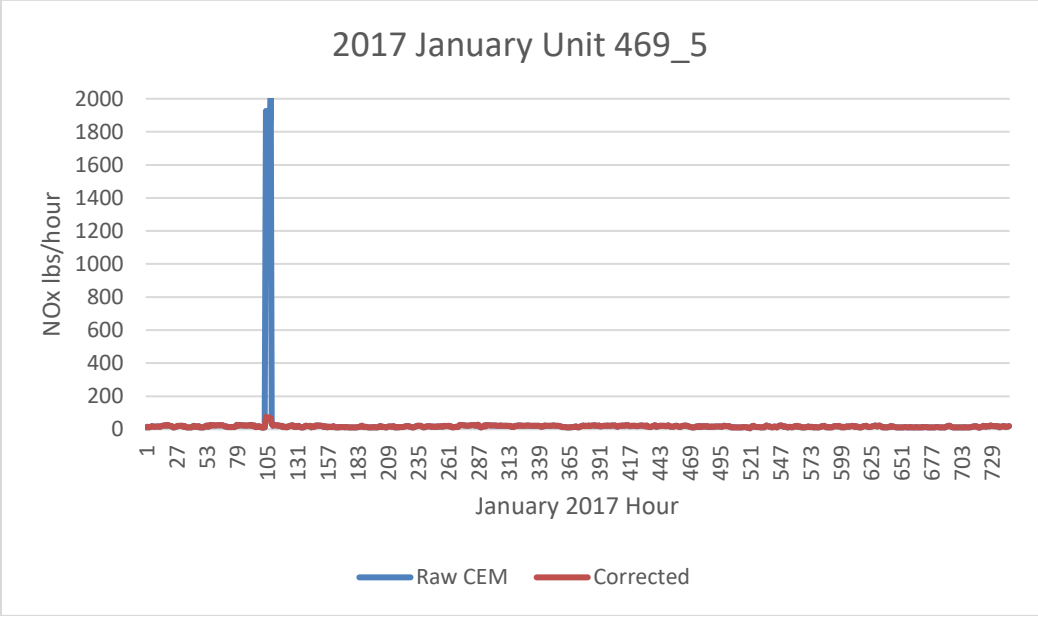
surface coating for metals were changed to use hourly profiles number 11 that reflects operations from 7AM to 5PM local time.

3.3.3 Electric Generating Utility temporal allocation (ptegu)

Electric generating unit (EGU) sources matched to ORIS units were temporally allocated to hourly emissions needed for modeling using the hourly CEMS data for units that could be matched to the CEMS emissions. Those hourly data were processed through v2.1 of the CEMCorrect tool to mitigate the impact of unmeasured values in the data.

The temporal allocation procedure for EGUs in the base year is differentiated by whether or not the unit could be directly matched to a unit with CEMS data via its ORIS facility code and boiler ID. Note that for units matched to CEMS data, annual totals of their emissions input to CMAQ may be different than the values in the annual inventory because the CEMS data replace the NO_x and SO_2 annual inventory data for the seasons in which the CEMS are operating. If a CEMS-matched unit is determined to be a partial year reporter, as can happen for sources that run CEMS only in the summer, emissions totaling the difference between the annual emissions and the total CEMS emissions are allocated to the non-summer months. Prior to use of the CEMS data in SMOKE it is processed through the CEMCorrect tool. The CEMCorrect tool identifies hours for which the data were not measured as indicated by the data quality flags in the CEMS data files. Unmeasured data can be filled in with maximum values and thereby cause erroneously high values in the CEMS data. When data were flagged as unmeasured and the values were found to be more than three times the annual mean for that unit, the data for those hours were replaced with annual mean values (Adelman et al., 2012). These adjusted CEMS data were then used for the remainder of the temporal allocation process described below (see Figure 3-3 for an example).

Figure 3-3. Eliminating unmeasured spikes in CEMS data



The region, fuel, and type (peaking or non-peaking) must be identified for each input EGU with CEMS data so the data can be used to generate profiles. The identification of peaking units was done using

hourly heat input data from 2022 and the two previous years (2020 and 2021). The heat input was summed for each year. Equation 1 shows how the annual heat input value is converted from heat units (BTU/year) to power units (MW) using the NEEDS v6 derived unit-level heat rate (BTU/kWh). In equation 2 a capacity factor is calculated by dividing the annual unit MW value by the NEEDS v6 unit capacity value (MW) multiplied by the hours in the year. A peaking unit was defined as any unit that had a maximum capacity factor of less than 0.2 for every year (2020, 2021, and 2022) and a 3-year average capacity factor of less than 0.1.

Equation 1. Annual unit power output

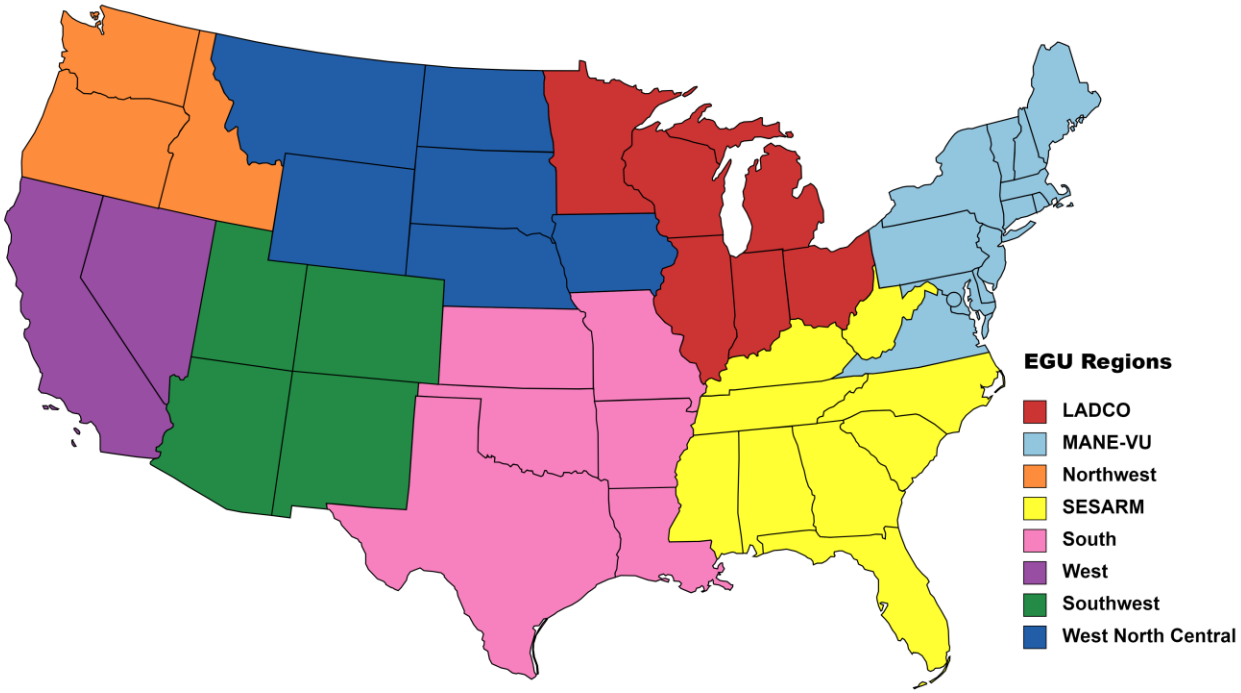
$$Annual\ Unit\ Output\ (MW) = \frac{\sum_{i=0}^{8760} Hourly\ HI\ (BTU) * 1000\ \left(\frac{MW}{kW}\right)}{NEEDS\ Heat\ Rate\ \left(\frac{BTU}{kW\,h}\right)}$$

Equation 2. Unit capacity factor

$$Capacity\ Factor = \frac{Annual\ Unit\ Output\ (MW)}{NEEDS\ Unit\ Capacity\ \left(\frac{MW}{h}\right) * 8760\ (h)}$$

Input regions were determined from one of the eight EGU modeling regions based on MJO and climate regions. Regions were used to group units with similar climate-based load demands. Region assignment is made on a state level, where all units within a state were assigned to the appropriate region. Unit fuel assignments were made using the primary NEEDS v6 fuel. Units fueled by bituminous, subbituminous, or lignite were assigned to the coal fuel type. Natural gas units were assigned to the gas fuel type. Distillate and residual fuel oil were assigned to the oil fuel type. Units with any other primary fuel were assigned the “other” fuel type. Figure 3-4 shows the regions used to generate the profiles. Currently there are 64 unique profiles available based on 8 regions, 4 fuels, and 2 for peaking unit status (peaking and non-peaking).

Figure 3-4. Regions used to Compute Temporal non-CEMS EGU Temporal Profiles



The daily and diurnal profiles were calculated for each region, fuel, and peaking type group from the year 2022 CEMS heat input values. The heat input values were summed for each input group to the annual level at each level of temporal resolution: monthly, month-of-day, and diurnal. The sum by temporal resolution value was then divided by the sum of annual heat input in that group to get a set of temporalization factors. Diurnal factors were created for both the summer and winter seasons to account for the variation in hourly load demands between the seasons. For example, the sum of all hour 1 heat input values in the group was divided by the sum of all heat inputs over all hours to get the hour 1 factor. Each grouping contained 12 monthly factors, up to 31 daily factors per month, and two sets of 24 hourly factors. The profiles were weighted by unit size where the units with more heat input have more influence on the shape of the profile. Composite profiles were created for each region and type across all fuels as a way to provide profiles for a fuel type that does not have hourly CEMS data in that region. Figure 3-5 shows peaking and non-peaking daily temporal profiles for the gas fuel type in the LADCO region. Figure 3-6 shows the diurnal profiles for the coal fuel type in the Mid-Atlantic Northeast Visibility Union (MANE-VU) region.

Figure 3-5. Example Daily Temporal Profiles for the LADCO Region and the Gas Fuel Type

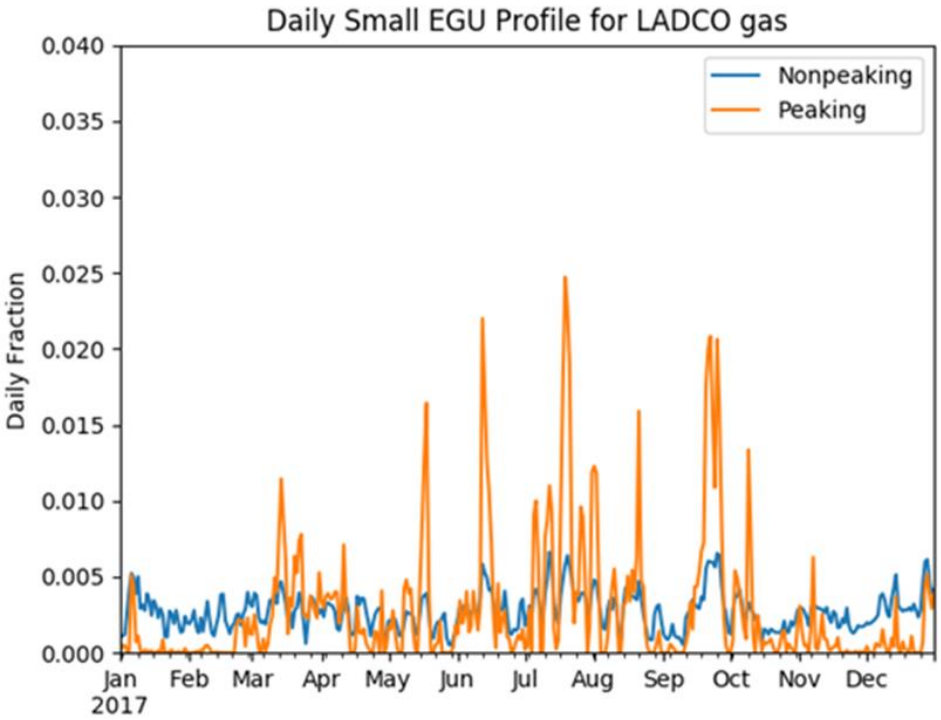
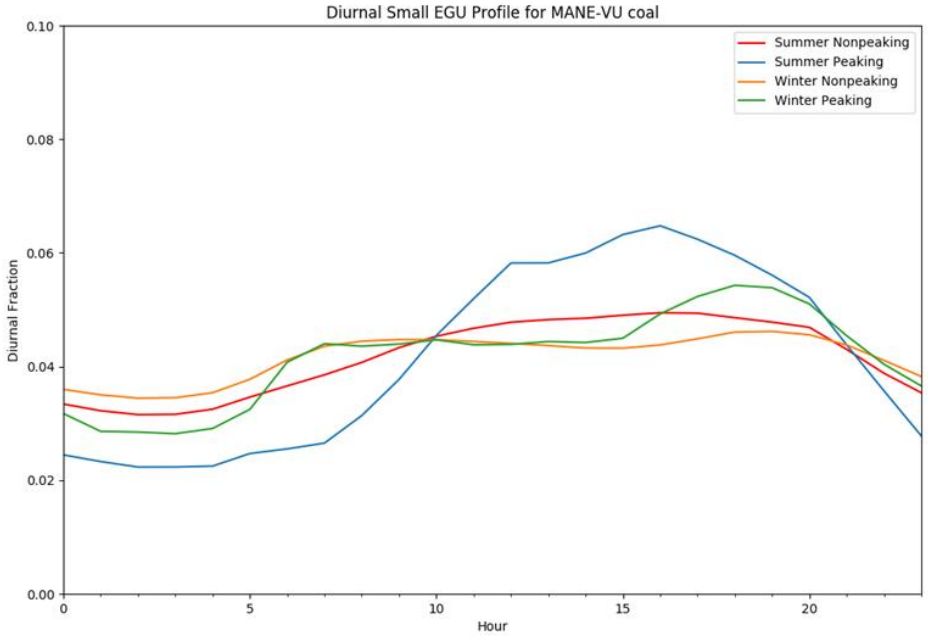


Figure 3-6. Example Diurnal Temporal Profiles for the MANE-VU Region and the Coal Fuel Type



SMOKE uses a cross-reference file to select a monthly, daily, and diurnal profile for each source. For the 2022 platform, the temporal profiles were assigned in the cross-reference at the unit level to EGU sources without hourly CEMS data. An inventory of all EGU sources without CEMS data was used to identify the region, fuel type, and type (peaking/non-peaking) of each source. The region used to select the temporal profile is assigned based on the state from the unit FIPS. The fuel was assigned by SCC to

one of the four fuel types: coal, gas, oil, and other. A fuel type unit assignment is made by summing the VOC, NOX, PM2.5, and SO2 for all SCCs in the unit. The SCC that contributed the highest total emissions to the unit for selected pollutants was used to assign the unit fuel type. Peaking units were identified as any unit with an oil, gas, or oil fuel type with a NAICS of 22111 or 221112. Some units may be assigned to a fuel type within a region that does not have an available input unit with a matching fuel type in that region. These units without an available profile for their group were assigned to use the regional composite profile. Municipal waste combustor and cogeneration units were identified using the NEEDS primary fuel type and cogeneration flag, respectively, from the NEEDS v6 database. Assignments for each unit needed a profile were made using the regions shown in Figure 3-4.

3.3.4 Airport Temporal allocation (airports)

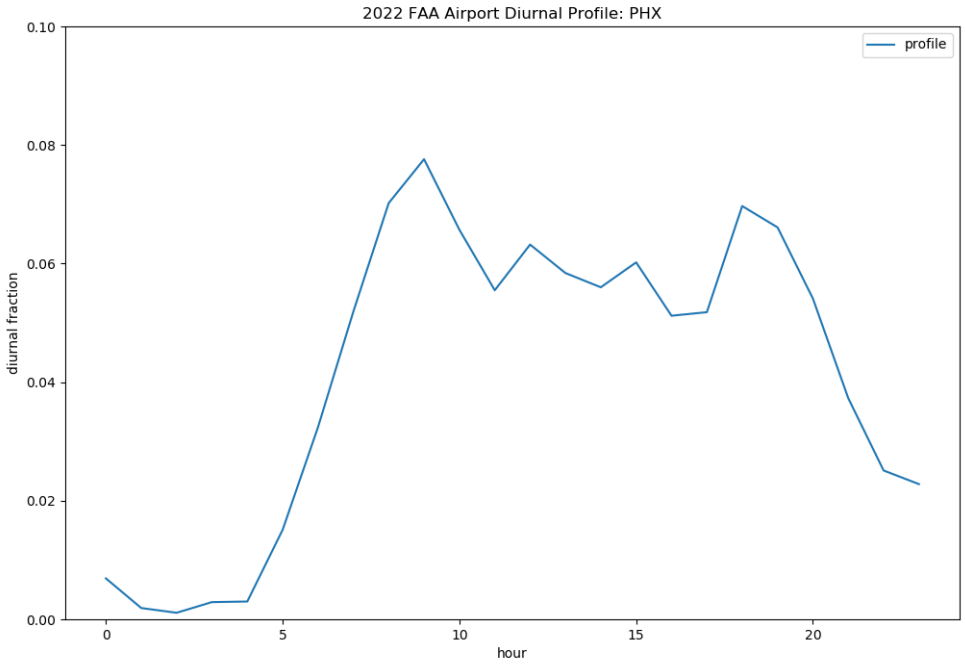
Airport temporal profiles were updated to 2022-specific temporal profiles for all airports other than Alaska seaplanes. Hourly airport operations data were obtained from the Aviation System Performance Metrics (ASPM) Airport Analysis website (https://aspm.faa.gov/apm/sys/AnalysisAP.asp). A report of 2022 hourly Departures and Arrivals for Metric Computation by airport was generated. An overview of the ASPM metrics is at https://aspmhelp.faa.gov/index/Aviation_System_Performance_Metrics_(ASPM).html. Figure 3-7 shows examples of diurnal airport profiles for the Phoenix airport (PHX) and the default profile for Texas.

Month-to-day and Annual-to month temporal profiles were developed based on a separate query of the 2022 Aviation System Performance Metrics (ASPM) Airport Analysis (https://aspm.faa.gov/apm/sys/AnalysisAP.asp). A report of all airport operations (takeoffs and landings) by day for 2022 was generated. Annual-to-month profiles were derived directly from the daily airport operations report and examples are shown for Wisconsin and Atlanta in Figure 3-8.

For 2022, all airport SCCs (i.e., 2275*, 2265008005, 2267008005, 2268008005 and 2270008005) were assigned to individual commercial airports where a match could be made between the inventory facility and the FAA identifier in the ASPM derived data. State average profiles were calculated as the average of the temporal fractions for all airports within a state. The state average profiles were assigned by state to all airports in the inventory that did not have an airport specific match in the ASPM data. Package processing hubs at the Memphis (MEM), Indianapolis (IND), Louisville (SDF), and Chicago Rockford (RFD) airports produced peaks in the average state profiles at times not typical for activity in smaller commercial airports. These packaging hubs were removed from the state averages. Airports that required state-defaults in states lacking ASPM data use national average profiles calculated from the average of the state temporal profiles.

Alaska seaplanes, which are outside the CONUS domain use the monthly profile in Figure 3-9. These were assigned based on the facility ID.

Figure 3-7. 2022 Airport Diurnal Profiles for PHX and state of Texas



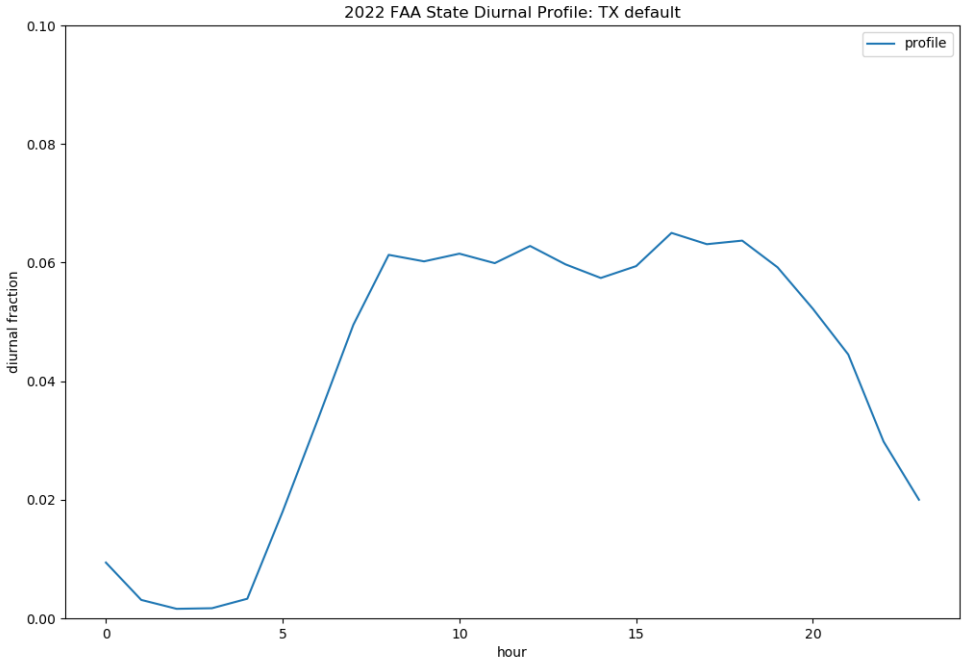
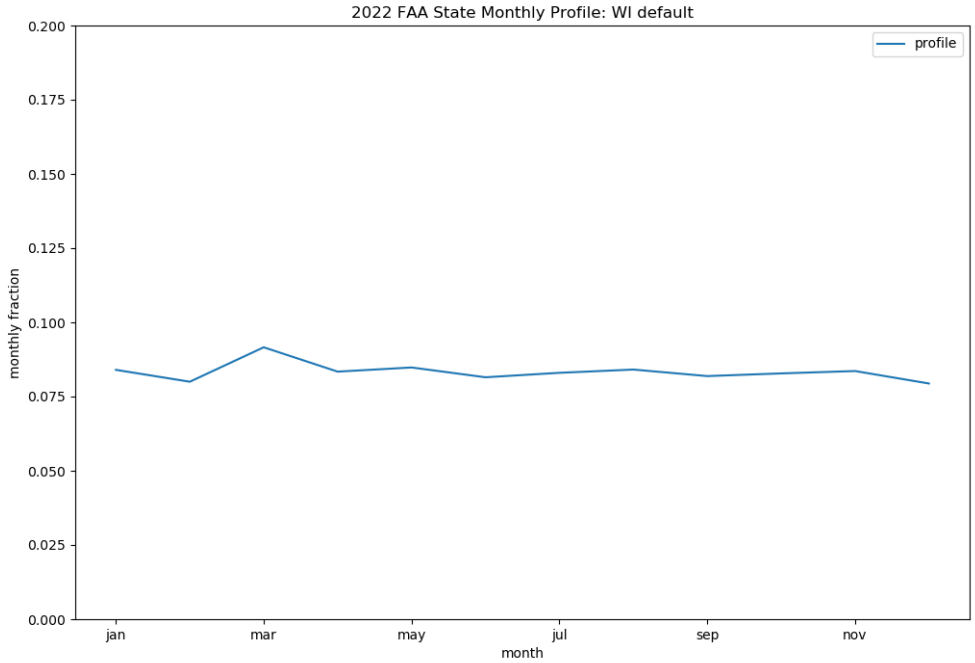


Figure 3-8. 2022 Wisconsin and Atlanta annual-to-month profile for airport emissions



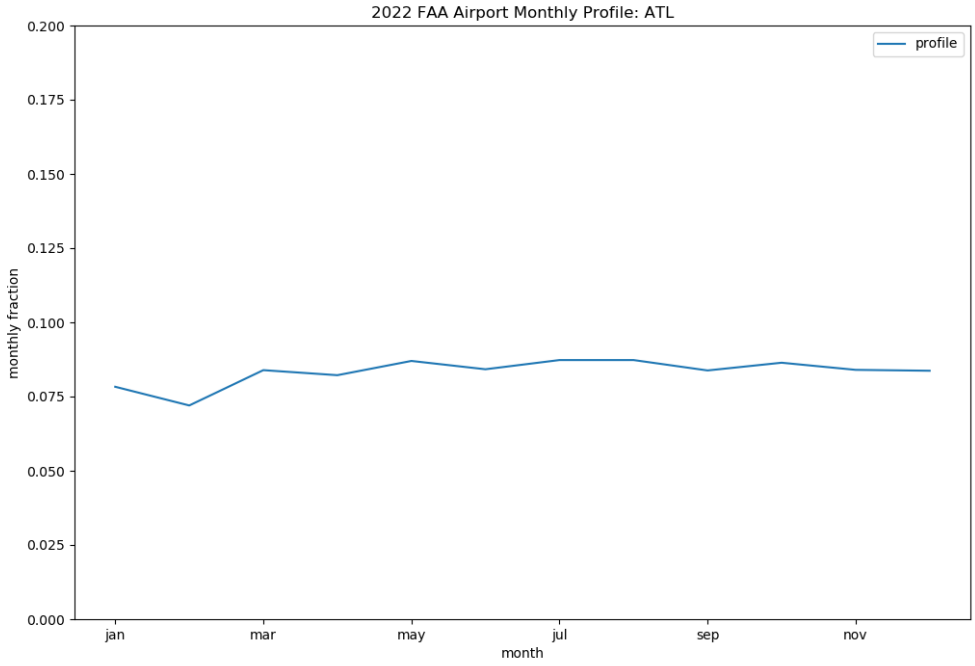
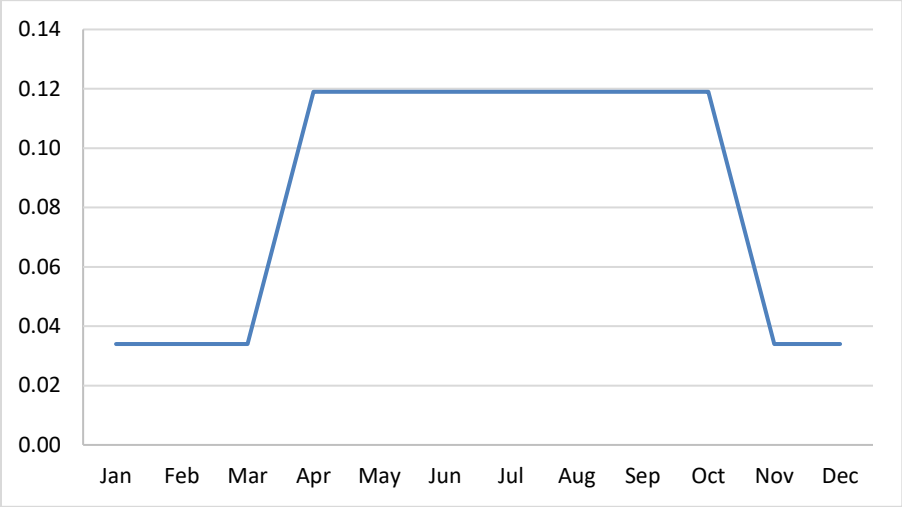


Figure 3-9. Alaska seaplane profile



3.3.5 Residential Wood Combustion Temporal allocation (rwc)

There are many factors that impact the timing of when emissions occur, and for some sectors this includes meteorology. The benefits of utilizing meteorology as a method for temporal allocation are: (1) a meteorological dataset consistent with that used by the AQ model is available (e.g., outputs from WRF); (2) the meteorological model data are highly resolved in terms of spatial resolution; and (3) the meteorological variables vary at hourly resolution and can, therefore, be translated into hour-specific temporal allocation.

The SMOKE program Gentpro provides a method for developing meteorology-based temporal allocation. Currently, the program can utilize three types of temporal algorithms: annual-to-day temporal allocation for residential wood combustion (RWC); month-to-hour temporal allocation for agricultural livestock NH_3; and a generic meteorology-based algorithm for other situations. Meteorological-based temporal allocation was used for portions of the rwc sector and for the entire ag sector.

Gentpro reads in gridded meteorological data (output from MCIP) along with spatial surrogates and uses the specified algorithm to produce a new temporal profile that can be input into SMOKE. The meteorological variables and the resolution of the generated temporal profile (hourly, daily, etc.) depend on the selected algorithm and the run parameters. For more details on the development of these algorithms and running Gentpro, see the Gentpro documentation and the SMOKE documentation at http://www.cmascenter.org/smoke/documentation/3.1/GenTPRO_TechnicalSummary_Aug2012_Final.pdf and https://www.cmascenter.org/smoke/documentation/4.5/html/ch05s03s05.html, respectively.

For the RWC sector, two different algorithms for calculating temporal allocation are used. For most SCCs in the sector, in which wood burning is more prominent on colder days, Gentpro was used to compute annual to day-of-year temporal profiles based on the daily minimum temperature. These profiles distribute annual RWC emissions to the coldest days of the year. On days where the minimum temperature does not drop below a user-defined threshold, RWC emissions for most sources in the sector are zero. Conversely, the program temporally allocates the largest percentage of emissions to the

coldest days. Similar to other temporal allocation profiles, the total annual emissions do not change, only the distribution of the emissions within the year is affected. The temperature threshold for RWC emissions was 50 ˚F for most of the country, and 60 ˚F for the following states: Alabama, Arizona, California, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas. The algorithm is as follows:

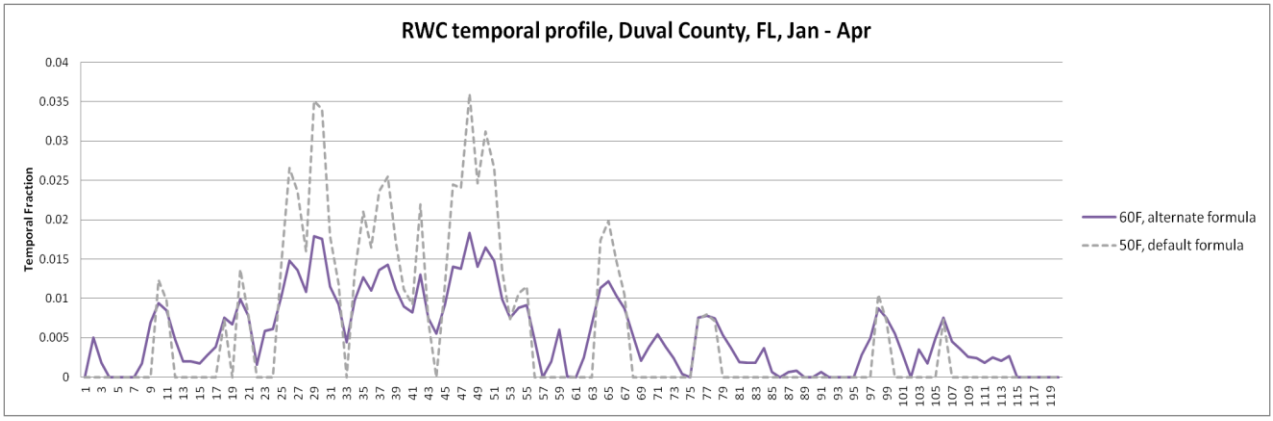
If Td >= Tt: no emissions that day
If Td < Tt: daily factor = 0.79*(Tt -Td)

where (Td = minimum daily temperature; Tt = threshold temperature, which is 60 degrees F in southern states and 50 degrees F elsewhere).

Once computed, the factors were normalized to sum to 1 to ensure that the total annual emissions are unchanged (or minimally changed) during the temporal allocation process.

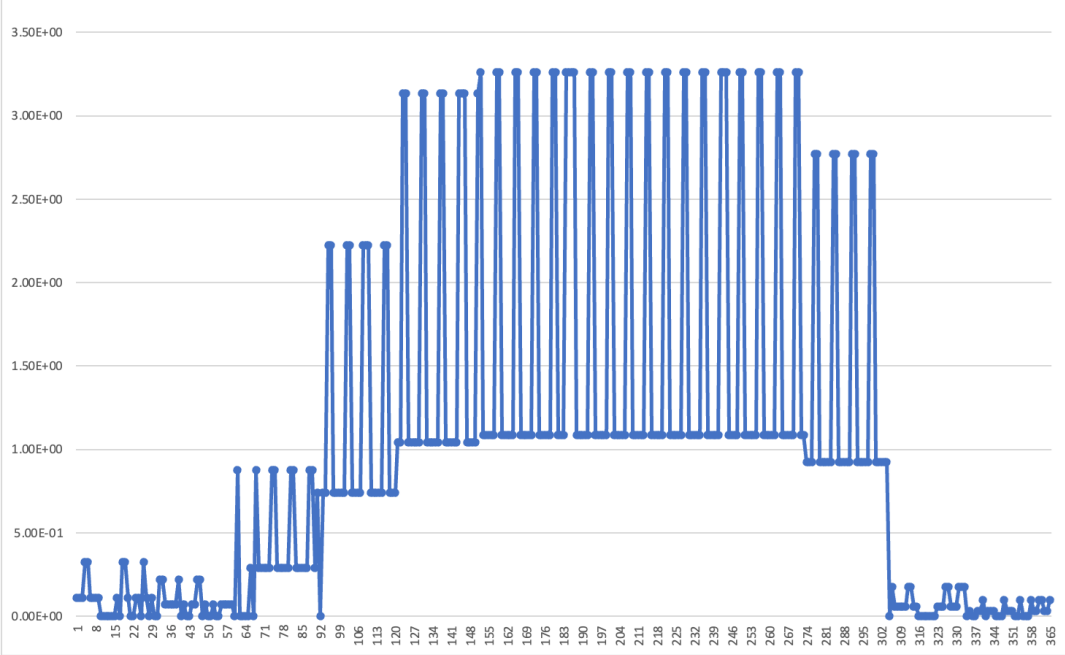
Figure 3-10 illustrates the impact of changing the temperature threshold for a warm climate county. The plot shows the temporal fraction by day for Duval County, Florida, for the first four months of 2007. The default 50 ˚F threshold creates large spikes on a few days, while the 60 ˚F threshold dampens these spikes and distributes a small amount of emissions to the days that have a minimum temperature between 50 and 60 ˚F.

Figure 3-10. Example of RWC temporal allocation using a 50 versus 60 ˚F threshold



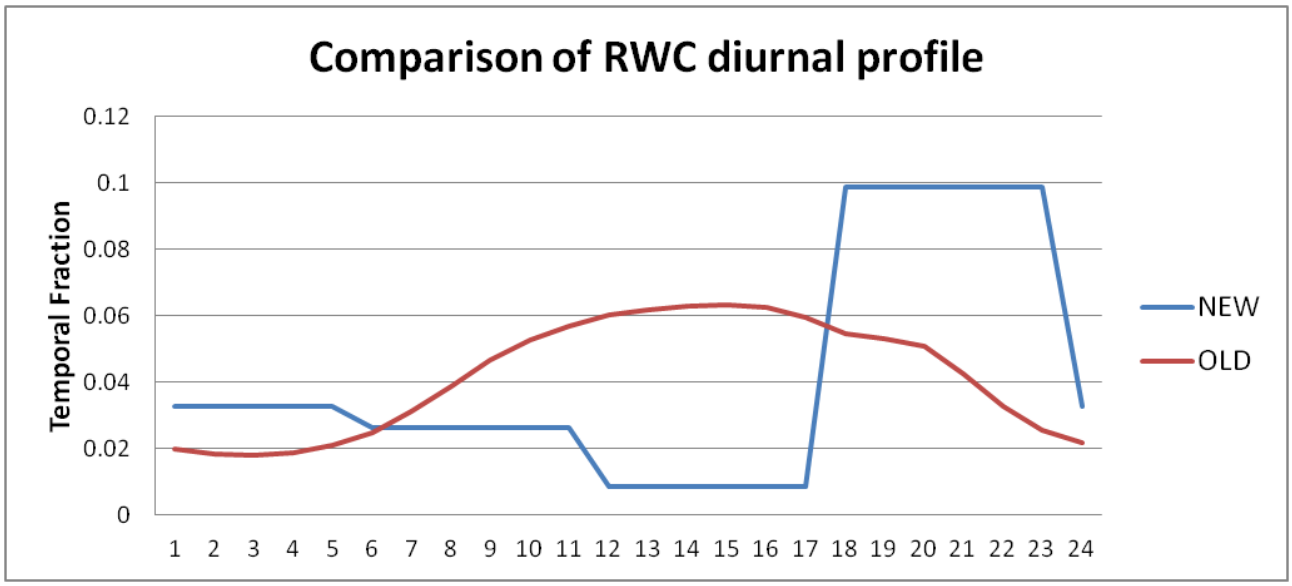
For the 2022 emissions modeling platform, a separate algorithm is used to determine temporal allocation of recreational wood burning, e.g., fire pits (SCC 2104008700) and is applied by Gentpro. Recreational wood burning depends on both minimum and maximum daily temperatures by county, and also uses a day-of-week temporal profile (61500) in which emissions are much higher on weekends than on weekdays. According to the recreational wood burning algorithm, only days in which the temperature falls within a range of 50°F and 80°F at some point during the day receive emissions. On days when the maximum temperature is less than 50°F or the minimum temperature is above 80°F, the daily temporal factor is zero. For all other days, the day-of-week profile 61500 is applied, which has 33% of the emissions on each weekend day and lower emissions on weekdays. An example is shown in Figure 3-11. As a result of applying this algorithm, northern states have more recreational wood burning in summer months while southern states show a flatter pattern with emissions distributed more evenly throughout the months.

Figure 3-11. Example of Annual-to-day temporal pattern of recreational wood burning emissions



The diurnal profile used for most RWC sources (see Figure 3-12) places more of the RWC emissions in the morning and the evening when people are typically using these sources. This profile is based on a 2004 MANE-VU survey (MANE-VU, 2004). This profile was created by averaging three indoor and three RWC outdoor temporal profiles from counties in Delaware and aggregating them into a single RWC diurnal profile. This new profile was compared to a concentration-based analysis of aethalometer measurements in Rochester, New York (Wang *et al.* 2011) for various seasons and days of the week and was found that the new RWC profile generally tracked the concentration based temporal patterns.

Figure 3-12. RWC diurnal temporal profile



The temporal profiles for hydronic heaters" (i.e., SCCs=2104008610 [outdoor], 2104008620 [indoor], and 2104008620 [pellet-fired]) are not based on temperature data, because the meteorologically based temporal allocation used for the rest of the rwc sector did not agree with observations for how these appliances are used.

For hydronic heaters, the annual-to-month, day-of-week and diurnal profiles were modified based on information in the New York State Energy Research and Development Authority's (NYSERDA) "Environmental, Energy Market, and Health Characterization of Wood-Fired Hydronic Heater Technologies, Final Report" (NYSERDA, 2012), as well as a Northeast States for Coordinated Air Use Management (NESCAUM) report "Assessment of Outdoor Wood-fired Boilers" (NESCAUM, 2006). A Minnesota 2008 Residential Fuelwood Assessment Survey of individual household responses (MDNR, 2008) provided additional annual-to-month, day-of-week, and diurnal activity information for OHH as well as recreational RWC usage.

Data used to create the diurnal profile for hydronic heaters, shown in Figure 3-13, are based on a conventional single-stage heat load unit burning red oak in Syracuse, New York.

Annual-to-month temporal allocation for OHH was computed from the MDNR 2008 survey and is illustrated in Figure 3-14. The hydronic heater emissions still exhibit strong seasonal variability, but do not drop to zero because many units operate year-round for water and pool heating.

Figure 3-13. Data used to produce a diurnal profile for hydronic heaters

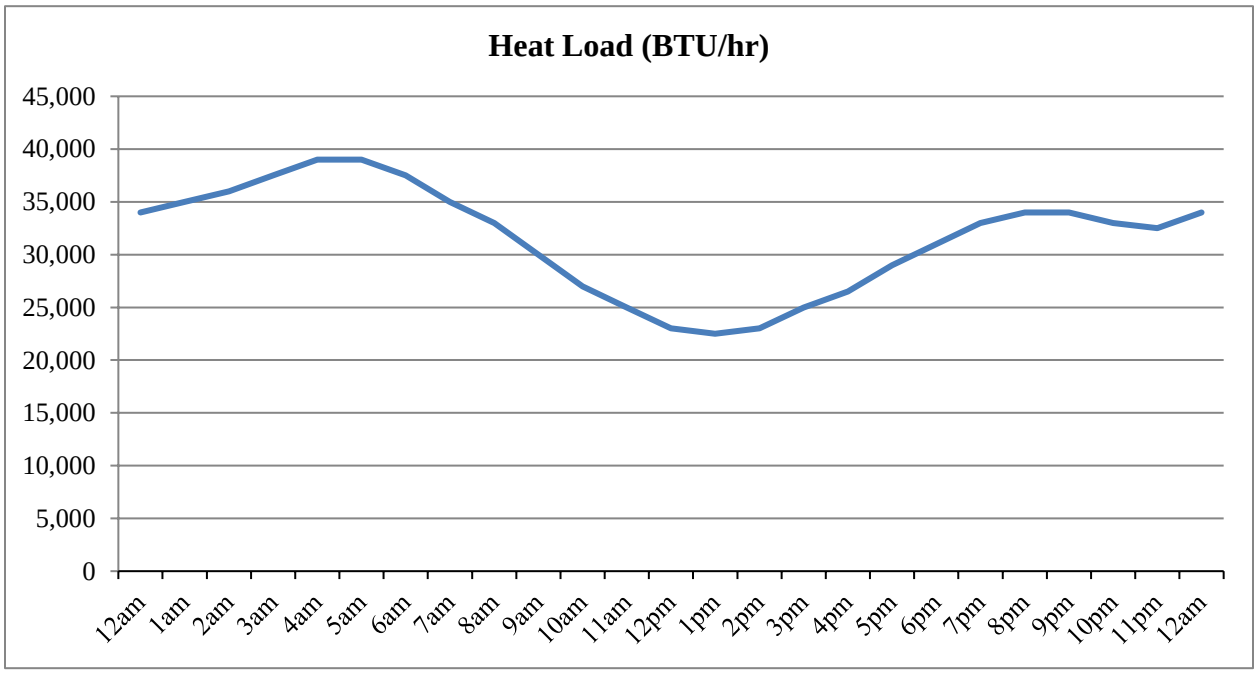
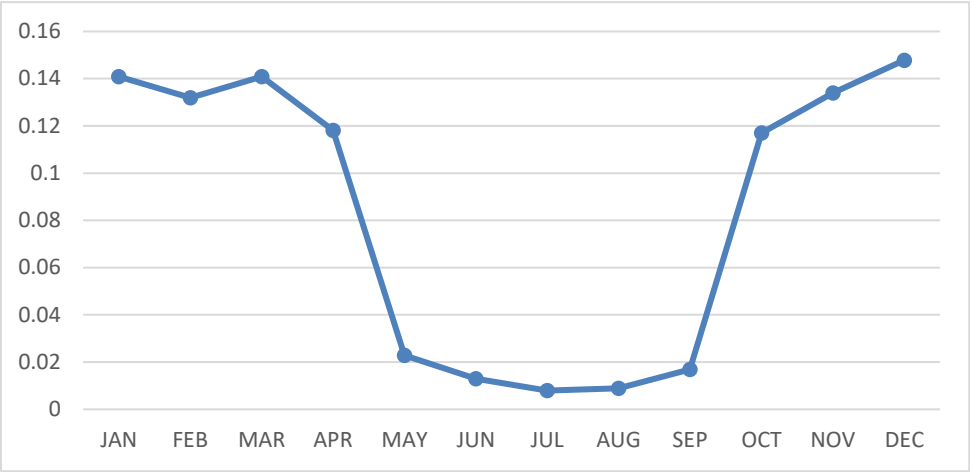


Figure 3-14. Monthly temporal profile for hydronic heaters



3.3.6 Agricultural Ammonia Temporal Profiles (livestock)

For the ag sector, agricultural GenTPRO temporal allocation was applied to livestock emissions and to all pollutants within the sector, not just NH_3. The GenTPRO algorithm is based on an equation derived by Jesse Bash of EPA ORD based on the Zhu, Henze, et al. (2014) empirical equation. This equation is based on observations from the TES satellite instrument with the GEOS-Chem model and its adjoint to estimate diurnal NH_3 emission variations from livestock as a function of ambient temperature, aerodynamic resistance, and wind speed. The equations are:

$$E_{i,h} = [161500/T_{i,h} \times e^{(-1380/T_{i,h})}] \times AR_{i,h}$$ Equation 3-1

$$PE_{i,h} = E_{i,h} / Sum(E_{i,h})$$ Equation 3-2

where

- $PE_{i,h}$ = Percentage of emissions in county *i* on hour *h*
- $E_{i,h}$ = Emission rate in county *i* on hour *h*
- $T_{i,h}$ = Ambient temperature (Kelvin) in county *i* on hour *h*
- $AR_{i,h}$ = Aerodynamic resistance in county *i*

Some examples plots of the profiles by animal type in different parts of the country are shown in Figure 3-15.

To develop month-to-hour temporal profiles of livestock emissions, GenTPRO was run using the "BASH_NH3" profile method to create for these sources. Because these profiles distribute to the hour based on monthly emissions, the monthly emissions were obtained from a monthly inventory, or from an annual inventory that has been temporalized to the month. Figure 3-16 compares the daily emissions for Minnesota from the "old" approach (uniform monthly profile) with the "new" approach (GenTPRO generated month-to-hour profiles) for 2014. Although the GenTPRO profiles show daily (and hourly) variability, the monthly total emissions are the same between the two approaches.

Figure 3-15. Examples of livestock temporal profiles in several parts of the country

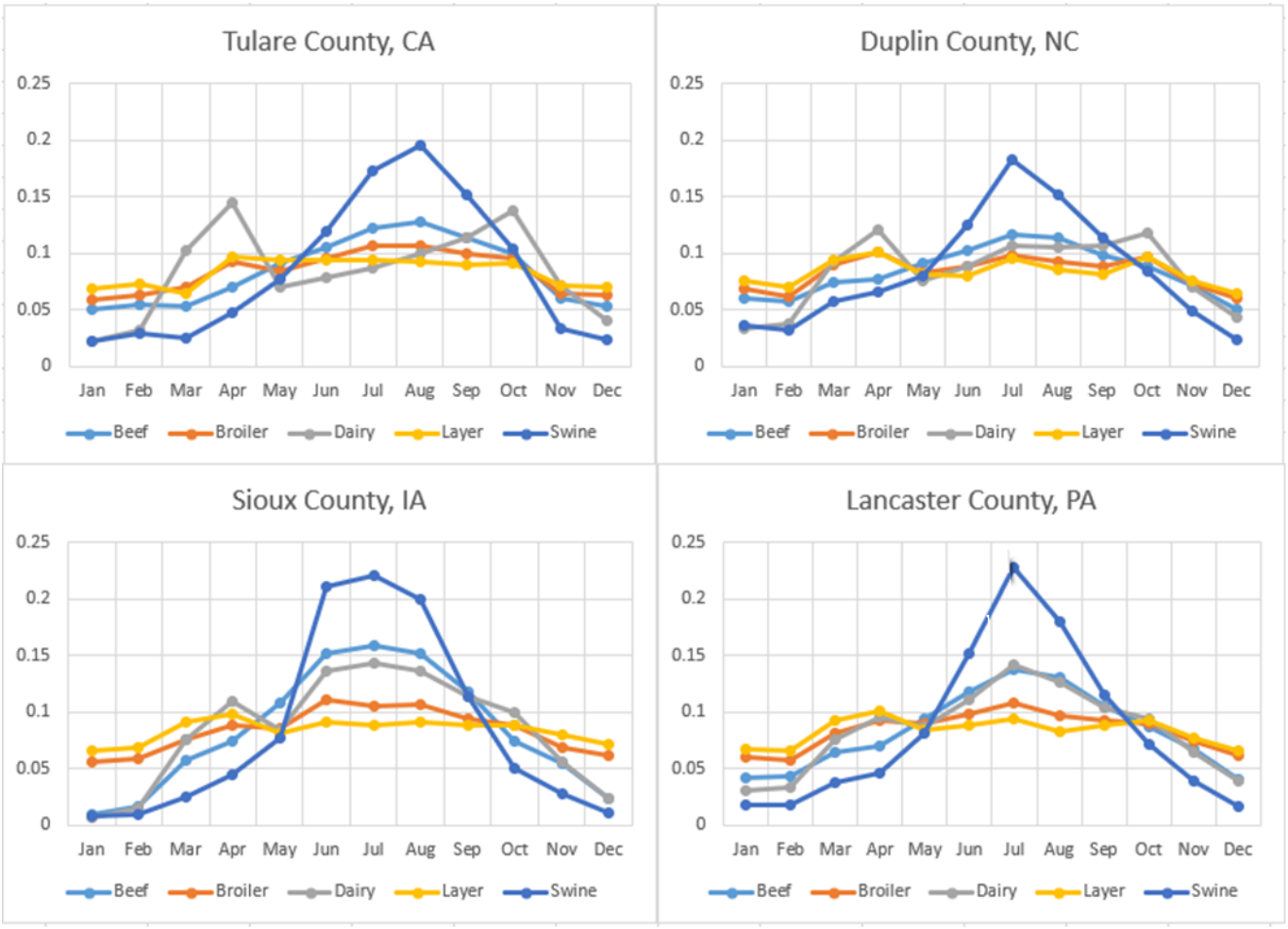
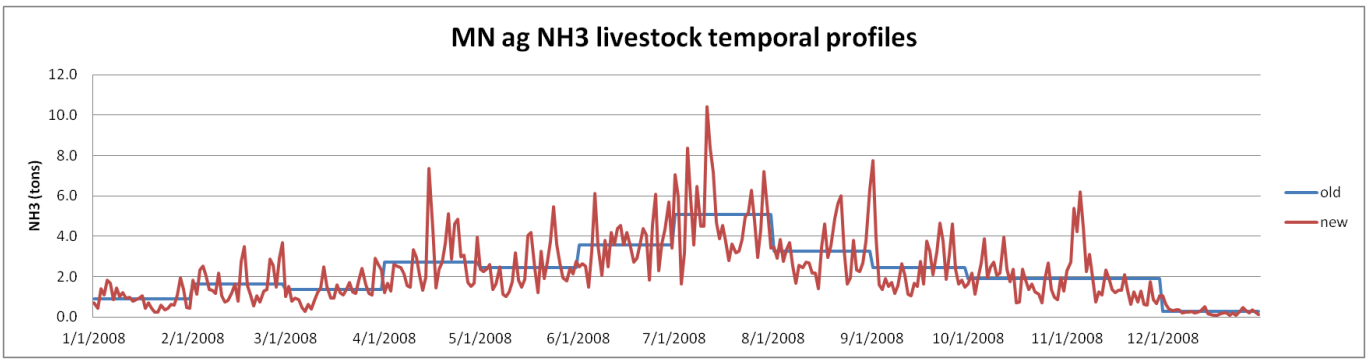


Figure 3-16. Example of animal NH_3 emissions temporal allocation approach (daily total emissions)



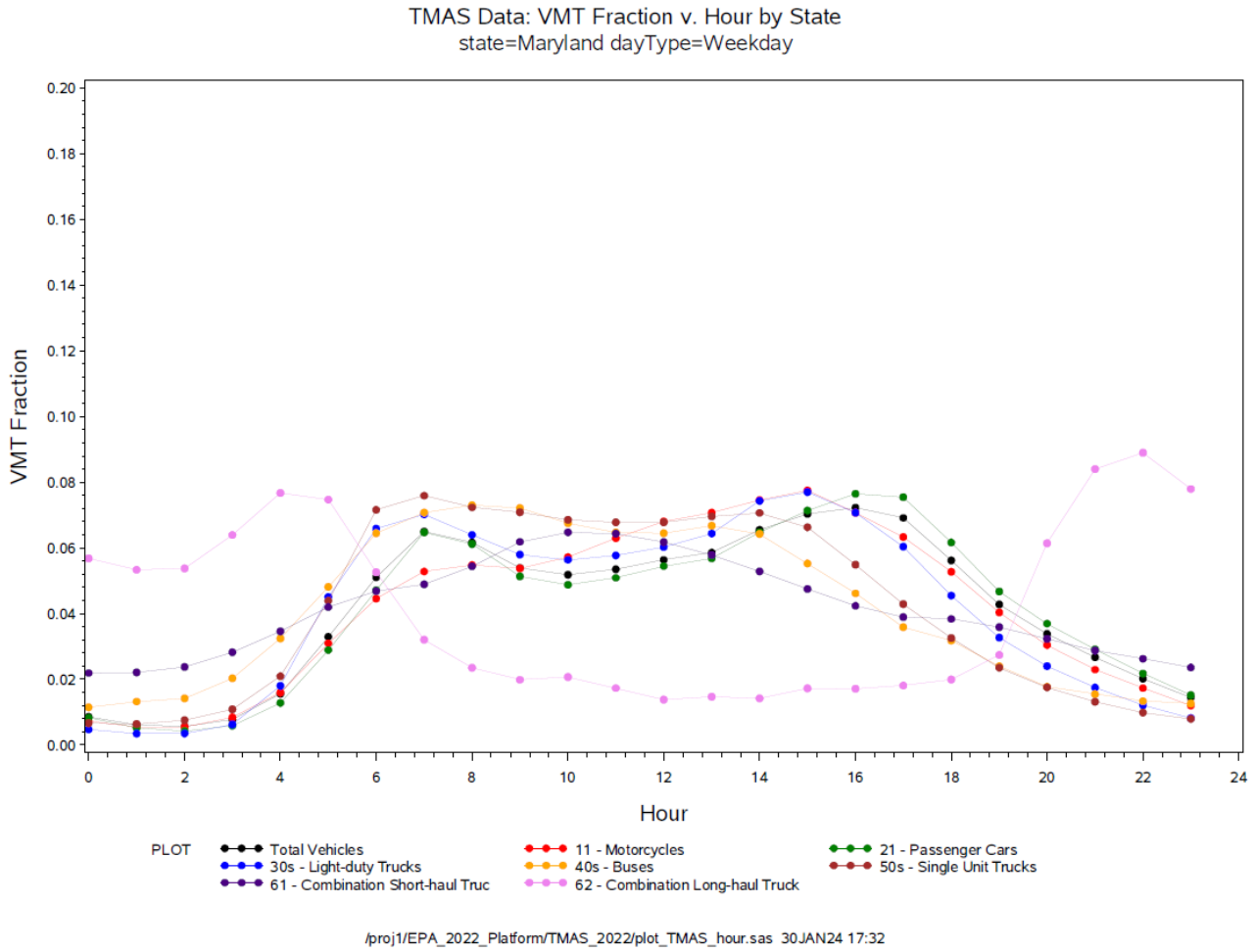
3.3.7 Oil and gas temporal allocation (np_oilgas)

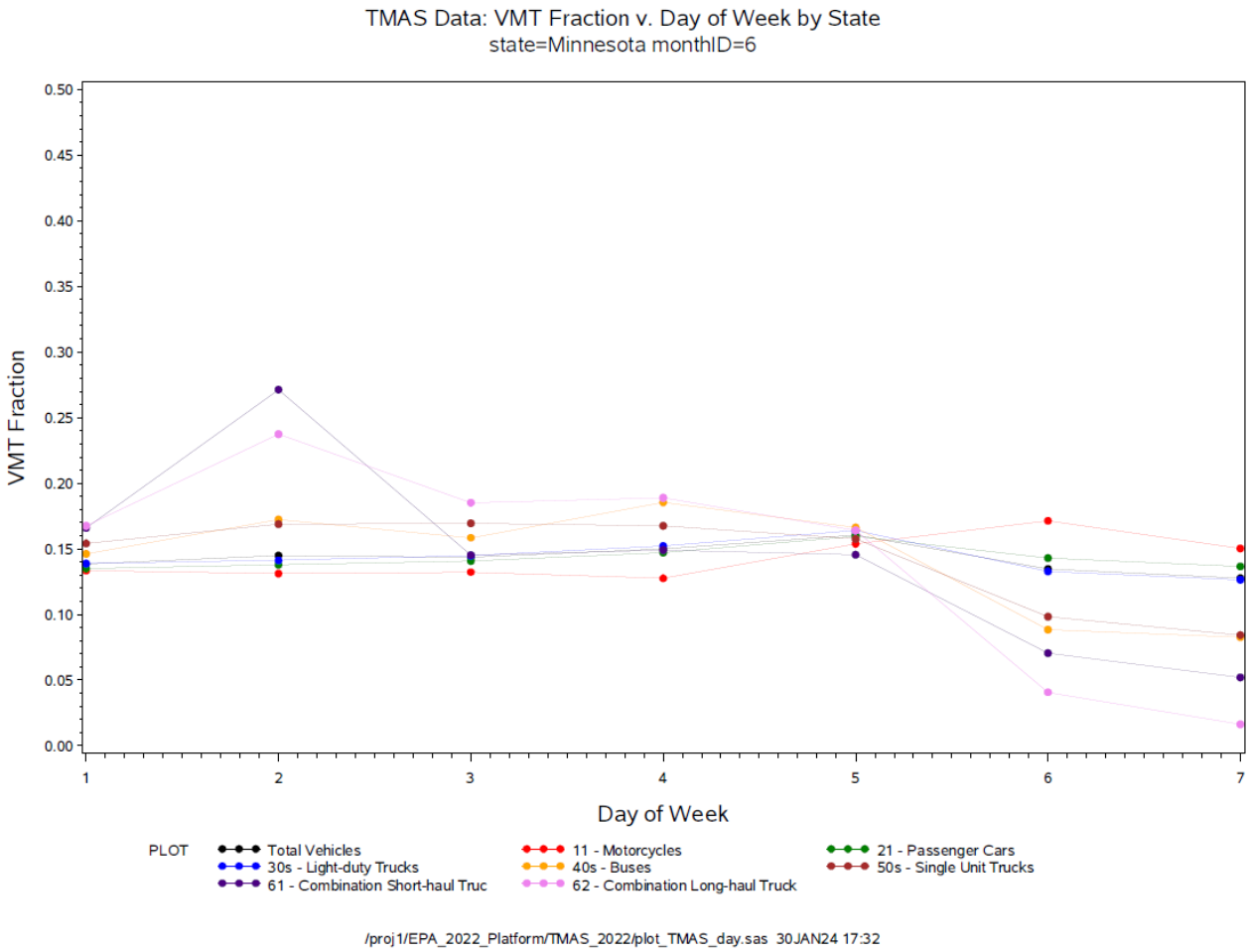
Monthly temporalization of np_oilgas emissions is based primarily on year-specific monthly factors from the Oil and Gas Tool (OGT). Factors were specific to each county and SCC. For use in SMOKE, each unique set of factors was assigned a label (OG20M_0001 through OG20M_6306), and then a SMOKE-formatted ATPRO_MONTHLY and an ATREF were developed. This dataset of monthly temporal factors included profiles for all counties and SCCs in the Oil and Gas Tool inventory. Because we are using non-tool datasets in some states, this monthly temporalization dataset did not cover all counties and SCCs in the entire inventory used for this study. To fill in the gaps in those states, state average monthly profiles for oil, natural gas, and combination sources were calculated from Energy Information Administration (EIA) data and assigned to each county/SCC combination not already covered by the OGT monthly temporal profile dataset. Coal bed methane (CBM) and natural gas liquid sources were assigned flat monthly profiles where there was not already a profile assignment in the dataset.

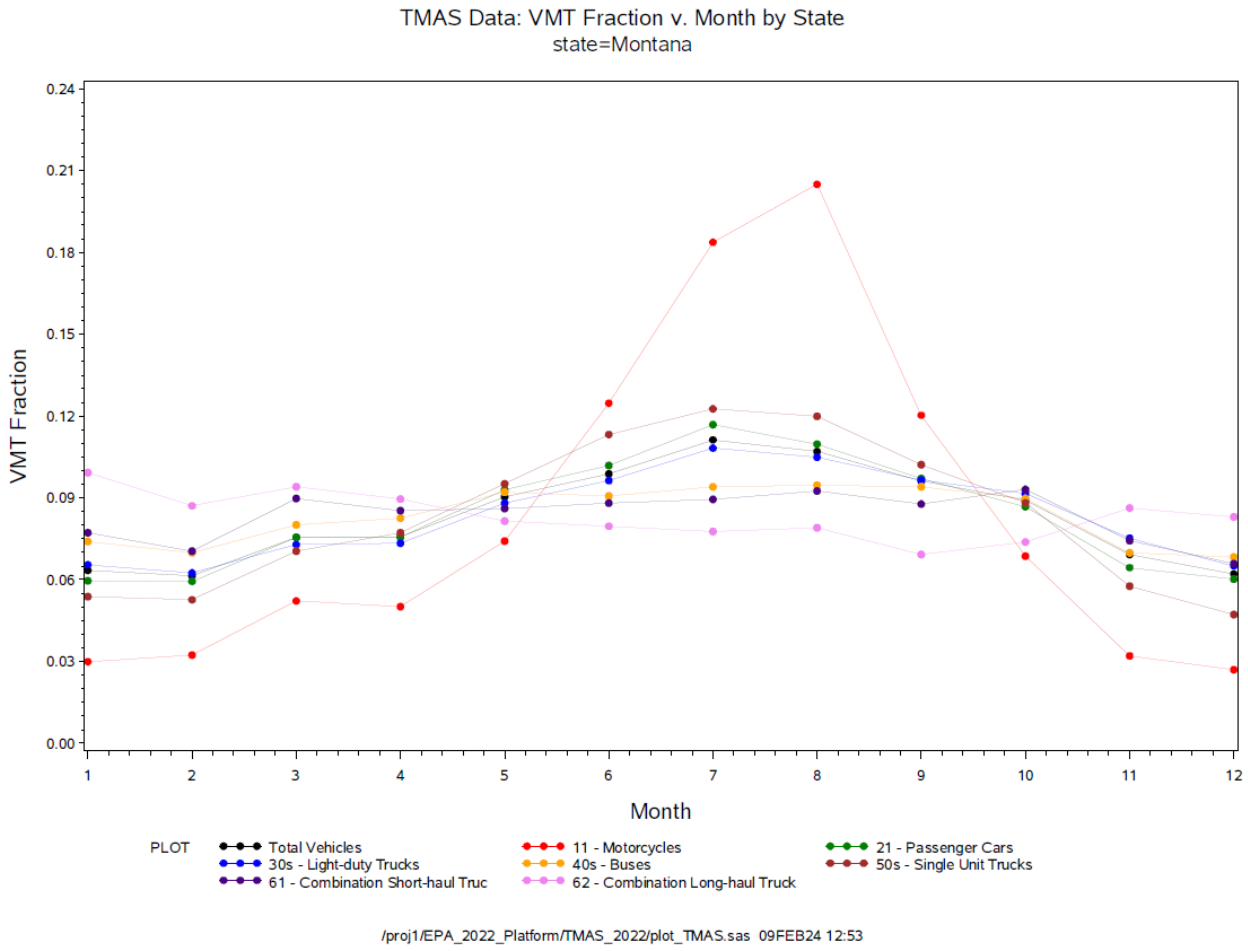
3.3.8 Onroad mobile temporal allocation (onroad)

For the onroad sector, the temporal distribution of emissions is a combination of traditional temporal profiles and the influence of meteorology. For the 2022 platform EPA utilized the FHWA's Travel Monitoring and Analysis System (TMAS). This system measures monthly traffic volume, by class and weight. The primary purpose for using TMAS in 2022 platform was to replace the month VMT distribution from 2020, which were marked by the COVID pandemic shutdowns in mid-March/April. The 2022 TMAS month VMT distribution looks more like a typical nonpandemic year. We also used day/hour distributions from the same dataset because they were available and for the correct year (2022). TMAS data was processed for each state, for each month, and vehicle class. Figure 3-17 shows TMAS data. The first plot shows hour of the day for the state of Maryland. Note that you can see the rush hour in the morning and the evening. The second plot shows the state of Minnesota for the month of June. Notice that motorcycles come out in the spring (winter months show less VMT for motorcycles) and are driven more on Saturday. The third plot shows an annual, by month plot of Montana. Note that there is an increase in passenger cars and light duty trucks during the month of July. This may be due to an increase in tourism during the warmer months.

Figure 3-17. TMAS Data: VMT Fraction by Hour of Day and Day of Week




TMAS Data: VMT Fraction v. Day of Week by State
state=Minnesota monthID=6
VMT Fraction
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
6
7
Day of Week
PLOT
Total Vehicles
11 - Motorcycles
21 - Passenger Cars
30s - Light-duty Trucks
40s - Buses
50s - Single Unit Trucks
61 - Combination Short-haul Truc
62 - Combination Long-haul Truck
/proj1/EPA_2022_Platform/TMAS_2022/plot_TMAS_day.sas 30JAN24 17:32

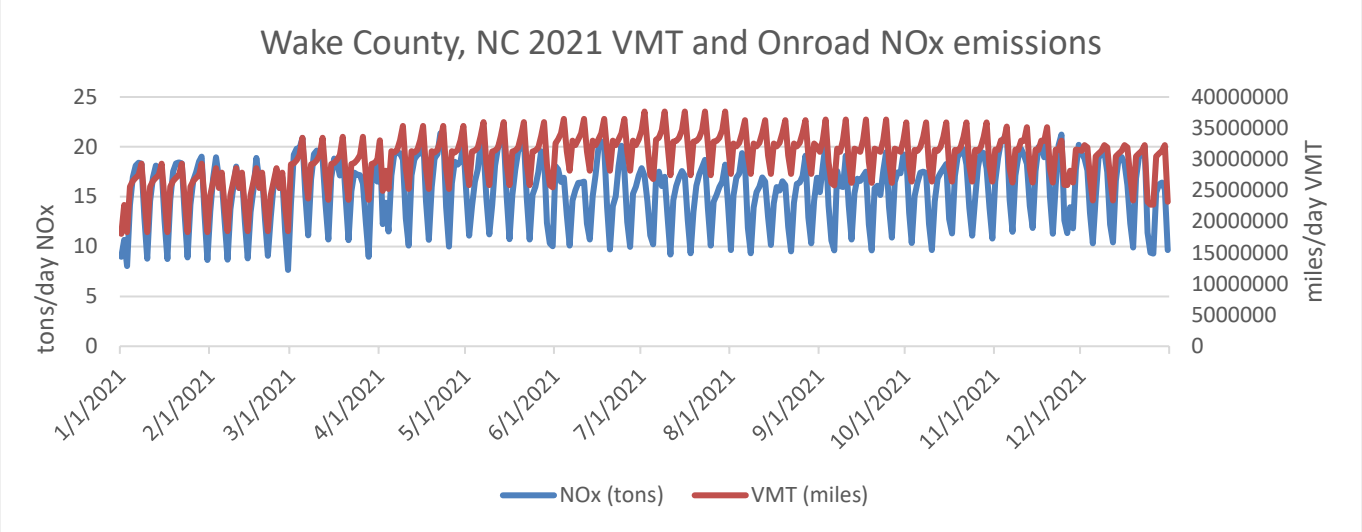


The "inventories" referred to in Table 3-16 consist of activity data for the onroad sector, not emissions. VMT is the activity data used for on-network rate-per-distance (RPD) processes. The off-network emissions from the rate-per-profile (RPP) and rate-per-vehicle (RPV) processes use the VPOP activity data, which are annual and do not need temporal allocation. For rate-per-hour (RPH) processes that result from hoteling of combination trucks, the HOTELING inventory is annual and was temporalized to month, day of the week, and hour of the day through temporal profiles. Day-of-week and hour-of-day temporal profiles are also used to temporalize the starts activity used for rate-per-start (RPS) processes, and the off-network idling (ONI) hours activity used for rate-per-hour-ONI (RPHO) processes. The inventories for starts and ONI activity contain monthly activity so that monthly temporal profiles are not needed.

For on-roadway RPD processes, the VMT activity data are annual for some sources and monthly for other sources, depending on the source of the data. Sources without monthly VMT were temporalized from annual to month through temporal profiles. VMT was also temporalized from month to day of the week, and then to hourly through temporal profiles. The RPD processes also use hourly speed distributions (SPDIST) as discussed in Section 2.3. For onroad, the temporal profiles and SPDIST will impact not only the distribution of emissions through time but also the total emissions. SMOKE-MOVES calculates emissions for RPD processed based on the VMT, speed and meteorology. Thus, if the VMT or

speed data were shifted to different hours, it would align with different temperatures and hence different emission factors. In other words, two SMOKE-MOVES runs with identical annual VMT, meteorology, and MOVES emission factors, will have different total emissions if the temporal allocation of VMT changes. Figure 3-18 (from 2021) illustrates the temporal allocation of the onroad activity data (i.e., VMT) and the pattern of the emissions that result after running SMOKE-MOVES. In this figure, it can be seen that the meteorologically varying emission factors add variation on top of the temporal allocation of the activity data.

Figure 3-18. Example temporal variability of VMT compared to onroad NO_X emissions



Meteorology is not used in the development of the temporal profiles, but rather it impacts the calculation of the hourly emissions through the program Movesmrg. The result is that the emissions vary at the hourly level by grid cell. More specifically, the on-network (RPD) and the off-network parked and stationary vehicle (RPV, RPH, RPHO, RPS, and RPP) processes use the gridded meteorology (MCIP) either directly or indirectly. For RPD, RPV, RPH, RPHO, and RPS, Movesmrg determines the temperature for each hour and grid cell and uses that information to select the appropriate emission factor for the specified SCC/pollutant/mode combination. For RPP, instead of reading gridded hourly meteorology, Movesmrg reads gridded daily minimum and maximum temperatures. The total of the emissions from the combination of these six processes (RPD, RPV, RPH, RPHO, RPS, and RPP) comprise the onroad sector emissions. In summary, the temporal patterns of emissions in the onroad sector are influenced by meteorology.

Day-of-week, hour-of-day, and month-of-year temporal profiles for VMT were developed from TMAS data. Data were provided for motorcycles (11), passenger vehicles (21), light duty trucks (30s), buses (40s), single unit trucks (50s), and combination short-haul trucks (61), and combination long-haul trucks (62). The dataset includes temporal profiles for individual states.

The StreetLight temporal profiles were used in areas of the contiguous United States that did not submit temporal profiles of sufficient detail for the 2020 NEI. For this platform, the data selection hierarchy favored local input data over EPA-developed information, with the exception of the three MOVES tables `hourVMTFraction`, dayVMTFraction`, and `avgSpeedDistribution` where county-level, telematics-based EPA Defaults were adopted for the NEI universally. For hoteling, day-of-week profiles are the same as

non-hoteling for combination trucks, while hour-of-day non-hoteling profiles for combination trucks were inverted to create new hoteling profiles that peak overnight instead of during the day.

Temporal profiles for RPHO are based on the same temporal profiles as the on-network processes in RPD, but since the on-network profiles are road-type-specific and ONI is not road-type-specific, the RPHO profiles were assigned to use rural unrestricted profiles for counties considered "rural" and urban unrestricted profiles for counties considered "urban." RPS uses the same day-of-week profiles as on-network processes in RPD, but uses a separate set of diurnal temporal profiles specifically for starts activity. For starts, there are two hour-of-day temporal profiles for each source type, one for weekdays and one for weekends. The starts diurnal temporal profiles are applied nationally and are based on the default starts-hour-fraction tables from MOVES.

3.3.9 Nonroad mobile temporal allocation (nonroad)

For nonroad mobile sources, temporal allocation is performed differently for different SCCs. Beginning with the final 2011 platform, improvements to temporal allocation of nonroad mobile sources were made to make the temporal profiles more realistically reflect real-world practices. The specific updates were made for agricultural sources (e.g., tractors), construction, and commercial residential lawn and garden sources. In the 2022v1 platform, temporal profiles for residential and commercial snowblowers were changed to be flat for each day of the week since snowfall is not influenced by the day of the week.

Figure 3-19 shows two previously existing temporal profiles (9 and 18) and a newer temporal profile (19) which has lower emissions on weekends. In this platform, construction and commercial lawn and garden sources use the new profile 19 which has lower emissions on weekends. Residental lawn and garden sources continue to use profile 9 and agricultural sources continue to use profile 19.

Figure 3-19. Example Nonroad Day-of-week Temporal Profiles

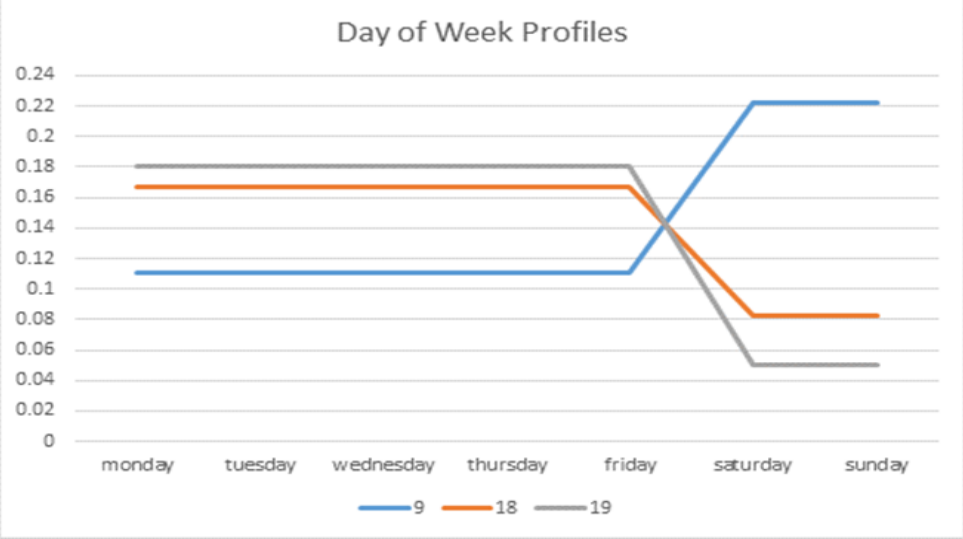
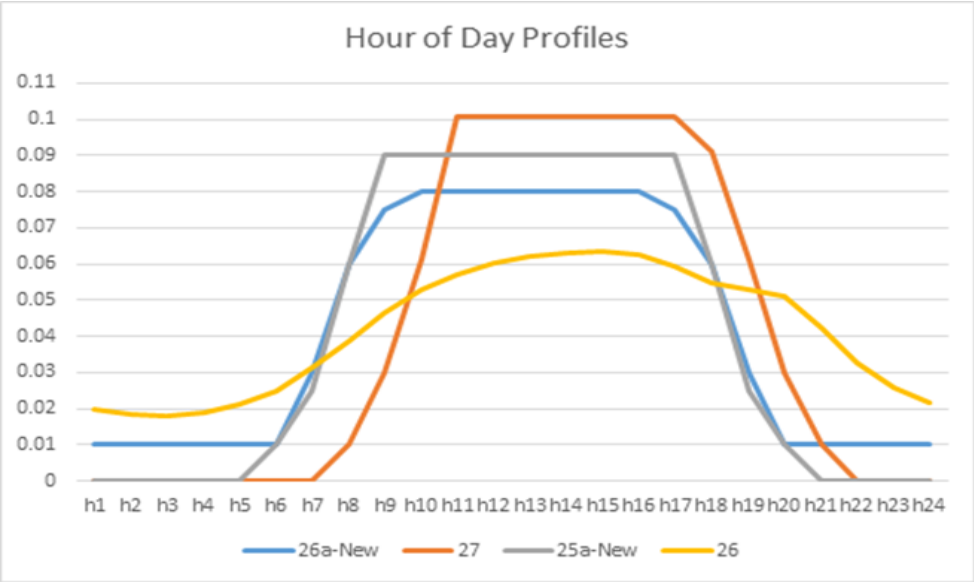


Figure 3-20 shows the previously existing temporal profiles 26 and 27 along with newer temporal profiles (25a and 26a) which have lower emissions overnight. In this platform, construction sources use profile 26a. Commercial lawn and garden and agriculture sources use the profiles 26a and 25a, respectively. Residental lawn and garden sources use profile 27.

Figure 3-20. Example Nonroad Diurnal Temporal Profiles



Additionally, the temporal profile for residential and commercial snowblowers were changed to flat day-of-week, since snow falls when it falls regardless of weekday/weekend. For the nonroad sector, while the NEI only stores the annual totals, the modeling platform uses monthly inventories from output from MOVES. For California, CARB's annual inventory was temporalized to monthly using monthly temporal profiles applied in SMOKE by SCC.

3.3.10 Fugitive dust temporal profiles (afdust)

For the afdust sector, meteorology is not used in the development of the temporal profiles, but it is used to reduce the total emissions based on meteorological conditions. These adjustments are applied through sector-specific scripts, beginning with the application of land use-based gridded transport fractions and then subsequent zero-outs for hours during which precipitation occurs or there is snow cover on the ground. The land use data used to reduce the NEI emissions explain the amount of emissions that are subject to transport. This methodology is discussed in (Pouliot et al., 2010), and in "Fugitive Dust Modeling for the 2008 Emissions Modeling Platform" (Adelman, 2012). The precipitation adjustment is applied to remove all emissions for hours where measurable rain occurs, or where there is snow cover. Therefore, the afdust emissions vary day-to-day based on the precipitation and/or snow cover for each grid cell and hour. Both the transport fraction and meteorological adjustments are based on the gridded resolution of the platform; therefore, somewhat different emissions will result from different grid resolutions. Application of the transport fraction and meteorological adjustments prevents the overestimation of fugitive dust impacts in the grid modeling as compared to ambient samples.

In the 2022v1 platform, some changes were made to temporal profiles in the afdust sector as follows:

- New temporal profiles (monthly, weekly, hourly) were created for paved and unpaved road dust. The monthly profile is based on monthly emissions from the 2022hc onroad PM2.5 brake and tire wear, since that has less temperature dependence than other pollutants and process. Weekly and hourly profiles are based on averages of the TMAS profiles used in SMOKE-MOVES. Unpaved road dust profiles use averages of passenger trucks only; paved road dust profiles use weighted averages of 3/4 light-duty vehicle emissions excluding motorcycles, and 1/4 heavy duty emissions excluding buses. There are separate hourly profiles for weekdays vs weekends.
- For agricultural tilling, flat day-of-week profiles are now being used along with new monthly profiles mostly based on nonroad ag emissions. The monthly nonroad ag profiles are based on LADCO-provided MOVES data and more accurately reflect tilling activities, peaking in spring and fall.
- For dust from livestock, the monthly profiles for 2805100010 and 2805100050 (beef cattle and swine) were updated to the 2022 data from https://u.osu.edu/beef/2023/10/25/more-heifers-supporting-feedlot-inventory/. Profiles for other livestock dust are not changed from the 2020 platform.

3.3.11 Additional sector specific details (beis, cmv, rail, nonpt, np_solvents, ptfire-rx, ptfire-wild)

In the 2022v1 platform, some changes were made to temporal profiles in the nonpt sector:

- Evaporative SCCs starting with 250105 and 250106 were updated to use monthly temporal profiles based on monthly total VOC emissions computed from the 2022hc onroad evaporative off-network processes in the RPP and RPV subsectors contained in the final 2022 onroad emissions.
- Residential natural gas (SCC 2104006000) monthly temporal profiles were derived for each state based on Energy Information Administration (EIA) data for 2022.

In the 2022v1 platform, some changes were made to temporal profiles in the np_solvents sector:

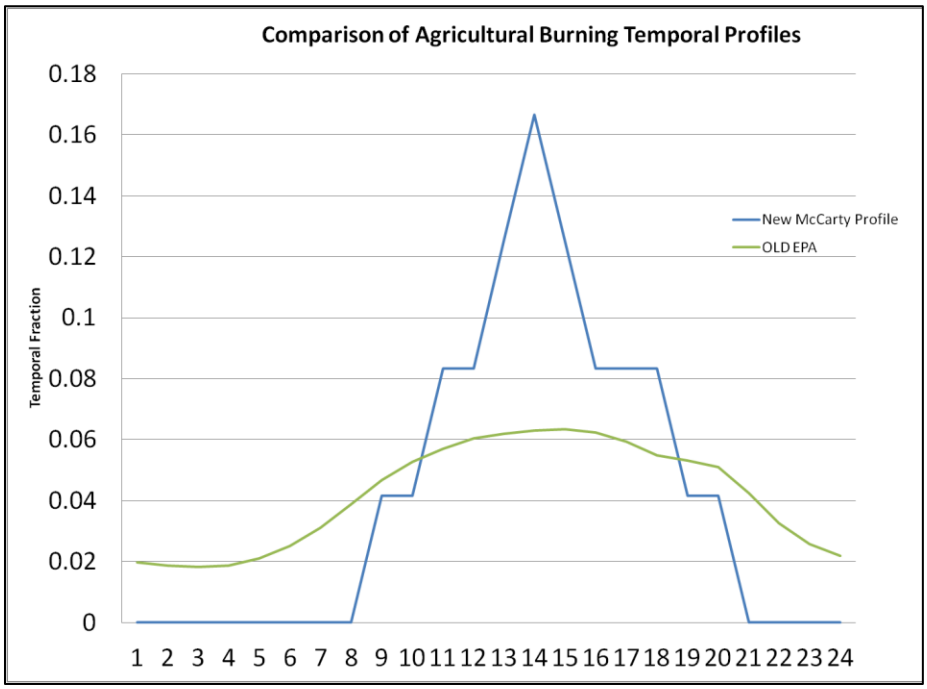
- All asphalt SCCs (paving and roofing) are using new EIA-based monthly profiles for “asphalt and road oil” by PADD region. The data source is https://www.eia.gov/dnav/pet/PET_CONS_PSUP_A_EPPA_VPP_MBBL_A.htm.
- For interior painting, a.k.a. architectural coating (2401001000): created a new monthly profile PAINT22 based on 2022 data from https://fred.stlouisfed.org/series/MRTSSM44412USN/.
- For pesticides (SCCs 2461850000, 2461800001, and 2460800000), monthly profiles were changed as follows: AZ/CA/FL/HI/TX (the warmest states) are flat annual. Other moderately warm southeast states from North Carolina south and west to Oklahoma are flat from March through October, and zero in other months. All other states are flat from April through September and zero in other months.

Biogenic emissions from the BEIS model vary each day of the year because they are developed using meteorological data including temperature, surface pressure, and radiation/cloud data. The emissions are computed using appropriate emission factors according to the vegetation in each model grid cell, while taking the meteorological data into account.

For the cmv sectors, most areas use hourly emission inventories derived from the 5-minute AIS data. For the rail sector, monthly profiles from the 2016 platform were used. Monthly temporal allocation for rail freight emissions is based on AAR Rail Traffic Data, Total Carloads and Intermodal, for 2016. For passenger trains, monthly temporal allocation is flat for all months. Rail passenger miles data is available by month but it is not known how closely rail emissions track with passenger activity since passenger trains run on a fixed schedule regardless of how many passengers are aboard, and so a flat profile is chosen for passenger trains. Rail emissions are allocated with flat day of week profiles, and most emissions are allocated with flat hourly profiles.

For the ptagfire sector, the inventories are in the daily point fire format FF10 PTDAY. The diurnal temporal profile for ag fires reflects the fact that burning occurs during the daylight hours - see Figure 3-21 (McCarty et al., 2009). This puts most of the emissions during the work-day and suppresses the emissions during the middle of the night.

Figure 3-21. Agricultural burning diurnal temporal profile

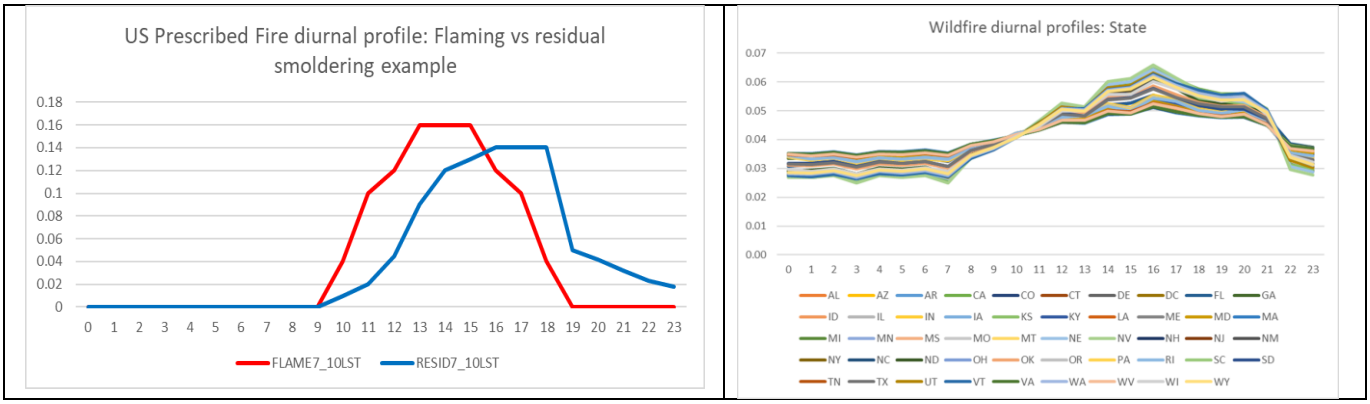


Industrial processes that are not likely to shut down on Sundays, such as those at cement plants, use profiles that include emissions on Sundays, while those that would shut down on Sundays use profiles that reflect Sunday shutdowns.

For the ptfire sectors, the inventories are in the daily point fire format FF10 PTDAY, so temporal profiles are only used to go from day-specific to hourly emissions. Separate hourly profiles for prescribed and wildfires were used. For ptfire, state-specific hourly profiles were used, with distinct profiles for

prescribed fires and wildfires. Figure 3-22 below shows the profiles used for each state for the platform. The wildfire diurnal profiles are similar but vary according to the average meteorological conditions in each state. For all agricultural burning, the diurnal temporal profile used reflects the fact that burning occurs during the daylight. This puts most of the emissions during the workday and suppresses the emissions during the middle of the night. This diurnal profile was used for each day of the week for all agricultural burning emissions in all states.

Figure 3-22. Prescribed and Wildfire diurnal temporal profiles



3.4 Spatial Allocation

The methods used to perform spatial allocation are summarized in this section. For the modeling platform, spatial factors are typically applied by county and SCC. Spatial allocation was performed for each of the modeling grids shown in Section 3.1. To accomplish this, SMOKE used national 12-km spatial surrogates and a SMOKE area-to-point data file. For the U.S., the EPA updated surrogates to use circa 2020 data. The U.S., Mexican, and Canadian 12-km surrogates cover the entire CONUS domain 12US1 shown in Figure 3-1. While highlights of information are provided below, the file *Surrogate_specifications_2022_platform_US_Can_Mex.xlsx* documents the complete configuration for generating the surrogates and can be referenced for more details.

3.4.1 Spatial Surrogates for U.S. emissions

There are more than 90 spatial surrogates available for spatially allocating U.S. county-level emissions to the 12-km grid cells used by the air quality model. As described in Section 3.4.2, an area-to-point approach overrides the use of surrogates for airport refueling sources.

The surrogates for the platform are based on a variety of geospatial data sources, including the American Community Survey (ACS) for census-related data, the National Land Cover Database (NLCD) Onroad surrogates are based on average annual daily traffic counts (AADT) from the highway monitoring performance system (HPMS).

U.S. Surrogate datasets used for this platform include:

- County boundaries used for all surrogates use the 2020 TIGER boundaries.
- Oil and gas surrogates represent activity from the year 2022.
- ACS-based surrogates use the 2020 ACS.
- NLCD-based surrogates use NLCD 2019.

- Animal specific livestock waste surrogates were derived from National Pollutant Discharge Elimination System (NPDES) animal operation water permits and Food and Agriculture Organization (FAO) gridded livestock count data.
- Surrogates for fuel stations, asphalt surfaces, and unpaved roads are based on data from the OpenStreetMap database.
- Gravel and lead mines use separate surrogates based on the more general United States Geological Survey (USGS) mining surrogate.
- Residential wood combustion surrogates are based on ACS data.

When developing modeling platforms, EPA routinely updates surrogates to utilize updated versions of the underlying surrogate databases or to use a different source of data when it is deemed more representative for a particular source category. In the 2020 platform, NLCD-based surrogates were updated from using the 2011 National Land Cover Database (NLCD) to use the 2019 National Land Cover Database. During these updates, EPA also examined the Residential Wood Combustion (RWC) surrogates that were based on the NLCD. This was done to see if there are other sources of spatial data that could improve the geographic representation of the RWC sector when disaggregating the county-level emissions provided by the emissions inventory to grid cells. For the RWC sector prior to the 2020 platform, the spatial surrogate used was #300 computed from "NLCD Low Intensity development" (i.e., land areas with 20-49% impervious surface). This surrogate was initially selected for RWC to capture geographic areas where there may be houses but generally in less developed spaces. However, this surrogate does not differentiate by development or structure type. The result is that RWC emissions can end up concentrated around roads, commercial, and other low to moderately developed grid cells.

In the 2020 platform, housing data provided by the American Community Survey (ACS) were used. The particular attributes used are: single family detached, single family attached, dual family and mobile home and combinations of these, depending on the particular RWC specific source category. Using types of housing seemed more reflective of where RWC emissions would be located. However, a downside of using the ACS housing data is that the census shapes are broad (particularly in rural areas), so the emissions can appear more spread out in some areas than when using the NLCD-based surrogates. When comparing the two approaches for RWC surrogates (NLCD vs ACS), the ACS-based surrogates looked reasonable, and in fact better than the NLCD Low intensity development surrogate. A comparison of the $PM_{2.5}$ emissions gridded with each of these approaches is shown in Figure 3-23 and Figure 3-24. In the future, a goal is to further improve the resolution surrogates, as such, the use of building structure data weighted by the ACS will be examined for future platform updates.

Figure 3-23. 2020 Residential Wood Combustion Emissions using NLCD Low Intensity Surrogate

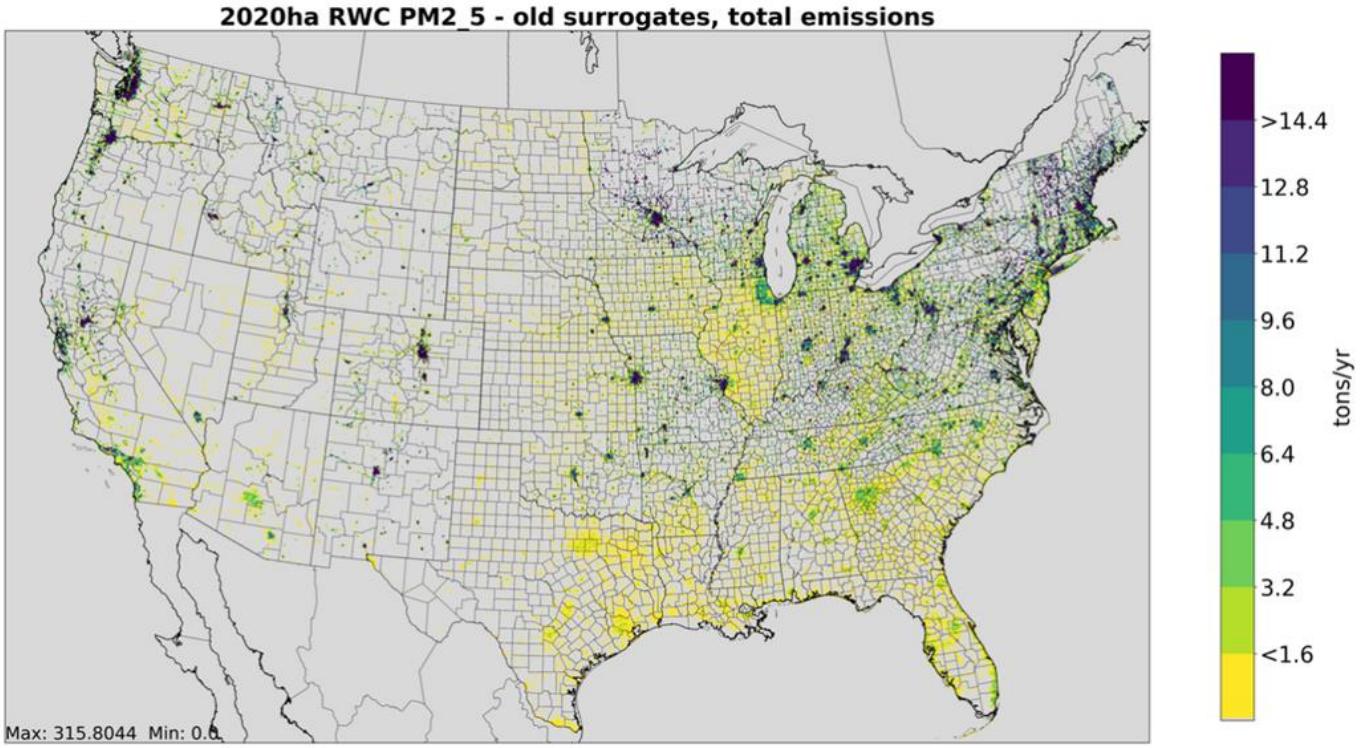
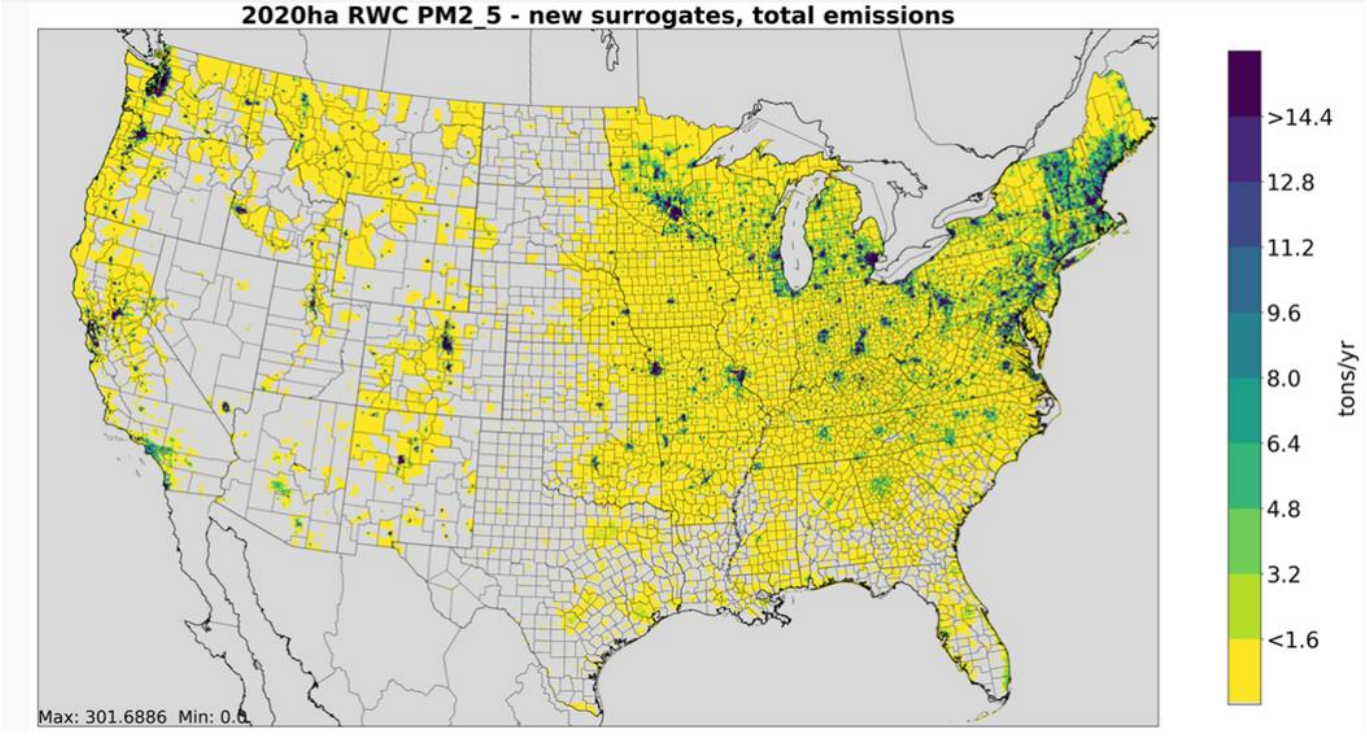


Figure 3-24. 2020 Residential Wood Combustion Emissions using ACS-based Surrogate



Surrogates for the U.S. were generated using the Surrogate Tools DB with the Java-based Surrogate tools used to perform gapfilling and normalization where needed. The tool and documentation for the original Surrogate Tool are available at https://www.cmascenter.org/sa-

tools/documentation/4.2/SurrogateToolUserGuide_4_2.pdf, and the tool and documentation for the Surrogate Tools DB is available from https://www.cmascenter.org/surrogate_tools_db/. Table 3-17 lists the codes and descriptions of the surrogates. Surrogate names and codes listed in *italics* are not directly assigned to any sources in the platform, but they are sometimes used to gapfill other surrogates. When the source data for a surrogate have no values for a particular county, gap filling is used to provide values for the spatial surrogate in those counties to ensure that no emissions are dropped when the spatial surrogates are applied to the emission inventories. The Shapefiles used to develop the US surrogates along with the attributes and filters used are shown in Table 3-18.

Table 3-17. U.S. Surrogates available for the 2022 modeling platforms

Code	Surrogate Description	Code	Surrogate Description
N/A	Area-to-point approach (see 3.6.2)	650	Refineries and Tank Farms
100	Population	*669*	*All Abandoned Wells*
110	*Housing*	*6691*	*All Abandoned Oil Wells*
135	Detached Housing	*6692*	*All Abandoned Gas Wells*
136	Single and Dual Unit Housing	*6693*	*All Abandoned CBM Wells*
137	Single + Dual Unit + Manufactured Housing	6694	All Abandoned Oil Wells - Plugged
150	Residential Heating - Natural Gas	6695	All Abandoned Gas Wells - Plugged
170	Residential Heating - Distillate Oil	*6696*	*All Abandoned CBM Wells - Plugged*
180	Residential Heating - Coal	6697	All Abandoned Oil Wells - Unplugged
190	Residential Heating - LP Gas	6698	All Abandoned Gas Wells - Unplugged
205	Extended Idle Locations	670	Spud Count - CBM Wells
239	Total Road AADT	671	Spud Count - Gas Wells
240	Total Road Miles	*672*	*Gas Production at Oil Wells*
242	All Restricted AADT	*673*	*Oil Production at CBM Wells*
244	All Unrestricted AADT	674	Unconventional Well Completion Counts
258	*Intercity Bus Terminals*	676	Well Count - All Producing
259	Transit Bus Terminals	*677*	*Well Count - All Exploratory*
260	*Total Railroad Miles*	678	Completions at Gas Wells
261	NTAD Total Railroad Density	679	Completions at CBM Wells
271	NTAD Class 1 2 3 Railroad Density	681	Spud Count - Oil Wells
300	NLCD Low Intensity Development	683	Produced Water at All Wells
304	NLCD Open + Low	6831	Produced Water at CBM Wells
305	NLCD Low + Med	6832	Produced Water at Gas Wells
306	NLCD Med + High	6833	Produced Water at Oil Wells
307	NLCD All Development	685	Completions at Oil Wells
308	NLCD Low + Med + High	*686*	*Completions at All Wells*
309	NLCD Open + Low + Med	687	Feet Drilled at All Wells
310	NLCD Total Agriculture	689	Gas Produced - Total
318	*NLCD Pasture Land*	691	Well Counts - CBM Wells
319	NLCD Crop Land	692	Spud Count - All Wells
320	NLCD Forest Land	693	Well Count - All Wells

321	NLCD Recreational Land	694	Oil Production at Oil Wells
340	*NLCD Land*	695	Well Count - Oil Wells
350	NLCD Water	696	Gas Production at Gas Wells
401	*FAO 2010 Cattle*	697	Oil Production at Gas Wells
4011	FAO 2010 Large Cattle Operations	698	Well Count - Gas Wells
4012	NPDES 2020 Beef Cattle	699	Gas Production at CBM Wells
4013	NPDES 2020 Dairy Cattle	711	Airport Areas
402	*FAO 2010 Pig*	801	Port Areas
4021	NPDES 2020 Swine	850	Golf Courses
403	*FAO 2010 Chicken*	860	Mines
4031	NPDES 2020 Chicken	861	Sand and Gravel Mines
404	*FAO 2010 Goat*	862	Lead Mines
4041	NPDES 2020 Goat	863	Crushed Stone Mines
405	FAO 2010 Horse	900	OSM Fuel
406	FAO 2010 Sheep	901	OSM Asphalt Surfaces
4071	NPDES 2020 Turkey	902	OSM Unpaved Roads
508	Public Schools		

Table 3-18. Shapefiles used to develop U.S. Surrogates

Code	Surrogate	Weight Shapefile	Weight Attribute	Filter Function
100	Population	ACS_2020_5YR_BG_pop_hu	POP2020	
110	Housing	ACS_2020_5YR_BG_pop_hu	HU2020	
135	Detached Housing	ACS_2020_5YR_BG_pop_hu	detachedh	
136	Single and Dual Unit Housing	ACS_2020_5YR_BG_pop_hu	lttriunit	
137	Single + Dual Unit + Manufactured Housing	ACS_2020_5YR_BG_pop_hu_mobile	sngdlmobl	
150	Residential Heating - Natural Gas	ACS_2020_5YR_BG_pop_hu	UTIL_GAS	
170	Residential Heating - Distillate Oil	ACS_2020_5YR_BG_pop_hu	FUEL_OIL	
180	Residential Heating - Coal	ACS_2020_5YR_BG_pop_hu	COAL	
190	Residential Heating - LP Gas	ACS_2020_5YR_BG_pop_hu	LP_GAS	
205	Extended Idle Locations	pil_2019_06_24	rev_truck	rev_truck>0
239	Total Road AADT	hpms2017_v3_04052020	aadt	moves2014 IN ('02','03','04','05')
240	Total Road Miles	hpms2017_v3_04052020	NONE	moves2014 IN ('02','03','04','05')
242	All Restricted AADT	hpms2017_v3_04052020	aadt	moves2014 IN ('02','04')
Code	**Surrogate**	**Weight Shapefile**	**Weight Attribute**	**Filter Function**

244	All Unrestricted AADT	hpms2017_v3_04052020	aadt	moves2014 IN ('03','05')
259	Transit Bus Terminals	ntad_2016_ipcd	NONE	bus_t=1
260	Total Railroad Miles	tiger_2014_rail	NONE	
261	NTAD Total Railroad Density	ntad_2014_rail_fixed	dens	RAILTYPE IN (1,2,3)
271	NTAD Class 1 2 3 Railroad Density	ntad_2014_rail_fixed	dens	RAILTYPE=1
300	NLCD Low Intensity Development	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE=22
304	NLCD Open + Low	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (21,22)
305	NLCD Low + Med	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (22,23)
306	NLCD Med + High	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (23,24)
307	NLCD All Development	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (21,22,23,24)
308	NLCD Low + Med + High	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (22,23,24)
309	NLCD Open + Low + Med	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (21,22,23)
310	NLCD Total Agriculture	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (81,82)
318	NLCD Pasture Land	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE=81
319	NLCD Crop Land	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE=82
320	NLCD Forest Land	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (41,42,43)
321	NLCD Recreational Land	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE IN (21,31,41,42,43,52,71)
340	NLCD Land	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE != 11
350	NLCD Water	nlcd_2019_land_cover_l48_20210604_500m_ll	NONE	GRIDCODE=11
401	FAO 2010 Cattle	fao_Cattle_2010_Da_nlcdproj_masked	DN	
4011	FAO 2010 Large Cattle Operations	fao_LargeCattle_2010_Da_nlcdproj_masked	DN	
4012	NPDES 2020 Beef Cattle	livestock_npdes_state_permits_subset	Population	Animal = 'Beef'
4013	NPDES 2020 Dairy Cattle	livestock_npdes_state_permits_subset	Population	Animal = 'Dairy'
402	FAO 2010 Pig	fao_Pig_2010_Da_nlcdproj_masked	DN	
4021	NPDES 2020 Swine	livestock_npdes_state_permits_subset	Population	Animal = 'Swine'
Code	**Surrogate**	**Weight Shapefile**	**Weight Attribute**	**Filter Function**
403	FAO 2010 Chicken	fao_Chicken_2010_Da_nlcdproj_masked	DN	

4031	NPDES 2020 Chicken	livestock_npdes_state_permits_subset	Population	Animal = 'Chicken'
404	FAO 2010 Goat	fao_Goat_2010_Da_nlcdproj_masked	DN	
4041	NPDES 2020 Goat	livestock_npdes_state_permits_subset	Population	Animal = 'Goat'
405	FAO 2010 Horse	fao_Horse_2010_Da_nlcdproj_masked	DN	
406	FAO 2010 Sheep	fao_Sheep_2010_Da_nlcdproj_masked	DN	
4071	NPDES 2020 Turkey	livestock_npdes_state_permits_subset	Population	Animal = 'Turkey'
508	Public Schools	public_schools_2018_2019	TOTAL	
650	Refineries and Tank Farms	eia_2015_us_oil	NONE	
669	All Abandoned Wells	AW_ALL_COUNTS_669_2022	ACTIVITY	
6696	All Abandoned CBM Wells – Plugged	AW_CBM_PLUGGED_6696_2022	ACTIVITY	
6693	All Abandoned CBM Wells	AW_CBM_PLUGGED_UNPLUGGED_6693_2022	ACTIVITY	
6695	All Abandoned Gas Wells – Plugged	AW_GAS_PLUGGED_6695_2022	ACTIVITY	
6692	All Abandoned Gas Wells	AW_GAS_PLUGGED_UNPLUGGED_6692_2022	ACTIVITY	
6698	All Abandoned Gas Wells – Unplugged	AW_GAS_UNPLUGGED_6698_2022	ACTIVITY	
6694	All Abandoned Oil Wells – Plugged	AW_OIL_PLUGGED_6694_2022	ACTIVITY	
6691	All Abandoned Oil Wells	AW_OIL_PLUGGED_UNPLUGGED_6691_2022	ACTIVITY	
6697	All Abandoned Oil Wells – Unplugged	AW_OIL_UNPLUGGED_6697_2022	ACTIVITY	
670	Spud Count - CBM Wells	SPUD_CBM_670_2022	ACTIVITY	
671	Spud Count - Gas Wells	SPUD_GAS_671_2022	ACTIVITY	
672	Gas Production at Oil Wells	ASSOCIATED_GAS_PRODUCTION_672_2022	ACTIVITY	
673	Oil Production at CBM Wells	CONDENSATE_CBM_PRODUCTION_673_2022	ACTIVITY	
674	Unconventional Well Completion Counts	COMPLETIONS_UNCONVENTIONAL_674_2022	ACTIVITY	
676	Well Count - All Producing	TOTAL_PROD_WELL_676_2022	ACTIVITY	
677	Well Count - All Exploratory	TOTAL_EXPL_WELL_677_2022	ACTIVITY	
678	Completions at Gas Wells	COMPLETIONS_GAS_678_2022	ACTIVITY	
679	Completions at CBM Wells	COMPLETIONS_CBM_679_2022	ACTIVITY	
681	Spud Count - Oil Wells	SPUD_OIL_681_2022	ACTIVITY	
683	Produced Water at All Wells	PRODUCED_WATER_ALL_683_2022	ACTIVITY	
Code	**Surrogate**	**Weight Shapefile**	**Weight Attribute**	**Filter Function**
6831	Produced Water at CBM Wells	PRODUCED_WATER_CBM_6831_2022	ACTIVITY	
6832	Produced Water at Gas Wells	PRODUCED_WATER_GAS_6832_2022	ACTIVITY	

6833	Produced Water at Oil Wells	PRODUCED_WATER_OIL_6833_2022	ACTIVITY	
685	Completions at Oil Wells	COMPLETIONS_OIL_685_2022	ACTIVITY	
686	Completions at All Wells	COMPLETIONS_ALL_686_2022	ACTIVITY	
687	Feet Drilled at All Wells	FEET_DRILLED_687_2022	ACTIVITY	
689	Gas Produced - Total	TOTAL_GAS_PRODUCTION_689_2022	ACTIVITY	
691	Well Counts - CBM Wells	CBM_WELLS_691_2022	ACTIVITY	
692	Spud Count - All Wells	SPUD_ALL_692_2022	ACTIVITY	
693	Well Count - All Wells	TOTAL_WELL_693_2022	ACTIVITY	
694	Oil Production at Oil Wells	OIL_PRODUCTION_694_2022	ACTIVITY	
695	Well Count - Oil Wells	OIL_WELLS_695_2022	ACTIVITY	
696	Gas Production at Gas Wells	GAS_PRODUCTION_696_2022	ACTIVITY	
697	Oil Production at Gas Wells	CONDENSATE_GAS_PRODUCTION_697_2022	ACTIVITY	
698	Well Count - Gas Wells	GAS_WELLS_698_2022	ACTIVITY	
699	Gas Production at CBM Wells	CBM_PRODUCTION_699_2022	ACTIVITY	
711	Airport Areas	airport_area	area	
801	Port Areas	Ports_2014NEI	area_sqmi	
850	Golf Courses	usa_golf_courses_2019_10	NONE	
860	Mines	usgs_mrds_active_mines	NONE	
861	Sand and Gravel Mines	usgs_mrds_active_mines	NONE	CAT='Gravel'
862	Lead Mines	usgs_mrds_active_mines	NONE	CAT='Lead'
863	Crushed Stone Mines	usgs_mrds_active_mines	NONE	CAT='Stone'
900	OSM Fuel	osm_fuel_points_us_mar2023	NONE	
901	OSM Asphalt Surfaces	osm_asphalt_surfaces_us_mar2023	NONE	
902	OSM Unpaved Roads	osm_unpaved_roads_us_mar2023	NONE	

The 'Data Shapefile' used for all of the U.S. surrogates except for those based on HPMS data is cb_2020_us_county_500k, while the HPMS-based surrogates use hpms2017_v3_04052020. Similarly, most surrogates use the GEOID as the Data attribute while the HPMS surrogates use FIPS. The gapfilling configuration for the surrogates is shown in Table 3-19. If there are no entries for a county for the primary surrogate, the values for the county from the secondary surrogate are used. If there are also no entries for the secondary surrogate, the values for the tertiary surrogate are used, with the quarternary surrogate being the final fallback. Typically, only surrogates that should have values for all counties are selected as the quarternary surrogate. This process is used to limit any emissions that could be dropped if there are emissions in the inventory in a county for which the primary surrogate does not have values. It is important to note that once gapfilling is performed, SMOKE does not know that emissions for that county were from a secondary, tertiary or quarternary surrogate and any reports will assign the emissions in gapfilled counties to the primary surrogate.

Table 3-19. Surrogates used to gapfill U.S. Surrogates

SURROGATE CODE	SURROGATE	SECONDARY SURROGATE	TERTIARY SURROGATE	QUARTERNARY SURROGATE
100	Population			
110	Housing	Population		
135	Detached Housing	NLCD Low Intensity Development		
136	Single and Dual Unit Housing	NLCD Low Intensity Development		
137	Single + Dual Unit + Manufactured Housing	NLCD Low Intensity Development	NLCD Land	
150	Residential Heating - Natural Gas	Population		
170	Residential Heating - Distillate Oil	Housing		
180	Residential Heating – Coal	Housing		
190	Residential Heating - LP Gas	Housing		
205	Extended Idle Locations	Total Road Miles		
239	Total Road AADT	Total Road Miles		
240	Total Road Miles			
242	All Restricted AADT	Total Road Miles		
244	All Unrestricted AADT	Total Road Miles		
259	Transit Bus Terminals	Population	NLCD Land	
260	Total Railroad Miles	Total Road Miles	Population	
261	NTAD Total Railroad Density	Total Railroad Miles	Total Road Miles	Population
271	NTAD Class 1 2 3 Railroad Density	NTAD Total Railroad Density	Total Railroad Miles	Total Road Miles
300	NLCD Low Intensity Development	Housing	Population	NLCD Land
304	NLCD Open + Low	Housing	Population	NLCD Land
305	NLCD Low + Med	Housing	Population	NLCD Land
306	NLCD Med + High	Housing	Population	NLCD Land
307	NLCD All Development	Housing	Population	NLCD Land
308	NLCD Low + Med + High	Housing	Population	NLCD Land
309	NLCD Open + Low + Med	Housing	Population	NLCD Land
310	NLCD Total Agriculture	NLCD Open + Low	NLCD Land	
318	NLCD Pasture Land	Housing	NLCD Land	
319	NLCD Crop Land	Housing	NLCD Land	
320	NLCD Forest Land	Housing	NLCD Land	
321	NLCD Recreational Land	Housing	NLCD Land	
340	NLCD Land			
350	NLCD Water			
401	FAO 2010 Cattle	NLCD Total Agriculture	NLCD Open + Low	
4011	FAO 2010 Large Cattle Operations	FAO 2010 Cattle	NLCD Total Agriculture	NLCD Open + Low
4012	NPDES 2020 Beef Cattle	FAO 2010 Cattle	NLCD Total Agriculture	NLCD Open + Low

SURROGATE CODE	SURROGATE	SECONDARY SURROGATE	TERTIARY SURROGATE	QUARTERNARY SURROGATE
4013	NPDES 2020 Dairy Cattle	FAO 2010 Large Cattle Operations	NLCD Total Agriculture	NLCD Open + Low
402	FAO 2010 Pig	NLCD Total Agriculture	NLCD Open + Low	
4021	NPDES 2020 Swine	FAO 2010 Pig	NLCD Total Agriculture	NLCD Open + Low
403	FAO 2010 Chicken	NLCD Total Agriculture	NLCD Open + Low	
4031	NPDES 2020 Chicken	FAO 2010 Chicken	NLCD Total Agriculture	NLCD Open + Low
404	FAO 2010 Goat	NLCD Total Agriculture	NLCD Open + Low	
4041	NPDES 2020 Goat	FAO 2010 Goat	NLCD Total Agriculture	NLCD Open + Low
405	FAO 2010 Horse	NLCD Total Agriculture	NLCD Open + Low	
406	FAO 2010 Sheep	NLCD Total Agriculture	NLCD Open + Low	
4071	NPDES 2020 Turkey	NLCD Total Agriculture	NLCD Open + Low	
508	Public Schools	Population	NLCD Land	
650	Refineries and Tank Farms	NLCD Low + Med	Population	NLCD Land
669	All Abandoned Wells	Well Count - All Wells	NLCD Open + Low	
6696	All Abandoned CBM Wells - Plugged	All Abandoned CBM Wells	Well Count - All Wells	NLCD Open + Low
6693	All Abandoned CBM Wells	Well Count - All Wells	NLCD Open + Low	
6695	All Abandoned Gas Wells - Plugged	All Abandoned Gas Wells	Well Count - All Wells	NLCD Open + Low
6692	All Abandoned Gas Wells	Well Count - All Wells	NLCD Open + Low	
6698	All Abandoned Gas Wells - Unplugged	All Abandoned Gas Wells	Well Count - All Wells	NLCD Open + Low
6694	All Abandoned Oil Wells - Plugged	All Abandoned Oil Wells	Well Count - All Wells	NLCD Open + Low
6691	All Abandoned Oil Wells	Well Count - All Wells	NLCD Open + Low	
6697	All Abandoned Oil Wells - Unplugged	All Abandoned Oil Wells	Well Count - All Wells	NLCD Open + Low
670	Spud Count - CBM Wells	Spud Count - All Wells	Well Count - All Wells	
671	Spud Count - Gas Wells	Well Count - Gas Wells	Well Count - All Wells	
672	Gas Production at Oil Wells	NLCD Open + Low	Well Count - Oil Wells	Well Count - All Wells
673	Oil Production at CBM Wells	Well Count - CBM Wells	Well Count - All Wells	NLCD Open + Low
674	Unconventional Well Completion Counts	Completions at All Wells	Well Count - All Wells	NLCD Open + Low
676	Well Count - All Producing	Well Count - All Wells	NLCD Open + Low	
677	Well Count - All Exploratory	Well Count - All Wells	NLCD Open + Low	
678	Completions at Gas Wells	Spud Count - All Wells	Well Count - All Wells	NLCD Open + Low
679	Completions at CBM Wells	Spud Count - All Wells	Well Count - All Wells	NLCD Open + Low
681	Spud Count - Oil Wells	Well Count - Oil Wells	Well Count - All Wells	NLCD Open + Low

SURROGATE CODE	SURROGATE	SECONDARY SURROGATE	TERTIARY SURROGATE	QUARTERNARY SURROGATE
683	Produced Water at All Wells	Completions at All Wells	Well Count - All Wells	NLCD Open + Low
6831	Produced Water at CBM Wells	Well Counts - CBM Wells	Well Count - All Wells	NLCD Open + Low
6832	Produced Water at Gas Wells	Well Count - Gas Wells	Well Count - All Wells	NLCD Open + Low
6833	Produced Water at Oil Wells	Well Count - Oil Wells	Well Count - All Wells	NLCD Open + Low
685	Completions at Oil Wells	Spud Count - All Wells	Well Count - All Wells	NLCD Open + Low
686	Completions at All Wells	Well Count - All Exploratory	Well Count - All Wells	NLCD Open + Low
687	Feet Drilled at All Wells	Well Count - All Exploratory	Well Count - All Wells	NLCD Open + Low
689	Gas Produced - Total	Well Count - All Wells	NLCD Open + Low	
691	Well Counts - CBM Wells	Completions at CBM Wells	Well Count - All Wells	NLCD Open + Low
692	Spud Count - All Wells	Completions at All Wells	Well Count - All Wells	NLCD Open + Low
693	Well Count - All Wells	NLCD Open + Low		
694	Oil Production at Oil Wells	Completions at Oil Wells	Well Count - All Wells	NLCD Open + Low
695	Well Count - Oil Wells	Completions at Oil Wells	Well Count - All Wells	NLCD Open + Low
696	Gas Production at Gas Wells	Completions at Gas Wells	Well Count - All Wells	NLCD Open + Low
697	Oil Production at Gas Wells	Well Count - Gas Wells	Well Count - All Wells	NLCD Open + Low
698	Well Count - Gas Wells	Completions at Gas Wells	Well Count - All Wells	NLCD Open + Low
699	Gas Production at CBM Wells	Well Counts - CBM Wells	Well Count - All Wells	NLCD Open + Low
711	Airport Areas	Population	NLCD Land	
801	Port Areas	NLCD Water		
850	Golf Courses	Housing	Population	NLCD Land
860	Mines	NLCD Open + Low	NLCD Land	
861	Sand and Gravel Mines	Mines	NLCD Open + Low	NLCD Land
862	Lead Mines	Mines	NLCD Open + Low	NLCD Land
863	Crushed Stone Mines	Mines	NLCD Open + Low	NLCD Land
900	OSM Fuel	Total Road AADT	Total Road Miles	
901	OSM Asphalt Surfaces	NLCD All Development		
902	OSM Unpaved Roads	NLCD Open + Low		

For the onroad sector, the on-network (RPD) emissions were spatially allocated differently from other off-network processes (i.e., RPV, RPP, RPHO, RPS, RPH). Surrogates for on-network processes are based on AADT data and off network processes (including the off-network idling included in RPHO) are based on land use surrogates as shown in Table 3-20. Emissions from the extended (i.e., overnight) idling of trucks were assigned to surrogate 205, which is based on locations of overnight truck parking spaces.

The underlying data for this surrogate were updated during the development of the various 2016 platforms to include additional data sources and corrections based on comments received and these updates were carried into this platform.

Table 3-20. Off-Network Mobile Source Surrogates

Source type	Source Type name	Surrogate ID	Description
11	Motorcycle	307	NLCD All Development
21	Passenger Car	307	NLCD All Development
31	Passenger Truck	307	NLCD All Development
32	Light Commercial Truck	308	NLCD Low + Med + High
41	Other Bus	306	NLCD Med + High
42	Transit Bus	259	Transit Bus Terminals
43	School Bus	508	Public Schools
51	Refuse Truck	306	NLCD Med + High
52	Single Unit Short-haul Truck	306	NLCD Med + High
53	Single Unit Long-haul Truck	306	NLCD Med + High
54	Motor Home	304	NLCD Open + Low
61	Combination Short-haul Truck	306	NLCD Med + High
62	Combination Long-haul Truck	306	NLCD Med + High

For the oil and gas sources in the np_oilgas sector, the spatial surrogates were updated to those shown in Table 3-21 using 2022 data consistent with what was used to develop the nonpoint oil and gas emissions. The exploration and production of oil and gas have generally increased in terms of quantities and locations over recent years, primarily due to the use of new technologies, such as hydraulic fracturing. Census-tract, 2-km, and 4-km sub-county Shapefiles were developed, from which the 2020 oil and gas surrogates were generated. All spatial surrogates for np_oilgas are developed based on known locations of oil and gas activity for year 2022.

The primary activity data source used for the development of the oil and gas spatial surrogates was data from ENVERUS [formerly Drilling Info (DI) Desktop's HPDI] database (ENVERUS, 2023). This database contains well-level location, production, and exploration statistics at the monthly level. Due to a proprietary agreement with ENVERUS, individual well locations and ancillary production cannot be made publicly available, but aggregated statistics are allowed. These data were supplemented with data from state Oil and Gas Commission (OGC) websites (Alaska, Arizona, Idaho, Illinois, Indiana, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Nevada, Oregon, Pennsylvania, and Tennessee). In cases when the desired surrogate parameter was not available (e.g., feet drilled), data for an alternative surrogate parameter (e.g., number of spudded wells) were downloaded and used. Under that methodology, both completion date and date of first production from HPDI were used to identify wells completed during 2022. The spatial surrogates were gapfilled using fallback surrogates as shown in Table 3-19. All gapfilling was performed with the Surrogate Tool.

Table 3-21. Spatial Surrogates for Oil and Gas Sources

Surrogate Code	Surrogate Description
669	*All Abandoned Wells*

Surrogate Code	Surrogate Description
6691	*All Abandoned Oil Wells*
6692	*All Abandoned Gas Wells*
6693	*All Abandoned CBM Wells*
6694	All Abandoned Oil Wells – Plugged
6695	All Abandoned Gas Wells – Plugged
6696	*All Abandoned CBM Wells – Plugged*
6697	All Abandoned Oil Wells – Unplugged
6698	All Abandoned Gas Wells – Unplugged
670	Spud Count - CBM Wells
671	Spud Count - Gas Wells
672	Gas Production at Oil Wells
673	Oil Production at CBM Wells
674	Unconventional Well Completion Counts
676	Well Count - All Producing
677	Well Count - All Exploratory
678	Completions at Gas Wells
679	Completions at CBM Wells
681	Spud Count - Oil Wells
683	Produced Water at All Wells
685	Completions at Oil Wells
686	Completions at All Wells
687	Feet Drilled at All Wells
689	Gas Produced – Total
691	Well Counts - CBM Wells
692	Spud Count - All Wells
693	Well Count - All Wells
694	Oil Production at Oil Wells
695	Well Count - Oil Wells
696	Gas Production at Gas Wells
697	Oil Production at Gas Wells
698	Well Count - Gas Wells
699	Gas Production at CBM Wells
6831	Produced water at CBM wells
6832	Produced water at gas wells
6833	Produced water at oil wells

Table 3-22 shows the CAP emissions (i.e., NH_3, NOx, $PM_{2.5}$, SO_2, and VOC) by sector assigned to each spatial surrogate.

Table 3-22. Selected 2022 CAP emissions by sector for U.S. Surrogates (short tons in 12US1)

Sector	ID	Description	NH3	NOX	PM2_5	SO2	VOC
afdust	240	Total Road Miles	0	0	305,537	0	0
afdust	306	NLCD Med + High	0	0	41,167	0	0
afdust	308	NLCD Low + Med + High	0	0	122,726	0	0
afdust	310	NLCD Total Agriculture	0	0	502,702	0	0
afdust	861	Sand and Gravel Mines	0	0	271	0	0
afdust	863	Crushed Stone Mines	0	0	291	0	0
afdust	902	OSM Unpaved Roads	0	0	852,397	0	0
afdust	4012	NPDES 2020 Beef Cattle	0	0	185,956	0	0
afdust	4013	NPDES 2020 Dairy Cattle	0	0	12,408	0	0
afdust	4021	NPDES 2020 Swine	0	0	630	0	0
afdust	4031	NPDES 2020 Chicken	0	0	4,948	0	0
afdust	4071	NPDES 2020 Turkey	0	0	1,948	0	0
fertilizer	310	NLCD Total Agriculture	1,671,401	0	0	0	0
livestock	405	FAO 2010 Horse	31,973	0	0	0	2,558
livestock	406	FAO 2010 Sheep	18,425	0	0	0	1,474
livestock	4012	NPDES 2020 Beef Cattle	775,290	0	0	0	62,023
livestock	4013	NPDES 2020 Dairy Cattle	350,829	0	0	0	28,066
livestock	4021	NPDES 2020 Swine	839,869	0	0	0	67,190
livestock	4031	NPDES 2020 Chicken	473,844	0	0	0	37,908
livestock	4041	NPDES 2020 Goat	17,609	0	0	0	1,409
livestock	4071	NPDES 2020 Turkey	82,538	0	0	0	6,603
nonpt	100	Population	454	0	0	0	36
nonpt	150	Residential Heating - Natural Gas	47,317	228,596	2,638	1,522	13,491
nonpt	170	Residential Heating - Distillate Oil	1,718	29,360	3,626	738	1,246
nonpt	180	Residential Heating - Coal	0	2	1	7	2
nonpt	190	Residential Heating - LP Gas	136	39,187	156	175	1,539
nonpt	239	Total Road AADT	0	0	0	0	6,536
nonpt	244	All Unrestricted AADT	0	0	0	0	98,151
nonpt	271	NTAD Class 1 2 3 Railroad Density	0	0	0	0	2,074
nonpt	300	NLCD Low Intensity Development	155	2,315	12,856	180	21,920
nonpt	306	NLCD Med + High	17,744	245,613	372,811	66,676	131,535
nonpt	307	NLCD All Development	0	0	0	0	19
nonpt	308	NLCD Low + Med + High	1,066	176,213	18,723	5,179	10,910
nonpt	310	NLCD Total Agriculture	517	311	504	31	440
nonpt	319	NLCD Crop Land	0	0	95	70	292
nonpt	320	NLCD Forest Land	0	11	31	0	44
nonpt	650	Refineries and Tank Farms	0	0	0	0	98,366
nonpt	711	Airport Areas	0	0	0	0	414
nonpt	801	Port Areas	0	0	0	0	2,351
nonpt	900	OSM Fuel	0	0	0	0	221,575
nonpt	4011	FAO 2010 Large Cattle Operations	0	0	0	0	295,993
nonroad	136	Single and Dual Unit Housing	100	14,634	2,946	38	90,886

Sector	ID	Description	NH3	NOX	PM2_5	SO2	VOC
nonroad	261	NTAD Total Railroad Density	3	1,484	146	1	314
nonroad	304	NLCD Open + Low	6	1,580	140	4	5,554
nonroad	305	NLCD Low + Med	5	869	1,028	2	21,946
nonroad	306	NLCD Med + High	387	155,659	8,689	256	99,729
nonroad	307	NLCD All Development	113	28,711	16,198	44	185,409
nonroad	308	NLCD Low + Med + High	597	202,020	16,431	231	41,323
nonroad	309	NLCD Open + Low + Med	134	21,959	1,310	51	50,916
nonroad	310	NLCD Total Agriculture	355	214,932	14,943	158	23,324
nonroad	320	NLCD Forest Land	15	1,614	379	7	3,423
nonroad	321	NLCD Recreational Land	79	13,629	4,747	28	173,733
nonroad	350	NLCD Water	203	111,936	3,865	95	220,708
nonroad	850	Golf Courses	13	2,143	123	5	6,017
nonroad	860	Mines	2	2,316	210	1	423
np_oilgas	670	Spud Count - CBM Wells	0	0	0	0	43
np_oilgas	671	Spud Count - Gas Wells	0	0	0	0	2,275
np_oilgas	674	Unconventional Well Completion Counts	51	41,657	742	19	1,877
np_oilgas	678	Completions at Gas Wells	0	6,122	130	1,773	14,674
np_oilgas	679	Completions at CBM Wells	0	5	0	750	694
np_oilgas	681	Spud Count - Oil Wells	0	0	0	0	28,651
np_oilgas	683	Produced Water at All Wells	0	0	0	0	48
np_oilgas	685	Completions at Oil Wells	0	384	0	2,218	33,301
np_oilgas	687	Feet Drilled at All Wells	0	79,175	1,823	47	2,881
np_oilgas	689	Gas Produced - Total	0	232	26	2	58,012
np_oilgas	691	Well Counts - CBM Wells	0	19,717	469	10	15,442
np_oilgas	692	Spud Count - All Wells	0	15	1	1	1
np_oilgas	694	Oil Production at Oil Wells	0	3,428	0	31,148	801,395
np_oilgas	695	Well Count - Oil Wells	0	170,141	4,207	243,928	668,363
np_oilgas	696	Gas Production at Gas Wells	0	2,738	0	0	422,743
np_oilgas	698	Well Count - Gas Wells	3,771	352,214	4,846	142	471,083
np_oilgas	699	Gas Production at CBM Wells	0	32	4	0	3,816
np_oilgas	6694	All Abandoned Oil Wells - Plugged	0	0	0	0	115
np_oilgas	6695	All Abandoned Gas Wells - Plugged	0	0	0	0	64
np_oilgas	6697	All Abandoned Oil Wells - Unplugged	0	0	0	0	166,197
np_oilgas	6698	All Abandoned Gas Wells - Unplugged	0	0	0	0	14,255
np_oilgas	6831	Produced water at CBM wells	0	0	0	0	1,024
np_oilgas	6832	Produced water at gas wells	0	340	0	0	10,113
np_oilgas	6833	Produced water at oil wells	0	0	0	0	68,474
np_solvents	100	Population	0	0	0	0	1,376,197
np_solvents	240	Total Road Miles	0	0	0	0	43,466
np_solvents	306	NLCD Med + High	0	0	0	0	391,245
np_solvents	307	NLCD All Development	0	0	0	0	235,011
np_solvents	308	NLCD Low + Med + High	0	0	0	0	31,056
np_solvents	310	NLCD Total Agriculture	0	0	0	0	173,739

Sector	ID	Description	NH3	NOX	PM2_5	SO2	VOC
np_solvents	901	OSM Asphalt Surface	0	0	0	0	339,778
onroad	205	Extended Idle Locations	0	33,669	265	17	2,724
onroad	242	All Restricted AADT	58,506	724,836	18,562	2,918	110,498
onroad	244	All Unrestricted AADT	119,030	1,031,723	41,897	5,264	301,493
onroad	259	Transit Bus Terminals	20	1,458	30	1	468
onroad	304	NLCD Open + Low	0	467	13	0	2,532
onroad	306	NLCD Med + High	1,217	97,909	2,136	75	22,427
onroad	307	NLCD All Development	5,938	157,433	6,858	444	515,072
onroad	308	NLCD Low + Med + High	292	16,565	482	27	26,500
onroad	508	Public Schools	19	1,984	59	1	392
openburn	135	Detached Housing	0	16,359	81,108	2,724	18,946
openburn	300	NLCD Low Intensity Development	2,704	1,113	4,159	226	4,514
openburn	307	NLCD All Development	76,463	28,172	126,918	10,917	81,324
rail	261	NTAD Total Railroad Density	16	26,427	763	18	1,249
rail	271	NTAD Class 1 2 3 Railroad Density	287	430,178	10,685	324	17,539
rwc	135	Detached Housing	6,875	9,428	135,997	3,348	126,771
rwc	137	Single + Dual Unit + Manufactured Housing	15,722	35,166	312,817	8,545	324,110

3.4.2 Allocation method for airport-related sources in the U.S.

There are numerous airport-related emission sources in the NEI, such as aircraft, airport ground support equipment, and jet refueling. The modeling platform includes the aircraft and airport ground support equipment emissions as point sources. For the modeling platform, the EPA used the SMOKE "area-to-point" approach for only jet refueling in the nonpt sector. The following SCCs use this approach: 2501080050 and 2501080100 (petroleum storage at airports), and 2810040000 (aircraft/rocket engine firing and testing). The ARTOPNT file that lists the nonpoint sources to locate using point data was unchanged from the 2005-based platform.

3.4.3 Surrogates for Canada and Mexico emission inventories

The surrogates for Canada to spatially allocate the Canadian emissions are based on the 2020 Canadian inventories and associated data. The spatial surrogate data came from ECCC, along with cross references. The shapefiles they provided were used in the Surrogate Tool (previously referenced) to create spatial surrogates. The Canadian surrogates used for this platform are listed in Table 3-23. The Shapefiles used to compute these surrogates and some configuration information are shown in Table 3-24. Note that the name of most Data Shapefiles have been abbreviated to shorten the table. The complete names and additional details on surrogate computation for Canada and Mexico are available in the file *Surrogate_specifications_2022_platform_US_Can_Mex.xlsx* that is posted in the reports folder for this platform.

Mexico surrogates were updated for the 2021 EMP. The data source for the Mexico population surrogate is the INEGI National Geostatistical Framework's Censo de Población y Vivienda 2020 based on the 2020 GPW v4 (see https://en.www.inegi.org.mx/app/biblioteca/ficha.html?upc=889463807469). Other data sources used are Sistema Nacional de Informacion Estadistic y Geografica (SNIEG), US Department of Transportation's (DOT) North American Rail Network Lines, and US DOT's Bureau of

Transportation Statistics Border Crossing Data. The Shapefiles and some configuration information used to develop the Mexico surrogates are shown in Table 3-25. The Data Shapefile for all Mexico surrogates is areas_geoestadisticas_municipales_II and the Data Attribute is FIPS. Most of the CAP emissions allocated to the Mexico and Canada surrogates are shown in Table 3-26.

Table 3-23. Canadian Spatial Surrogates

Code	Canadian Surrogate Description	Code	Description
100	Population	925	Manufacturing and Assembly
101	total dwelling	926	Distribution and Retail (no petroleum)
102	*urban dwelling*	927	Commercial Services
103	*rural dwelling*	933	Rail-Passenger
104	capped total dwelling	934	Rail-Freight
105	*capped meat cooking dwelling*	935	Rail-Yard
106	ALL_INDUST	940	PAVED ROADS NEW
113	Forestry and logging	*945*	*Commercial Marine Vessels*
116	*Total Resources*	946	Construction and mining
200	Urban Primary Road Miles	*948*	*Forest*
210	Rural Primary Road Miles	*949*	*Combination of Dwelling*
211	*Oil and Gas Extraction*	951	Wood Consumption Percentage
212	Mining except oil and gas	*952*	*Residential Fuel Wood Combustion (PIRD)*
220	Urban Secondary Road Miles	955	UNPAVED_ROADS_AND_TRAILS
221	Total Mining	*960*	*TOTBEEF*
222	Utilities	961	80110_Broilers
230	Rural Secondary Road Miles	962	80111_Cattle_dairy_and_Heifer
233	*Total Land Development*	963	80112_Cattle_non-Dairy
240	capped population	964	80113_Laying_hens_and_Pullets
308	Food manufacturing	965	80114_Horses
321	Wood product manufacturing	966	80115_Sheep_and_Lamb
323	Printing and related support activities	967	80116_Swine
324	Petroleum and coal products manufacturing	968	80117_Turkeys
326	Plastics and rubber products manufacturing	969	80118_Goat
327	Non-metallic mineral product manufacturing	*970*	*TOTPOUL*
331	Primary Metal Manufacturing	971	80119_Buffalo
340	*Construction - Oil and Gas*	972	80120_Llama_and_Alpacas
350	*Water*	973	80121_Deer
412	Petroleum product wholesaler-distributors	974	80122_Elk
448	clothing and clothing accessories stores	975	80123_Wild boars
562	Waste management and remediation services	976	80124_Rabbit
601	SCL:12003 Petroleum Liquids Transportation (PIRD)	977	80125_Mink

Code	Canadian Surrogate Description	Code	Description
602	SCL:12007 Oil Sands In-Situ Extraction and Processing (PIRD)	978	80126_Fox
603	SCL:12010 Light Medium Crude Oil Production (PIRD)	*980*	*TOTSWIN*
604	SCL:12011 Well Drilling (PIRD)	981	Harvest_Annual
605	SCL:12012 Well Servicing (PIRD)	*982*	*Harvest_Perennial*
606	SCL:12013 Well Testing (PIRD)	983	Synthfert_Annual
607	SCL:12014 Natural Gas Production (PIRD)	*984*	*Synthfert_Perennial*
608	SCL:12015 Natural Gas Processing (PIRD)	985	Tillage_Annual
609	*SCL:12016 Heavy Crude Oil Cold Production (PIRD)*	*990*	*TOTFERT*
610	*SCL:12018 Disposal and Waste Treatment (PIRD)*	996	urban_area
611	SCL:12019 Accidents and Equipment Failures (PIRD)	1251	OFFR_TOTFERT
612	SCL:12020 Natural Gas Transmission and Storage (PIRD)	1252	OFFR_MINES
651	*MEIT C1C2 Anchored*	1253	OFFR Other Construction not Urban
652	*MEIT C1C2 Underway*	1254	OFFR Commercial Services
653	*MEIT C1C2 Berthed*	1255	OFFR Oil Sands Mines
661	*MEIT C3 Anchored*	1256	OFFR Wood industries CANVEC
662	*MEIT C3 Underway*	1257	OFFR UNPAVED ROADS RURAL
663	*MEIT C3 Berthed*	1258	OFFR_Utilities
901	AIRPORT	1259	OFFR total dwelling
902	*Military LTO*	1260	OFFR_water
903	*Commercial LTO*	1261	OFFR_ALL_INDUST
904	*General Aviation LTO*	1262	OFFR Oil and Gas Extraction
905	*Air Taxi LTO*	1263	OFFR_ALLROADS
921	Commercial Fuel Combustion	*1264*	*OFFR_AIRPORT*
923	TOTAL INSTITUTIONAL AND GOVERNEMNT	1265	OFFR_RAILWAY
924	Primary Industry		

Table 3-24. Shapefiles and Attributes used to Compute Canadian Spatial Surrogates

Code	Surrogate	Data Shapefile	Data Attribute	Weight Shapefile	Weight Attribute
100	Population	gpr_gda	pruid	da_popdwell_100m_nolakes_1nov17	Pop
101	total dwelling	gpr_gda	pruid	da_popdwell_100m_nolakes_1nov17	Urdwell
102	urban dwelling	gpr_gda	pruid	da_popdwell_100m_nolakes_1nov17	Uadwell
103	rural dwelling	gpr_gda	pruid	da_popdwell_100m_nolakes_1nov17	Radwell
104	capped total dwelling	gpr_gda	pruid	da_popdwell_100m_nolakes_1nov17	CAP_URDWEL

Code	Surrogate	Data Shapefile	Data Attribute	Weight Shapefile	Weight Attribute
105	capped meat cooking dwelling	gpr	pruid	da_SimP_100m_pop_dwell_jul2014	Cap_Dwell
106	ALL_INDUST	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	ALL_INDUST
111	Farms	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	FARMS
113	Forestry and logging	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	FORLOG
116	Total Resources	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	TOTRESOURC
1251	OFFR_TOTFERT	gcd	CDID	naesi_fert	TOTFERT
1252	OFFR_MINES	gcd	CDID	mine	MINES
1253	OFFR Other Construction not Urban	gcd	CDID	construction_other	TOTAL
1254	OFFR Commercial Services	gcd	CDID	da2006_pop_labour_SimP_MaxOff_100m_noLake	COMSER
1255	OFFR Oil Sands Mines	gcd	CDID	OS_MinePit_D_v2	
1256	OFFR Wood industries CANVEC	gcd	CDID	wood_industries	WOOD
1257	OFFR UNPAVED ROADS RURAL	gcd	CDID	unpaved_ur	
1258	OFFR_Utilities	gcd	CDID	da2006_pop_labour_SimP_MaxOff_100m_noLake	UTILITIES
1259	OFFR total dwelling	gcd	CDID	da2006_pop_labour_SimP_MaxOff_100m_noLake	DATDWELL20
1260	OFFR_water	gcd	CDID	lu100_valid	
1261	OFFR_ALL_INDUST	gcd	CDID	da2006_pop_labour_SimP_MaxOff_100m_noLake	ALL_INDUST
1262	OFFR Oil and Gas Extraction	gcd	CDID	da2006_pop_labour_SimP_MaxOff_100m_noLake	OILGASEXTR
1263	OFFR_ALLROADS	gcd	CDID	allroads	
1264	OFFR_AIRPORT	gcd	CDID	offroad_osm_airport_locs_spring2017	Movements
1265	OFFR_RAILWAY	gcd	CDID	shp_railway_canvec_jul17_v2	LENGTH
200	Urban Primary Road Miles	gcd_ON4	CDID	NRN_CA_Simp2_16Apr2016_sphere	Class1
210	Rural Primary Road Miles	gcd_ON4	CDID	NRN_CA_Simp2_16Apr2016_sphere	Class2
211	Oil and Gas Extraction	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	OILGASEXTR
212	Mining except oil and gas	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	MINING2
215	Oil Sands Mines	prov2006	pruid	OS_MinePit_D_v2	
216	Oil Sands Tailing Ponds	prov2006	pruid	OS_WetTailing_D_2015	
217	Oil Sands Plants	prov2006	Pruid	OS_PlantSite_D_2015	
220	Urban Secondary Road Miles	gcd_ON4	CDID	NRN_CA_Simp2_16Apr2016_sphere	Class3
221	Total Mining	prov2006	Pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	TOTALMI3
222	Utilities	prov2006	Pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	UTILITIES

Code	Surrogate	Data Shapefile	Data Attribute	Weight Shapefile	Weight Attribute
230	Rural Secondary Road Miles	gcd_ON4	CDID	NRN_CA_Simp2_16Apr2016_sphere	Class4
233	Total Land Development	prov2006	Pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	TOTLND
240	capped population	gcd_ON4	CDID	da_popdwell_100m_nolakes_1nov17	CAPURPOP
308	Food manufacturing	prov2006	Pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	FOODMANU
321	Wood product manufacturing	prov2006	Pruid	da2006_SimplifyP_250m_sphere_treesa_Clip	WOODMANU
323	Printing and related support activities	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	PRINTSUPRT
324	Petroleum and coal products manufacturing	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	PETCOLMANU
326	Plastics and rubber products manufacturing	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	PLASTCMANU
327	Non-metallic mineral product manufacturing	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	MINERLMANU
331	Primary Metal Manufacturing	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	METALMANU
340	Construction - Oil and Gas	gpr_gda	pruid	loc_land_UOG2015_CO_v3_Que_NB_NS	
350	Water	coast	pruid	CONT42_pop_water_Clip_b	Pop
412	Petroleum product wholesaler-distributors	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	PETPRWSL
416	Building material and supplies wholesaler-distributors	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	BUILDPRWSL
447	Gasoline stations	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	GASSTOR
448	clothing and clothing accessories stores	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	CLOTHSTOR
482	Rail transportation	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	RAILTRANS
562	Waste management and remediation services	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	WASTEMGMT
901	AIRPORT	gcd	CDID	offroad_osm_airport_locs_spring2017	Movements
902	Military LTO	surg_2017	FAKEFIPS	aviation_runways_spring2017	Military
903	Commercial LTO	surg_2017	FAKEFIPS	aviation_runways_spring2017	Commercial
904	General Aviation LTO	surg_2017	FAKEFIPS	aviation_runways_spring2017	General_Av
905	Air Taxi LTO	prov2006	pruid	Airport_movements_2006_MultiRingBuffer	SCC2275060
921	Commercial Fuel Combustion	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	COMFUEL
923	TOTAL INSTITUTIONAL AND GOVERNEMNT	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	TOTINSTGOV
924	Primary Industry	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	PRIM1

Code	Surrogate	Data Shapefile	Data Attribute	Weight Shapefile	Weight Attribute
925	Manufacturing and Assembly	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	MANASSEM
926	Distribution and Retail (no petroleum)	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	DISRET
927	Commercial Services	prov2006	pruid	da2006_pop_labour_SimP_MaxOff_100m_noLake	COMSER
933	Rail-Passenger	gpr_gda	pruid	shp_railway_canvec_jul17_v2	Passenger
934	Rail-Freight	gpr_gda	pruid	shp_railway_canvec_jul17_v2	Fret
935	Rail-Yard	gpr_gda	pruid	shp_railway_canvec_jul17_v2	Yard
940	PAVED ROADS NEW	gpr	fips	NRN_CA_Simp2_16Apr2016_sphere	PAVEDRD
942	UNPAVED ROADS	prov2006	pruid	unpaved4	
945	Commercial Marine Vessels	lowmedjet_ll	CLASS	marine	SO2
946	Construction and mining			MERGE: 0.5*Mining except oil and gas+0.5*Total Land Development	
947	Agriculture Construction and mining			MERGE 0.34*Total Resources + 0.66 * Construction and mining	
948	Forest	prov2006	pruid	treesa_valid	
949	Combination of Dwelling			MERGE: 0.20*urban dwelling+0.80* rural dwelling	
951	Wood Consumption Percentage	gpr	fips	da2006_SimP_100m_WoodCon_1Aug14	WoodComp
955	UNPAVED_ROADS_AND_TRAILS	prov2006	pruid	unpaved5	
960	TOTBEEF	prov2006	pruid	naesi_livestk	TOTBEEF
970	TOTPOUL	prov2006	pruid	naesi_livestk	TOTPOULT
980	TOTSWIN	prov2006	pruid	naesi_livestk	TOTSWINE
990	TOTFERT	prov2006	pruid	naesi_fert	TOTFERT
996	urban_area	prov2006	pruid	ua2001	
961	80110_Broilers	gpr_gda	pruid	animal_nh3_to_agri_slc_80110_valid	QUANTITY
962	80111_Cattle_dairy_and_Heifer	gpr_gda	pruid	animal_nh3_to_agri_slc_80111_valid	QUANTITY
963	80112_Cattle_non-Dairy	gpr_gda	pruid	animal_nh3_to_agri_slc_80112_valid	QUANTITY
964	80113_Laying_hens_and_Pullets	gpr_gda	pruid	animal_nh3_to_agri_slc_80113_valid	QUANTITY
965	80114_Horses	gpr_gda	pruid	animal_nh3_to_agri_slc_80114_valid	QUANTITY
966	80115_Sheep_and_Lamb	gpr_gda	pruid	animal_nh3_to_agri_slc_80115_valid	QUANTITY
967	80116_Swine	gpr_gda	pruid	animal_nh3_to_agri_slc_80116_valid	QUANTITY

Code	Surrogate	Data Shapefile	Data Attribute	Weight Shapefile	Weight Attribute
968	80117_Turkeys	gpr_gda	pruid	animal_nh3_to_agri_slc_80117_valid	QUANTITY
969	80118_Goat	gpr_gda	pruid	animal_nh3_to_agri_slc_80118_valid	QUANTITY
971	80119_Buffalo	gpr_gda	pruid	animal_nh3_to_agri_slc_80119_valid	QUANTITY
972	80120_Llama_and_Alpacas	gpr_gda	pruid	animal_nh3_to_agri_slc_80120_valid	QUANTITY
973	80121_Deer	gpr_gda	pruid	animal_nh3_to_agri_slc_80121_valid	QUANTITY
974	80122_Elk	gpr_gda	pruid	animal_nh3_to_agri_slc_80122_valid	QUANTITY
975	80123_Wild boars	gpr_gda	pruid	animal_nh3_to_agri_slc_80123_valid	QUANTITY
976	80124_Rabbit	gpr_gda	pruid	animal_nh3_to_agri_slc_80124_valid	QUANTITY
977	80125_Mink	gpr_gda	pruid	animal_nh3_to_agri_slc_80125_valid	QUANTITY
978	80126_Fox	gpr_gda	pruid	animal_nh3_to_agri_slc_80126_valid	QUANTITY
979	80127_Mules_and_Asses	gpr_gda	pruid	animal_nh3_to_agri_slc_80127_valid	QUANTITY
981	Harvest_Annual	gpr_gda	pruid	harvest_pm10_Annual_to_agri_slc_valid	QUANTITY
982	Harvest_Perennial	gpr_gda	pruid	harvest_pm10_Perennial_to_agri_slc_valid	QUANTITY
983	Synthfert_Annual	gpr_gda	pruid	synth_fert_nh3_Annual_to_agri_slc_valid	QUANTITY
984	Synthfert_Perennial	gpr_gda	pruid	synth_fert_nh3_Perennial_to_agri_slc_valid	QUANTITY
985	Tillage_Annual	gpr_gda	pruid	tillage_pm10_Annual_to_agri_slc_valid	QUANTITY
601	SCL:12003 Petroleum Liquids Transportation (PIRD)	gpr_gda	pruid	scl12003_valid	
602	SCL:12007 Oil Sands In-Situ Extraction and Processing (PIRD)	gpr_gda	pruid	scl12007_valid	NONE
603	SCL:12010 Light Medium Crude Oil Production (PIRD)	gpr_gda	pruid	scl12010_valid	NONE
604	SCL:12011 Well Drilling (PIRD)	gpr_gda	pruid	scl12011_valid	NONE
605	SCL:12012 Well Servicing (PIRD)	gpr_gda	pruid	scl12012_valid	NONE
606	SCL:12013 Well Testing (PIRD)	gpr_gda	pruid	scl12013_valid	NONE
607	SCL:12014 Natural Gas Production (PIRD)	gpr_gda	pruid	scl12014_valid	NONE
608	SCL:12015 Natural Gas Processing (PIRD)	gpr_gda	pruid	scl12015_valid	NONE
609	SCL:12016 Heavy Crude Oil Cold Production (PIRD)	gpr_gda	pruid	scl12016_valid	NONE
610	SCL:12018 Disposal and Waste Treatment (PIRD)	gpr_gda	pruid	scl12018_valid	NONE

Code	Surrogate	Data Shapefile	Data Attribute	Weight Shapefile	Weight Attribute
611	SCL:12019 Accidents and Equipment Failures (PIRD)	gpr_gda	pruid	scl12019_valid	NONE
612	SCL:12020 Natural Gas Transmission and Storage (PIRD)	gpr_gda	pruid	scl12020	NONE
952	Residential Fuel Wood Combustion (PIRD)	gpr_gda	pruid	scl20401_valid	NONE
651	MEIT C1C2 Anchored	lowmedjet_ll	CLASS	MEIT_2280002101_2018	Fuel
652	MEIT C1C2 Underway	lowmedjet_ll	CLASS	MEIT_2280002202_2018	Fuel
653	MEIT C1C2 Berthed	lowmedjet_ll	CLASS	MEIT_2280002301_2018	Fuel
661	MEIT C3 Anchored	lowmedjet_ll	CLASS	MEIT_2280003101_2018	Fuel
662	MEIT C3 Underway	lowmedjet_ll	CLASS	MEIT_2280003200_2018	Fuel
663	MEIT C3 Berthed	lowmedjet_ll	CLASS	MEIT_2280003301_2018	Fuel

Table 3-25. Shapefiles and Attributes used to Compute Mexican Spatial Surrogates

Code	SURROGATE	WEIGHT SHAPEFILE	WEIGHT ATTRIBUTE
10	MEX Population	mex_population_2020	gridcode_Y
22	MEX Total Road Miles	mex_roads	NONE
24	MEX Total Railroads Miles	mex_railroads	NONE
26	MEX Total Agriculture	mex_agriculture	NONE
36	MEX Commercial plus Industrial Land	mex_com_ind_land	NONE
44	MEX Airports Area	mex_airports_area	NONE
45	MEX Airports Point	mex_airports_point	NONE
48	MEX Brick Kilns	mex_brick_kilns	NONE
50	MEX Border Crossings	mex_border_crossings	SUM_Value

Table 3-26. 2022 CAP Emissions Allocated to Mexican and Canadian Spatial Surrogates for 12US1 (short tons)

Code	Mexican or Canadian Surrogate Description	NH_3	NO_X	$PM_{2.5}$	SO_2	VOC
11	MEX Population	26,149	93,951	8,245	7,833	178,980
22	MEX Total Road Miles	2,887	310,214	14,588	6,483	76,211
24	MEX Total Railroads Miles	0	22,455	498	198	900
26	MEX Total Agriculture	137,457	11,648	13,703	13,570	2,370
36	MEX Commercial plus Industrial Land	44	5,532	2,531	26	295,777
44	MEX Airports Area	0	2,955	61	315	1,832
48	MEX Brick Kilns	0	227	3,692	151	182
50	MEX Mobile sources - Border Crossing	4	86	3	0	65
100	CAN Population	710	57	225	17	4,025
101	CAN total dwelling	0	0	0	0	109,016
104	CAN Capped Total Dwelling	305	31,578	2,383	1,928	1,620
106	CAN ALL_INDUST			596		

Code	Mexican or Canadian Surrogate Description	NH_3	NO_X	$PM_{2.5}$	SO_2	VOC
113	CAN Forestry and logging	83	627	2,934	15	2,715
200	CAN Urban Primary Road Miles	1,590	75,668	2,697	209	7,406
210	CAN Rural Primary Road Miles	608	40,578	1,422	89	2,995
212	CAN Mining except oil and gas	0	0	1,785	0	0
220	CAN Urban Secondary Road Miles	2,985	120,376	5,476	406	19,742
221	CAN Total Mining	0	0	13,564	0	0
222	CAN Utilities	0	1,998	2,751	32	89
230	CAN Rural Secondary Road Miles	1,613	75,161	2,728	211	7,997
240	CAN Total Road Miles	345	45,969	1,175	41	82,324
308	CAN Food manufacturing	0	0	17,199	0	5,233
321	CAN Wood product manufacturing	513	1,677	591	213	8,464
323	CAN Printing and related support activities	0	0	0	0	20,852
324	CAN Petroleum and coal products manufacturing	0	1,056	1,481	439	6,751
326	CAN Plastics and rubber products manufacturing	0	0	0	0	21,858
327	CAN Non-metallic mineral product manufacturing	0	0	7,206	0	0
331	CAN Primary Metal Manufacturing	0	148	5,247	28	62
412	CAN Petroleum product wholesaler-distributors	0	0	0	0	37,775
448	CAN clothing and clothing accessories stores	0	0	0	0	178
562	CAN Waste management and remediation services	2,707	1,230	2,300	2,159	16,100
601	CAN SCL:12003 Petroleum Liquids Transportation (PIRD)	0	0	12	154	6,042
602	CAN SCL:12007 Oil Sands In-Situ Extraction and Processing (PIRD)	0	0	0	0	110
603	CAN SCL:12010 Light Medium Crude Oil Production (PIRD)	0	0	0	0	2
604	CAN SCL:12011 Well Drilling (PIRD)	0	0	0	607	658
605	CAN SCL:12012 Well Servicing (PIRD)	0	0	0	68	73
606	CAN SCL:12013 Well Testing (PIRD)	0	0	0	0	0
607	CAN SCL:12014 Natural Gas Production (PIRD)	0	28	1	0	191
608	CAN SCL:12015 Natural Gas Processing (PIRD)	0	0	0	0	0
611	CAN SCL:12019 Accidents and Equipment Failures (PIRD)	0	0	0	0	90,229
612	CAN SCL:12020 Natural Gas Transmission and Storage (PIRD)	1	671	54	11	396
901	CAN Airport	0	98	9	0	0

Code	Mexican or Canadian Surrogate Description	NH_3	NO_X	$PM_{2.5}$	SO_2	VOC
921	CAN Commercial Fuel Combustion	190	21,587	2,373	435	940
923	CAN TOTAL INSTITUTIONAL AND GOVERNEMNT	0	0	0	0	14,522
924	CAN Primary Industry	0	0	0	0	33,308
925	CAN Manufacturing and Assembly	0	0	0	0	70,606
926	CAN Distribution and Retail (no petroleum)	0	0	0	0	6,666
927	CAN Commercial Services	0	0	0	0	30,828
933	CAN Rail-Passenger	1	3,089	63	1	115
934	CAN Rail-Freight	48	76,567	1,530	43	3,389
935	CAN Rail-Yard	1	4,536	95	1	276
940	CAN Paved Roads New	0	0	26,017	0	0
946	CAN Construction and Mining	44	2,842	163	281	41
951	CAN Wood Consumption Percentage	1,061	11,794	71,798	1,685	100,154
955	CAN UNPAVED_ROADS_AND_TRAILS	0	0	433,847	0	0
961	CAN 80110_Broilers	13,453	0	115	0	12,782
962	CAN 80111_Cattle_dairy_and_Heifer	61,989	0	276	0	40,501
963	CAN 80112_Cattle_non-Dairy	177,740	0	884	0	42,860
964	CAN 80113_Laying_hens_and_Pullets	10,085	0	40	0	10,592
965	CAN 80114_Horses	3,155	0	19	0	1,320
966	CAN 80115_Sheep_and_Lamb	2,278	0	6	0	170
967	CAN 80116_Swine	64,225	0	824	0	9,945
968	CAN 80117_Turkeys	5,215	0	41	0	4,507
969	CAN 80118_Goat	1,806	0	2	0	135
971	CAN 80119_Buffalo	2,258	0	6	0	517
972	CAN 80120_Llama_and_Alpacas	118	0	0	0	0
973	CAN 80121_Deer	20	0	0	0	0
974	CAN 80122_Elk	19	0	0	0	0
975	CAN 80123_Wild boars	37	0	0	0	0
976	CAN 80124_Rabbit	78	0	0	0	1
977	CAN 80125_Mink	287	0	0	0	951
978	CAN 80126_Fox	4	0	0	0	3
981	CAN Harvest_Annual	0	0	24,824	0	0
983	CAN Synthfert_Annual	164,425	3,513	2,111	5,807	127
985	CAN Tillage_Annual	0	0	106,806	0	0
996	CAN urban_area	0	0	3,716	0	0
1251	CAN OFFR_TOTFERT	84	59,946	4,056	57	113
1252	CAN OFFR_MINES	1	573	40	1	0
1253	CAN OFFR Other Construction not Urban	68	37,617	4,378	46	231
1254	CAN OFFR Commercial Services	47	16,663	2,499	40	11,046
1255	CAN OFFR Oil Sands Mines	0	0	0	0	0

Code	Mexican or Canadian Surrogate Description	NH_3	NO_X	$PM_{2.5}$	SO_2	VOC
1256	CAN OFFR Wood industries CANVEC	9	3,245	257	7	86
1257	CAN OFFR Unpaved Roads Rural	24	10,275	642	21	934

4 Analytic Year Emissions Inventories and Approaches

The emission inventories for the analytic year 2026 have been developed using projection methods that are specific to the type of emissions source. Analytic year emissions are projected from the base year either by running models to estimate analytic year emissions from specific types of emission sources (e.g., EGUs, and onroad and nonroad mobile sources), or for other types of sources by adjusting the base year emissions according to the best estimate of changes expected to occur in the intervening years (e.g., non-EGU point and nonpoint sources). The types of changes accounted for in the analytic year inventories include changes in expected activity data for the sector (e.g, VMT for onroadway sources) and changes in emission rates per unit of activity between the years. Emission rates can be predicted to change due to the adoption of improved processes, changes in the fuels used, market-driven impacts, or on-the-books regulations. In this platform, on-the-books federal and some state regulations that impacted CAPs that were on-the-books as of April 2024 are reflected.

For some sectors, the same emissions are used in the base and analytic years, such as biogenic, all fire sectors, and fertilizer. Emissions for these sectors are held constant in future years because the base year meteorological data are also used for the future year air quality model runs, and emissions for these sectors are highly correlated with meteorological conditions. For the remaining sectors, rules and specific legal obligations that go into effect in the intervening years, along with changes in activity for the sector, are considered when possible. For sectors that were projected, the methods used to project those sectors to the analytic year(s) for this platform are summarized in Table 4-1.

Table 4-1. Overview of projection methods by sector for the analytic years

Platform Sector: *abbreviation*	Description of Projection Methods for Analytic Year Inventories
EGU units: ***ptegu***	For 2026, an engineering analysis approach was used to develop emissions based on the most recently available measured emissions. **More information on this sector including a list of included rules is provided in Section 4.1**.
Point source oil and gas: ***pt_oilgas***	The production-related sources were grown from 2022 to 2026 based on growth factors derived from the Annual Energy Outlook (AEO) 2023 data for oil, natural gas, or a combination thereof. The grown emissions were then controlled to account for the impacts of New Source Performance Standards (NSPS) for oil and gas sources, process heaters, natural gas turbines, and reciprocating internal combustion engines (RICE). Known closures were also applied to the 2022 pt_oilgas sources. See Section 4.2.3.8 and several subsections of Section 4.2.4 for more details.
Airports: ***airports***	Point source airport emissions were grown from 2022 to 2026 using factors derived from the 2023 Terminal Area Forecast (TAF) released in January 2024 (see https://www.faa.gov/data_research/aviation/taf/). Factors outside of a specific range were set to state average factors. Analytic year emissions for the ATL airport were provided by the state of Georgia. See Section 4.2.3.2 for more details.

Platform Sector: *abbreviation*	Description of Projection Methods for Analytic Year Inventories
Remaining non-EGU point: ***ptnonipm***	2022 emissions were projected to 2026 using factors derived from AEO2023. Controls were applied to account for relevant NSPS for RICE, gas turbines, and process heaters. Emissions were reduced to account for NESHAP rules related to Hazardous Organic Compounds, Organic Liquids Distribution, and Taconite. Known closures were applied to the 2022 ptnonipm sources. Railyards are grown using the projection factors from the rail sector. Additional state-specific controls were applied. See Section 4.2.3.9 and several subsections of Section 4.2.4 for more details.
Category 1, 2 CMV: ***cmv_c1c2***	Category 1 and category 2 (C1C2) CMV emissions sources outside of California were projected to 2026 based on factors derived from the Freight Analysis Framework version 5. See the Category 3 CMV documentation (EPA, 2024a) for more details on the development of the projection factors for both C1C2 and C3 CMV vessels. See Section 4.2.3.3 for more details.
Category 3 CMV: ***cmv_c3***	Category 3 (C3) CMV emissions were projected to 2026 based on factors derived from the Freight Analysis Framework version 5. An additional adjustment to NOx was made to account for the penetration of cleaner engines over time based on an extrapolation of trends from recent ship registry data sets. See the Category 3 CMV documentation (EPA, 2024a) for more details on the development of the factors. See Section 4.2.3.4 for more details.
Locomotives: ***rail***	Rail emissions were projected based on factors derived for categories of locomotives based on AEO (fuel use) growth rates including some adjustments. See Section 4.2.3.10 for more details.
Area fugitive dust: ***afdust***	Paved road dust was grown to 2026 levels based on the growth in VMT from 2022. Emissions for the remainder of the sector were based on a combination of employment projections and livestock projection data. See Section 4.2.3.1 for more details.
Livestock: ***livestock***	Livestock were projected from 2022 to 2026 using factors derived from projections of animal counts from the Greenhouse Gas Inventory Tool versus the base year animal counts. See Section 4.2.3.5 for more details.
Nonpoint source oil and gas: ***np_oilgas***	Exploration-related sources were based on a multi-year average of 2017 through 2019 exploration data with NSPS controls applied, where applicable. Production-related emissions were projected from 2022 to 2026 based on factors generated from AEO2023 reference case. Based on the SCC, factors related to oil, gas, or combined growth were used. Coalbed methane SCCs were projected independently. Controls were then applied to account for NSPS for oil and gas and RICE. See Section 4.2.3.9, Section 4.2.4.1and Section 4.2.4.2 for more details.
Residential Wood Combustion: ***rwc***	RWC emissions were held constant at 2022 levels for 2026. See Section 4.2.3.11 for more details.
Solvents: ***np_solvents***	Emissions were projected from 2022 to 2026 by multiplying base year emissions by factors based on the ratio of the 'growth surrogate' for the analytic year divided by the value for the base year. Growth surrogates were based on human population, employment projections, and VMT projections. Controls were applied to reflect various national rules. State-specific controls were applied. See Section 4.2.3.7 and Section 4.2.4.6 for more details.

Platform Sector: *abbreviation*	Description of Projection Methods for Analytic Year Inventories
Remaining nonpoint: ***nonpt***	Projected base year to 2026 by multiplying base year emissions by factors derived from AEO 2023, human population projections, and employment projections. Controls were applied to reflect NSPS rules for reciprocating internal combustion engines (RICE). State-specific controls were also applied. See Section 4.2.3.6 and Section 4.2.4.2 for more details.
Nonroad: ***nonroad***	Outside of California, MOVES4 was run for 2026. The fuels used are specific to the analytic year, but the meteorological data represented the year 2022. Adjusted growth factors were used for North Carolina nonroad industrial based on information from NC. For CA 2016 platform inventories were used for 2026. See Section 4.3.1 for more details.
Onroad: ***onroad***	VMT was projected from 2022 to 2026 using projection factors based on AEO2023 projections and applied nationally by fuel type and broad vehicle type (light duty, medium duty for buses and single unit trucks, and heavy duty for combination trucks). Diesel light duty cars were held flat in projections, but diesel light duty trucks were projected using the AEO. Light duty VMT projections also incorporated a county-level adjustment based on projected human population trends, so that counties expected to grow more than the national average in population receive a corresponding increase in VMT for those counties, and vice versa. Four states (NJ, NY, NC, and WI) provided VMT for each analytic year. Additionally, projection factors were developed and applied to estimate the impact of federal rules that are on the books but were not included in MOVES4 for all states. See Section 4.3.2 for more details.
Onroad California: ***onroad_ca_adj***	For California, emissions were provided by CARB for 2026. Additionally, projection factors were developed and applied to estimate the impact of federal rules that are on the books. See Section 4.3.2 for more details.
Canada Area Fugitive dust: ***canada_afdust***	Area fugitive dust emissions were provided by ECCC for 2026. Mexico emissions are not included in this sector. See Section 4.3.3.1 for more details.
Canada Point Fugitive dust: ***canada_ptdust***	Point source fugitive dust emissions were provided by ECCC for 2026. Mexico emissions are not included in this sector. See Section 4.3.3.1 for more details.
Canada and Mexico point sources: ***canmex_point***	Canada point source emissions were provided by ECCC for 2026. Mexico point sources are held constant from the base year 2022 inventories. See Section 4.3.3.2 for more details.
Canada and Mexico ag: ***canmex_ag***	Canada agricultural emissions were provided by ECCC for 2026. Mexico agricultural sources are held constant from the base year 2022 inventories. See Section 4.3.3.2 for more details.
Canada oil and gas 2D: ***canada_og2D***	Low-level point oil and gas sources from the ECCC 2026 point source inventories. See Section 4.3.3.2 for more details.
Canada and Mexico nonpoint (except ag) and nonroad: ***canmex_area***	Canada nonpoint and nonroad emissions were provided by ECCC for 2026. Mexico nonpoint and nonroad sources are held constant from the base year 2022 inventories. See Section 4.3.3.3 for more details.
Other non-NEI onroad sources: ***canada_onroad***	For Canadian mobile onroad sources, analytic year inventories used Environment and Climate Change Canada (ECCC) provided emissions for 2026. See Section 4.3.3.4 for more details.

Platform Sector: *abbreviation*	Description of Projection Methods for Analytic Year Inventories
Other non-NEI onroad sources: *mexico_onroad*	Monthly onroad mobile inventories were developed at municipio resolution based on an interpolation of runs of MOVES-Mexico done for the 2016 platform for 2026. See Section 4.3.3.4 for more details.

4.1 EGU Point Source Projections (ptegu)

The analytic year EGU emissions inventories relied on Engineering Analysis for 2026.

Details on the development of the analytic year EGU emissions are as follows:

- EPA's 2026 Engineering Analysis emissions developed with the most recent data available as of summer 2024:
    - The starting point was 2023 NOx, SO2, and Hg emissions reported to Clean Air and Power Division (CAPD): https://campd.epa.gov/
    - Known unit retirements, coal to gas conversions, control retrofits, unit specific rate adjustments due to BART or state RACT rules, and new unit construction from the January 2024 NEEDS (which is equivalent to the data in the June 2024 NEEDS database).
    - PM, VOC, NH3, and CO emissions were calculated using NEI 2022 and Energy Information Administration (EIA) 860/923 emissions factors and CAPD generation data.
    - No additional Good Neighbor Plan (GNP) related changes reflected in 2026 inventory. All but two states were under their respective state budgets in 2023; these two states were under their assurance levels in 2023.
    - The 2026 engineering analysis data included emissions according to ORIS and CAPD IDs. The Engineering Analysis units were matched to EIS facility and unit IDs using existing CAPD-EIS matches from the 2022 base year point inventory and NEEDS database. For units with a CAPD -EIS match, units from 2022 were retained, with emissions adjusted to match the engineering analysis. All units from 2022 which were not matched in the engineering analysis were carried forward to 2026 with the same emissions, except for units listed as retired in the 2026 analysis. For all units in the 2026 analysis which were not matched to a unit in the 2022 base year inventory, new units were created with new point source IDs, SCCs for natural gas EGUs, and default stack parameters.

Data files and summaries related to the analytic year EGU emissions are posted in the point reports section of the FTP site.

IPM is a linear programming model that accounts for variables and information such as energy demand, planned unit retirements, and planned rules to forecast unit-level energy production and configurations. EPA's 2023 Reference case using IPM reflects current and existing state regulations, Renewable Portfolio Standards and Clean Energy Standards as of end of 2023.

Some of the key parameters used in the IPM run are:

- Demand: AEO 2023 non-EV demand + on-the-books OTAQ GHG LMDV and HDV Rules
- Gas and Coal Market assumptions: Gas market assumptions as of end of 2021 (with LNG export assumptions from AEO 2023) and coal market assumptions as of end of 2021 with adjustments for historic consumption
- Cost and performance of fossil generation technologies: AEO 2023

- Cost and performance of renewable energy generation technologies: NREL ATB 2023 (mid-case)
- Fleet: NEEDS rev 06-06-2024 (xlsx)

To maintain a temporal pattern consistent with the base year, the NOX and SO2 values in the base year hourly CEMS inventories are projected to match the total seasonal emissions values in analytic years as described in Section 3.3.3.

The EGU sector NO_x emissions by state are listed in Table 4-2 for the cases that comprise this platform. The state total emissions in this table may not exactly match the sum of the emissions for each state in the flat files for each season due to the process of apportioning seasonal total emissions to hours for input to SMOKE followed by summing the daily emissions back up to annual. However, any difference should be well within one percent of the state total emissions.

Table 4-2. EGU sector NOx emissions by State for the 2022v1 cases

State	2022hc	2026hc
Alabama	16,510	13,773
Arizona	15,668	9,637
Arkansas	17,015	14,550
California	5,816	5,757
Colorado	17,778	12,496
Connecticut	3,076	2,654
Delaware	911	462
District of Columbia	NA	NA
Florida	38,816	33,010
Georgia	20,636	19,122
Idaho	1,420	1,680
Illinois	20,575	10,239
Indiana	41,679	25,883
Iowa	16,966	14,182
Kansas	13,554	9,477
Kentucky	31,989	28,366
Louisiana	31,107	21,147
Maine	3,594	3,406
Maryland	4,405	3,584
Massachusetts	5,584	5,309
Michigan	29,158	18,484
Minnesota	14,491	11,131
Mississippi	16,333	12,262
Missouri	48,204	34,976
Montana	10,459	10,382
Nebraska	20,178	18,453
Nevada	4,488	2,101
New Hampshire	1,504	1,167
New Jersey	4,835	4,332

State	2022hc	2026hc
New Mexico	6,604	2,913
New York	13,762	11,768
North Carolina	26,865	24,036
North Dakota	28,897	28,549
Ohio	31,933	22,299
Oklahoma	18,700	18,150
Oregon	2,775	2,207
Pennsylvania	27,252	16,826
Rhode Island	302	619
South Carolina	14,016	13,900
South Dakota	1,144	1,085
Tennessee	8,262	6,834
Texas	93,611	86,224
Tribal Areas	8,412	7,616
Utah	23,396	9,442
Vermont	194	109
Virginia	12,598	10,898
Washington	7,659	3,201
West Virginia	30,156	22,916
Wisconsin	10,985	8,468
Wyoming	26,411	19,591

4.2 Sectors with Projections Computed using CoST

To project U.S. emissions for sectors other than EGUs, facility/unit closures information, growth (projection) factors and/or controls were applied to certain categories within those sectors. Some facility or sub-facility-level closure information was applied to the point sources. There are also a handful of situations where new inventories were generated for sources that did not exist in the NEI (e.g., biodiesel and cellulosic plants, yet-to-be constructed cement kilns). This subsection provides details on the data and projection methods used to develop analytic year emissions for sectors other than EGUs that were developed using the Control Strategy Tool.

Because the projection and control data are developed mostly independently from how the emissions modeling sectors are defined, this section is organized primarily by the type of projections data, with secondary consideration given to the emissions modeling sector (e.g., industrial source growth factors are applicable to multiple emissions modeling sectors). The rest of this section is organized in the order that the EPA uses the Control Strategy Tool (CoST) in combination with other methods to produce analytic year inventories: 1) for point sources, apply facility or sub-facility-level closure information via CoST; 2) apply all PROJECTION packets via CoST (these contain multiplicative factors that could cause increases or decreases); 3) apply all percent reduction-based CONTROL packets via CoST; and 4) append any other analytic-year inventories not generated via CoST. This organization allows consolidation of the discussion of the emissions categories that are contained in multiple sectors, because the data and

approaches used across the sectors are consistent and do not need to be repeated. Sector names associated with the CoST packets are provided in parentheses following the subsection titles.

The impacts of the projection and control factors on the emissions for each sector are shown in tables in this section. In addition, the actual projection and control factors used to develop the analytic year emissions are shown when they are general enough to fit into a table of reasonable length, although in some cases, there are hundreds or thousands of factors used and the tables would be too large. To see these factors, visit the spreadsheets under projection_controls on the FTP site for this platform.

4.2.1 Background on the Control Strategy Tool (CoST)

CoST is used to apply most non-EGU projection/growth factors, controls and facility/unit/stack-level closures to the base year emissions modeling inventories to create analytic year inventories for the following sectors: afdust, airports, cmv, livestock, nonpt, np_oilgas, np_solvents, pt_oilgas, ptnonipm, rail, and rwc. Information about CoST and related data sets is available from https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-analysis-modelstools-air-pollution.

CoST allows the user to apply projection (growth) factors, controls and closures at various geographic and inventory key field resolutions. Using these CoST datasets, also called "packets" or "programs," supports the process of developing and quality assuring control assessments as well as creating SMOKE-ready analytic year (i.e., projected) inventories. Analytic year inventories are created for each emissions modeling sector by applying a CoST control strategy type called "Project future year inventory" and each strategy includes all base year inventories and applicable CoST packets. For reasons to be discussed later, some emissions modeling sectors may require multiple CoST strategies to account for the compounding of control programs that impact the same type of sources. There are also available linkages to existing and user-defined control measure databases and it is up to the user to determine how control strategies are developed and applied. The EPA typically creates individual CoST packets that represent specific intended purposes (e.g., aircraft projections for airports are in a separate PROJECTION packet from residential wood combustion sales/appliance turnover-based projections). CoST uses three packet types:

- CLOSURE: Closure packets are applied first in CoST. This packet can be used to zero-out (close) point source emissions at resolutions as broad as a facility to as specific as a release point. The EPA uses these types of packets for known post-base year controls as well as information on closures provided by states on specific facilities, units or release points. This packet type is only used for the ptnonipm and pt_oilgas sectors.
- PROJECTION: Projection packets support the increase or decrease in emissions for virtually any geographic and/or inventory source level. Projection factors are applied as multiplicative factors to the base year emissions inventories prior to the application of any possible subsequent CONTROLs. A PROJECTION packet is necessary whenever emissions increase from the base year and is also desirable when information is based more on activity assumptions rather than on known control measures. The EPA uses PROJECTION packet(s) for many modeling sectors.
- CONTROL: Control packets are applied after any/all CLOSURE and PROJECTION packet entries. They support of similar level of specificity of geographic and/or inventory source level application

as PROJECTION packets. Control factors are expressed as a percent reduction (0 – meaning no reduction, to 100 – meaning full reduction) and can be applied in addition to any pre-existing inventory control, or as a replacement control. For replacement controls, any controls specified in the inventory are first backed out prior to the application of a more-stringent replacement control).

These packets use comma-delimited formats and are stored as data sets within the Emissions Modeling Framework. As mentioned above, CoST first applies any/all CLOSURE information for point sources, then applies PROJECTION packet information, followed by CONTROL packets. A hierarchy is used by CoST to separately apply PROJECTION and CONTROL packets. In short, in a separate process for PROJECTION and CONTROL packets, more specific information is applied in lieu of less-specific information in ANY other packets. For example, a facility-level PROJECTION factor will be replaced by a unit-level, or facility and pollutant-level PROJECTION factor. It is important to note that this hierarchy does not apply between packet types (e.g., CONTROL packet entries are applied irrespective of PROJECTION packet hierarchies). A more specific example: a state/SCC-level PROJECTION factor will be applied before a stack/pollutant-level CONTROL factor that impacts the same inventory record. However, an inventory source that is subject to a CLOSURE packet record is removed from consideration of subsequent PROJECTION and CONTROL packets.

The implication for this hierarchy and intra-packet independence is important to understand and quality assure when creating future year strategies. For example, with consent decrees, settlements and state comments, the goal is typically to achieve a targeted reduction (from the base year inventory) or a targeted analytic-year emissions value. Therefore, controls due to consent decrees and state comments for specific cement kilns (expressed as CONTROL packet entries) need to be applied *instead of* (not in addition to) the more general approach of the PROJECTION packet entries for cement manufacturing. By processing CoST control strategies with PROJECTION and CONTROL packets separated by the type of broad measure/program, it is possible to show actual changes from the base year inventory to the future (i.e., analytic) year inventory as a result of applying each packet.

Ultimately, CoST concatenates all PROJECTION packets into one PROJECTION dataset and uses a hierarchal matching approach to assign PROJECTION factors to the inventory. For example, a packet entry with Ranking=1 will supersede all other potential inventory matches from other packets. CoST then computes the projected emissions from all PROJECTION packet matches and then performs a similar routine for all CONTROL packets. Therefore, when summarizing “emissions reduced” from CONTROL packets, it is important to note that these reductions are not relative to the base year inventory, but rather to the intermediate inventory ***after*** application of any/all PROJECTION packet matches (and CLOSURES). A subset of the more than 70 hierarchy options is shown in Table 4-3, where the fields in the table are similar to those used in the SMOKE FF10 inventories. For example, “REGION_CD” is the county-state-county FIPS code (e.g., Harris County Texas is 48201) and “STATE” would be the 2-digit state FIPS code with three trailing zeroes (e.g., Texas is 48000).

Table 4-3. Subset of CoST Packet Matching Hierarchy

Rank	Matching Hierarchy	Inventory Type
1	REGION_CD, FACILITY_ID, UNIT_ID, REL_POINT_ID, PROCESS_ID, SCC, POLL	point
2	REGION_CD, FACILITY_ID, UNIT_ID, REL_POINT_ID, PROCESS_ID, POLL	point
3	REGION_CD, FACILITY_ID, UNIT_ID, REL_POINT_ID, POLL	point

Rank	Matching Hierarchy	Inventory Type
4	REGION_CD, FACILITY_ID, UNIT_ID, POLL	point
5	REGION_CD, FACILITY_ID, SCC, POLL	point
6	REGION_CD, FACILITY_ID, POLL	point
7	REGION_CD, FACILITY_ID, UNIT_ID, REL_POINT_ID, PROCESS_ID, SCC	point
8	REGION_CD, FACILITY_ID, UNIT_ID, REL_POINT_ID, PROCESS_ID	point
9	REGION_CD, FACILITY_ID, UNIT_ID, REL_POINT_ID	point
10	REGION_CD, FACILITY_ID, UNIT_ID	point
11	REGION_CD, FACILITY_ID, SCC	point
12	REGION_CD, FACILITY_ID	point
13	REGION_CD, NAICS, SCC, POLL	point, nonpoint
14	REGION_CD, NAICS, POLL	point, nonpoint
15	STATE, NAICS, SCC, POLL	point, nonpoint
16	STATE, NAICS, POLL	point, nonpoint
17	NAICS, SCC, POLL	point, nonpoint
18	NAICS, POLL	point, nonpoint
19	REGION_CD, NAICS, SCC	point, nonpoint
20	REGION_CD, NAICS	point, nonpoint
21	STATE, NAICS, SCC	point, nonpoint
22	STATE, NAICS	point, nonpoint
23	NAICS, SCC	point, nonpoint
24	NAICS	point, nonpoint
25	REGION_CD, SCC, POLL	point, nonpoint
26	STATE, SCC, POLL	point, nonpoint
27	SCC, POLL	point, nonpoint
28	REGION_CD, SCC	point, nonpoint
29	STATE, SCC	point, nonpoint
30	SCC	point, nonpoint
31	REGION_CD, POLL	point, nonpoint
32	REGION_CD	point, nonpoint
33	STATE, POLL	point, nonpoint
34	STATE	point, nonpoint
35	POLL	point, nonpoint

The contents of the controls, local adjustments and closures for the analytic year cases are described in the following subsections. Year-specific projection factors (PROJECTION packets) for each analytic year were used to create the analytic year cases, unless noted otherwise in the specific subsections. The contents of a few of these projection packets (and control reductions) are provided in the following subsections where feasible. However, most sectors used growth or control factors that varied geographically, and their contents could not be provided in the following sections (e.g., facilities and units subject to the Boiler MACT reconsideration has thousands of records). The remainder of Section 4.2 is divided into subsections that are summarized in Table 4-4. Note that independent analytic year inventories were used rather than projection or control packets for some sources.

Table 4-4. Summary of non-EGU projections subsections

Subsection	Title	Sector(s)	Brief Description
4.2.2	CoST Plant CLOSURE packet	ptnonipm, pt_oilgas	All facility/unit/stack closures information, primarily from Emissions Inventory System (EIS), also includes information from states and other organizations.
4.2.3	CoST PROJECTION packets	All	Introduces and summarizes national impacts of all CoST PROJECTION packets to the analytic year.
4.2.3.1	Fugitive dust growth	afdust	PROJECTION packet: county-level resolution, based on VMT growth plus some other surrogates such as livestock counts.
4.2.3.2	Airport sources	airports	PROJECTION packet: by-airport for all direct matches to FAA Terminal Area Forecast data, with state-level factors for non-matching airports.
4.2.3.3	Category 1 and 2 commercial marine vessels	cmv_c1c2	PROJECTION packet: Category 1 & 2 growth and control by pollutant, vessel type, and region.
4.2.3.4	Category 3 commercial marine vessels	cmv_c3	PROJECTION packet: Category 3 growth and control impacts by pollutant, vessel type, and region.
4.2.3.5	Livestock population growth	livestock	PROJECTION packet: national, by-animal type resolution, based on animal population projections.
4.2.3.6	Nonpoint sources	nonpt	PROJECTION packet: States projected with AEO-based factors for many sources. Human population used as growth for applicable sources.
4.2.3.7	Solvents	np_solvents	PROJECTION packet: including population-based, state factors and some other surrogtes.
4.2.3.8	Oil and gas and industrial source growth	nonpt, np_oilgas, ptnonipm, pt_oilgas	Several PROJECTION packets: varying geographic resolutions from state, county, and by-process/fuel-type applications. Data derived from AEO were used for nonpt, ptnonipm, np_oilgas, and pt_oilgas sectors.
4.2.3.9	Non-EGU Point Sources	ptnonipm	PROJECTION packet: AEO-based projection factors for industrial sources.
4.2.3.10	Railroads	rail	PROJECTION packet: Based on AEO and extrapolation from recent inventories.
4.2.3.11	Residential wood combustion	rwc	Held Constant. No growth or control in this platform
4.2.4	CoST CONTROL packets	ptnonipm, nonpt, np_oilgas, pt_oilgas, np_solvents	Introduces and summarizes national impacts of all CoST CONTROL packets to the analytic year.

Subsection	Title	Sector(s)	Brief Description
4.2.4.1	Oil and Gas NSPS	np_oilgas, pt_oilgas	CONTROL packets: reflect the impacts of the NSPS for oil and gas sources.
4.2.4.2	RICE NSPS	ptnonipm, nonpt, np_oilgas, pt_oilgas	CONTROL packets apply reductions for lean burn, rich burn, and combined engines for identified SCCs.
4.2.4.3	Organic Liquids Distribution NESHAP	ptnonipm	CONTROL packet: applies VOC reductions based on the NESHAP for organic liquids distribution.
4.2.4.4	Natural Gas Turbines NOx NSPS	ptnonipm	CONTROL packets apply NOx emission reductions established by the NSPS for turbines.
4.2.4.5	Process Heaters NOx NSPS	ptnonipm	CONTROL packet: applies NOx emission limits established by the NSPS for process heaters.
4.2.4.6	State-specific controls	nonpt, np_solvents, ptnonipm	CONTROL packet: applies controls specific to certain states

4.2.2 CoST CLOSURE Packet (ptnonipm, pt_oilgas)

Packets:

closures_2022v1_platform_fromEIS_16sep2024_v1
closures_2022v1_platform_fromSLT_21feb2025_v1

The CLOSURES packets contain facility, unit and stack-level closure information. The "fromEIS" closures packet is derived from an Emissions Inventory System (EIS) unit-level report from July 2024, with closure status equal to "PS" (permanent shutdown; i.e., post-2022 permanent facility/unit shutdowns known in EIS as of the date of the report). The "fromSLT" closures packet consists of any data provided by commenters for closures, updated to match the SMOKE FF10 inventory key fields, with all duplicates removed. These changes impact sources in the ptnonipm and pt_oilgas sectors. The cumulative reduction in emissions for ptnonipm and pt_oilgas from closures are shown in Table 4-5.

Table 4-5. Tons reduced from all facility/unit/stack-level closures in 2026 from 2022 emissions levels

Year	Pollutant	ptnonipm	pt_oilgas
2026	CO	10,059	961
2026	NH3	363	0
2026	NOX	11,082	1,984
2026	PM10	3,297	57
2026	PM2.5	2,691	57
2026	SO2	8,755	3
2026	VOC	8,299	239

4.2.3 CoST PROJECTION Packets (afdust, airports, cmv, livestock, nonpt, np_oilgas, np_solvents, ptnonipm, pt_oilgas, rail)

For point inventories, after the application of any/all CLOSURE packet information, the next step CoST performs when running a control strategy is to apply all of the PROJECTION packets. Regardless of inventory type (point or nonpoint), the PROJECTION packets are applied prior to the CONTROL packets. For several emissions modeling sectors (e.g., airports, np_oilgas, pt_oilgas), there is only one PROJECTION packet applied for each analytic year. For other sectors, there may be several different sources of projection data and as a result there are multiple PROJECTION packets that are concatenated by CoST during a control strategy run. The outputs are then quality-assured regarding duplicates and applicability to the inventories in the CoST strategy. Similarly, CONTROL packets are kept in distinct datasets for different control programs. Having the PROJECTION (and CONTROL) packets separated into "key" projection and control programs allows for quick summaries of the impacts of these distinct control programs on emissions.

Quantitative impacts of the projections on the emissions by sector nationally and by state are available in the reports folder on the FTP site. Some excerpts from this workbook are included in the subsections that follow.

4.2.3.1 Fugitive dust growth (afdust)

Packets:

nonpoint_projection_packet_2022_platform_2022hc_to_2026_updates_24dec2024_csv_24dec2024_v0

For paved roads (SCC 2294000000), the afdust emissions were projected to based on differences in county total VMT as follows:

Analytic year afdust paved roads = 2022 afdust paved roads * (Analytic year county total VMT) / (2022 county total VMT)

The VMT projections are described in the onroad section. Unpaved road dust emissions were held constant.

Other SCCs were projected based on the average of AEO2023 U.S. Census region specific employment and value of shipments (VOS) data to derive growth surrogates.

$$\frac{1}{2}\left(\frac{EMP_{analytic\ year}}{EMP_{base\ year}}+\frac{VOS_{analytic\ year}}{VOS_{base\ year}}\right)=GF$$

Where EMP is regional and industrial sector specific employment in millions of people and VOS is regional and industrial sector specific value of shipments (or revenue) in billion 2012 dollars. The average of analytic year over base year specific EMP and VOS factors were used as a growth factor, GF.

SCCs in the afdust sector used surrogates to derive projection factors in similar ways as shown above for the paved roads. Table 4-6 shows the growth indicators used to grow SCCs in the afdust sector. Table 4-7 shows the impact of the projections on the afdust sector emissions.

Table 4-6. Growth Indicators used to grow SCCs in the afdust sector

SCC	Sector	Growth Indicator	Source	Geography
2294000000	Dust - Paved Road Dust	Total VMT	2022v1 VMT	County
2296000000	Dust - Unpaved Road Dust	No Growth		
2311010000	Dust - Construction Dust	EMPIND25-27 (Construction: Building, Heavy/ Civil Engineering, Specialty Trade); REVIND48	AEO2023	Regional (Census Division)
2311020000	Dust - Construction Dust	EMPIND25-27 (Construction: Building, Heavy/Civil Engineering, Specialty Trade); REVIND48	AEO2023	Regional (Census Division)
2311030000	Dust - Construction Dust	Total VMT	2022v1 VMT	County
2325000000	Industrial Processes – Mining	EMPIND24 (Other Mining and Quarrying); REVIND47	AEO2023	Regional (Census Division)
2325020000	Industrial Processes – Mining	EMPIND24 (Other Mining and Quarrying); REVIND47	AEO2023	Regional (Census Division)
2325030000	Industrial Processes – Mining	EMPIND24 (Other Mining and Quarrying); REVIND47	AEO2023	Regional (Census Division)
2325060000	Industrial Processes - Mining	EMPIND24 (Other Mining and Quarrying); REVIND47	AEO2023	Regional (Census Division)
2801000000	Agriculture - Crops & Livestock Dust	EMPIND20 (Crop Production); REVIND42	AEO2023	Regional (Census Division)
2801000003	Agriculture - Crops & Livestock Dust	EMPIND20 (Crop Production); REVIND42	AEO2023	Regional (Census Division)
2801000005	Agriculture - Crops & Livestock Dust	EMPIND20 (Crop Production); REVIND42	AEO2023	Regional (Census Division)
2801000008	Agriculture - Crops & Livestock Dust	EMPIND20 (Crop Production); REVIND42	AEO2023	Regional (Census Division)
2801530000	Agriculture - Crops & Livestock Dust	EMPIND21 (Other Agriculture); REVIND44	AEO2023	Regional (Census Division)
2805100010	Agriculture - Crops & Livestock Dust	Beef Cattle surrogate	EPA State GHG Projections Tool	State
2805100020	Agriculture - Crops & Livestock Dust	Dairy Cattle surrogate	EPA State GHG Projections Tool	State
2805100030	Agriculture - Crops & Livestock Dust	Young Chickens surrogate	EPA State GHG Projections Tool	State
2805100040	Agriculture - Crops & Livestock Dust	Young Chickens surrogate	EPA State GHG Projections Tool	State

SCC	Sector	Growth Indicator	Source	Geography
2805100050	Agriculture - Crops & Livestock Dust	Hog surrogate	EPA State GHG Projections Tool	State
2805100060	Agriculture - Crops & Livestock Dust	Turkey surrogate	EPA State GHG Projections Tool	State

Table 4-7. Increase in afdust $PM_{2.5}$ emissions from projections

Sector	Year	$PM_{2.5}$ Emissions	Percent Increase vs 2022
Paved Roads	2022	308,622	N/A
All afdust	2022	2,048,850	N/A
Paved Roads	2026	321,732	4.2%
All afdust	2026	2,073,013	1.2%

4.2.3.2 Airport sources (airports)

Packets:

airport_projections_itn_taf2023_2022_2026_for_2022v1_platform_09aug2024_v0

Airport emissions were projected based on factors derived from the 2023 Terminal Area Forecast (TAF) data available from the Federal Aviation Administration (see https://www.faa.gov/data_research/aviation/taf/).

Projection factors were computed using the ratio of the itinerant (ITN) data from the Airport Operations table between the base and projection year. Where possible, airport-specific projection factors were used. For airports that could not be matched to a unit in the TAF data, state default growth factors by itinerant class (i.e., commercial, air taxi, and general) were created from the set of unmatched airports. Emission growth factors for facilities from 2022 to each analytic year were limited to a range of 0.2 (80% reduction) to 5.0 (400% growth), and the state default projection factors were limited to a range of 0.5 (50% reduction) to 2.0 (100% growth). Military state default projection values were kept flat (i.e., equal to 1.0) to reflect uncertainly in the data regarding these sources.

Table 4-8 shows the growth factors used for major airports from 2022 to 2026, respectively. Table 4-9 shows the impacts of the projections on the emissions at airports.

Table 4-8. TAF 2023 growth factors for major airports, 2022 to 2026

Facility ID	State	Airport	Commercial Aviation	General Aviation	Air Taxi
10583311	Arizona	Phoenix (PHX)	1.2128	0.9948	1.1883
2255111	California	Los Angeles (LAX)	1.2852	1.1855	0.5950
9997011	California	San Francisco (SFO)	1.5693	1.0780	0.4138
9816811	Colorado	Denver (DEN)	1.3866	1.1823	0.2922
9762111	Florida	Orlando (MCO)	1.3437	0.9609	1.3465
9791511	Florida	Fort Lauderdale (FLL)	1.2919	0.9084	1.0146
9806211	Florida	Miami (MIA)	1.1722	0.9639	0.9336

Facility ID	State	Airport	Commercial Aviation	General Aviation	Air Taxi
9748811	Georgia	Atlanta (ATL)	1.3163	1.1589	n/a
2681611	Illinois	Chicago O'Hare (ORD)	1.3371	1.1628	0.2221
9562811	Massachusetts	Boston (BOS)	1.1995	1.1036	1.0157
9535411	Michigan	Detroit (DTW)	1.3157	1.2204	n/a
6151711	Minnesota	Minneapolis (MSP)	1.3491	1.2410	0.3224
9392311	Nevada	Las Vegas (LAS)	1.2692	0.9862	0.8545
9376211	New Jersey	Newark (EWR)	1.1204	1.3308	0.9782
9333211	New York	La Guardia (LGA)	1.0985	1.1385	1.0505
9333311	New York	John F Kennedy (JFK)	1.2094	1.5024	0.5801
9279611	North Carolina	Charlotte (CLT)	1.2281	0.9295	0.6935
9246511	Oregon	Portland (PDX)	1.3413	1.0948	1.0077
9185011	Pennsylvania	Philadelphia (PHL)	1.2649	0.9929	0.6014
9171111	Tennessee	Memphis (MEM)	1.1364	1.0512	0.7085
9076711	Texas	Dallas/Fort Worth (DFW)	1.3230	1.0249	n/a
9128911	Texas	Houston Intercontinental (IAH)	1.2908	1.2748	0.2224
9076611	Utah	Salt Lake City (SLC)	1.1806	1.0166	0.7177
9063811	Virginia	Washington Dulles (IAD)	1.4615	1.0917	0.5722
9093911	Washington	Seattle (SEA)	1.166	1.7739	1.1613

Table 4-9. Impact of growth factors on 2022 airport emissions for 2026

Pollutant	2022 Emissions	2026 Emissions	2026 Emissions % Change
CO	385,527	420,226	9%
NOX	121,944	140,528	15%
PM10-PRI	9,528	10,079	6%
PM25-PRI	8,475	8,979	6%
SO2	12,502	14,357	15%
VOC	46,989	51,293	9%

4.2.3.3 Category 1, Category 2 Commercial Marine Vessels (cmv_c1c2)

Packets:

projection_packet_CMV_C1C2_2022_2026_csv_19aug2024_v0

Category 1 and category 2 (C1C2) CMV emissions were projected based on factors derived from the Freight Analysis Framework version 5. An additional adjustment was applied to NOx emissions. The adjustment factors are intended to account for fleet turnover to newer vessels that meet stricter Tier-2 and Tier-3 emissions standards. See the Category 3 CMV documentation for more details on the development of the projection factors for both C1C2 and C3 CMV vessels. Table 4-10 shows the CMV C1C2 emissions by broad region in the base year and 2026.

Table 4-10. Resulting C1C2 Emissions for 2026 Compared to 2022 (tons/yr)

Region	Pollutant	2022	2026
Alaska	CO	928	1,035
Alaska	CO2	427,960	476,873
Alaska	NH3	3	3
Alaska	NOX	5,972	6,660
Alaska	PM10	154	172
Alaska	PM2_5	150	167
Alaska	SO2	15	16
Alaska	VOC	196	219
Atlantic	CO	6,606	6,675
Atlantic	CO2	3,064,688	3,105,114
Atlantic	NH3	21	22
Atlantic	NOX	43,265	43,718
Atlantic	PM10	1,146	1,159
Atlantic	PM2_5	1,111	1,123
Atlantic	SO2	131	138
Atlantic	VOC	1,523	1,538
Gulf	CO	10,250	10,865
Gulf	CO2	5,203,728	5,517,554
Gulf	NH3	35	37
Gulf	NOX	68,743	72,870
Gulf	PM10	1,884	1,998
Gulf	PM2_5	1,826	1,935
Gulf	SO2	373	397
Gulf	VOC	2,697	2,859
Hawaii	CO	239	257
Hawaii	CO2	106,808	114,778
Hawaii	NH3	1	1
Hawaii	NOX	1,564	1,680
Hawaii	PM10	41	44
Hawaii	PM2_5	39	42
Hawaii	SO2	3	3
Hawaii	VOC	52	56
Inland	CO	4,211	4,177
Inland	CO2	1,960,291	1,950,915
Inland	NH3	16	16
Inland	NOX	29,997	29,734
Inland	PM10	843	836
Inland	PM2_5	817	810
Inland	SO2	133	136
Inland	VOC	1,289	1,275
Pacific	CO	3,490	3,706
Pacific	CO2	1,652,962	1,758,788
Pacific	NH3	11	12
Pacific	NOX	22,571	23,974
Pacific	PM10	595	633
Pacific	PM2_5	577	613

Region	Pollutant	2022	2026
Pacific	SO2	78	85
Pacific	VOC	777	825

4.2.3.4 Category 3 Commercial Marine Vessels (cmv_c3)

Packets:

projection_packet_CMV_C3_2022_2026_csv_19aug2024_v0

Category 3 (C3) CMV emissions were projected based on factors derived from the Freight Analysis Framework version 5. An additional adjustment was applied to NOx emissions. The adjustment factors are intended to account for fleet turnover to newer vessels that meet stricter Tier-2 and Tier-3 emissions standards. See the Category 3 CMV documentation for more details on the development of the factors. Table 4-11 shows the CMV C3 emissions by broad region in the base year and 2026.

Table 4-11. Resulting C3 Emissions for 2026 Compared to 2022 (tons/yr)

Region	Pollutant	2022	2026
Alaska	CO	1,043	1,156
Alaska	CO2	638,087	706,095
Alaska	NH3	4	4
Alaska	NOX	7,977	8,352
Alaska	PM10	212	231
Alaska	PM2_5	195	213
Alaska	SO2	512	555
Alaska	VOC	485	538
Atlantic	CO	19,235	20,215
Atlantic	CO2	9,427,314	9,864,041
Atlantic	NH3	71	74
Atlantic	NOX	156,984	155,296
Atlantic	PM10	3,992	4,163
Atlantic	PM2_5	3,673	3,830
Atlantic	SO2	9,225	9,599
Atlantic	VOC	9,447	9,952
Gulf	CO	13,441	14,287
Gulf	CO2	7,419,752	7,886,079
Gulf	NH3	45	47
Gulf	NOX	113,761	114,163
Gulf	PM10	2,513	2,671
Gulf	PM2_5	2,312	2,457
Gulf	SO2	5,705	6,063
Gulf	VOC	6,268	6,666
Hawaii	CO	170	182
Hawaii	CO2	118,423	127,172
Hawaii	NH3	1	1
Hawaii	NOX	1,617	1,643
Hawaii	PM10	32	34
Hawaii	PM2_5	29	31

Region	Pollutant	2022	2026
Hawaii	SO2	72	78
Hawaii	VOC	73	78
Inland	CO	820	801
Inland	CO2	441,645	431,914
Inland	NH3	2	2
Inland	NOX	8,121	7,488
Inland	PM10	128	125
Inland	PM2_5	118	115
Inland	SO2	269	263
Inland	VOC	387	378
Pacific	CO	13,797	15,039
Pacific	CO2	6,586,834	7,165,481
Pacific	NH3	62	67
Pacific	NOX	114,530	117,870
Pacific	PM10	3,474	3,790
Pacific	PM2_5	3,196	3,486
Pacific	SO2	8,282	9,035
Pacific	VOC	6,956	7,589

4.2.3.5 Livestock population growth (livestock)

Packets:

nonpoint_projection_packet_2022_platform_2022hc_to_2026_updates_24dec2024_csv_24dec2024_v0

The 2022v1 livestock emissions were projected to year 2026 using projection factors created from the Greenhouse Gas Inventory tool (EPA, 2024b) For each analytic year, projection factors were created based on ratios between animal inventory counts between 2026 as compared to 2022. This process was completed for the animal categories of beef, dairy, chickens, turkeys, and swine. National factors were used to project emissions from beef and dairy cows, and state-specific factors were used to project emissions from swine although North Carolina requested state swine emissions to be held constant. Other livestock categories were held flat.

The projection factors were then applied to the base year emissions for the specific animal type to estimate the NH_3 and VOC emissions for 2026 are shown in Table 4-12.

Table 4-12. Impact of 2026 projection factors on livestock

Animal	Pollutant	Inventory Emissions	Final Emissions	Emissions Change	Emissions % Change
Beef	NH3	775,290	753,970	-21,320	-2.75%
Beef	VOC	62,023	60,249	-1,774	-2.86%
Chickens	NH3	473,844	473,844	0	0.00%
Chickens	VOC	37,908	37,908	0	0.00%
Dairy	NH3	350,829	349,496	-1,333	-0.38%
Dairy	VOC	28,066	28,201	134	0.48%
Swine	NH3	839,869	867,285	27,416	3.26%
Swine	VOC	67,190	69,383	2,193	3.26%

Animal	Pollutant	Inventory Emissions	Final Emissions	Emissions Change	Emissions % Change
Turkeys	NH3	82,538	82,538	0	0.00%
Turkeys	VOC	6,603	6,603	0	0.00%

4.2.3.6 Nonpoint Sources (nonpt)

Packets:

nonpoint_projection_packet_2022_platform_2022hc_to_2026_updates_24dec2024_csv_24dec2024_v0

In 2022v1, SCCs in the sector for nonpoint emissions not covered in other sectors were projected based on factors derived from specific surrogates for each SCC as identified by the Collaborative Nonpoint task force. One of the surrogates used was population. The county-specific population dataset used to derive changes between the base and analytic years was the Woods and Poole dataset used by BenMAP. The AEO energy consumption projections and economic projections used for many growth surrogates was AEO 2023. VMT-based projections are based on the final county-level VMT data developed for each of the years of the 2022v1 platform. For a complete list of nonpoint growth surrogates by SCC, see the NP_AnalyticYr_Crosswalk spreadsheet in the reports / nonpoint folder on the FTP site. Table 4-13 shows the impacts of the projection factors on the nonpt sector for 2026. The task force recommended no growth for the SCCs shown in Table 4-14.

Table 4-13. Impact of 2022-2026 projection factors on nonpt emissions

Pollutant	Inventory Emissions	Final Emissions	Emissions Change	Emissions % Change
CO	842,395	845,504	3,110	0.4%
NH3	69,594	68,102	-1,492	-2.1%
NOX	741,248	715,965	-25,283	-3.4%
PM10-PRI	489,860	500,617	10,757	2.2%
PM25-PRI	421,788	433,078	11,289	2.7%
SO2	75,760	63,123	-12,637	-16.7%
VOC	949,760	973,450	23,690	2.5%

Table 4-14. SCCs in nonpt that were held constant

SCC	Description
2801600300	Miscellaneous Area Sources; Agriculture Production – Crops; Agricultural Field Burning – Pile Burning; Orchard Crop Other Not Elsewhere Classified
2801600320	Miscellaneous Area Sources; Agriculture Production – Crops; Agricultural Field Burning – Pile Burning; Orchard Crop is Apple
2801600330	Miscellaneous Area Sources; Agriculture Production – Crops; Agricultural Field Burning – Pile Burning; Orchard Crop is Apricot
2801600350	Miscellaneous Area Sources; Agriculture Production – Crops; Agricultural Field Burning – Pile Burning; Orchard Crop is Cherry
2801600410	Miscellaneous Area Sources; Agriculture Production – Crops; Agricultural Field Burning – Pile Burning; Orchard Crop is Peach
2801600420	Miscellaneous Area Sources; Agriculture Production – Crops; Agricultural Field Burning – Pile Burning; Orchard Crop is Pear

SCC	Description
2801600430	Miscellaneous Area Sources; Agriculture Production – Crops; Agricultural Field Burning – Pile Burning; Orchard Crop is Prune
2801600500	Miscellaneous Area Sources; Agriculture Production – Crops; Agricultural Field Burning – Pile Burning; Vine Crop Other Not Elsewhere Classified
2104008100	Stationary Source Fuel Combustion; Residential; Wood; Fireplace: general
2104008210	Stationary Source Fuel Combustion; Residential; Wood; Woodstove: fireplace inserts; non-EPA certified
2104008220	Stationary Source Fuel Combustion; Residential; Wood; Woodstove: fireplace inserts; EPA certified; non-catalytic
2104008230	Stationary Source Fuel Combustion; Residential; Wood; Woodstove: fireplace inserts; EPA certified; catalytic
2104008300	Stationary Source Fuel Combustion; Residential; Wood; Woodstove: freestanding, general
2104008310	Stationary Source Fuel Combustion; Residential; Wood; Woodstove: freestanding, non-EPA certified
2104008320	Stationary Source Fuel Combustion; Residential; Wood; Woodstove: freestanding, EPA certified, non-catalytic
2104008330	Stationary Source Fuel Combustion; Residential; Wood; Woodstove: freestanding, EPA certified, catalytic
2104008400	Stationary Source Fuel Combustion; Residential; Wood; Woodstove: pellet-fired, general (freestanding or FP insert)
2104008510	Stationary Source Fuel Combustion; Residential; Wood; Furnace: Indoor, cordwood-fired, non-EPA certified
2104008530	Stationary Source Fuel Combustion; Residential; Wood; Furnace: Indoor, pellet-fired, general
2104008610	Stationary Source Fuel Combustion; Residential; Wood; Hydronic heater: outdoor
2104008620	Stationary Source Fuel Combustion; Residential; Wood; Hydronic heater: indoor
2104008630	Stationary Source Fuel Combustion; Residential; Wood; Hydronic heater: pellet-fired
2104008700	Stationary Source Fuel Combustion; Residential; Wood; Outdoor wood burning device, NEC (fire-pits, chimeas, etc)
2104009000	Stationary Source Fuel Combustion; Residential; Firelog; Total: All Combustor Types
2296000000	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives
2461021000	Solvent Utilization; Miscellaneous Non-industrial: Commercial; Cutback Asphalt; Total: All Solvent Types
2501011011	Storage and Transport; Petroleum and Petroleum Product Storage; Residential Portable Gas Cans; Permeation
2501011012	Storage and Transport; Petroleum and Petroleum Product Storage; Residential Portable Gas Cans; Evaporation (includes Diurnal losses)
2501011014	Storage and Transport; Petroleum and Petroleum Product Storage; Residential Portable Gas Cans; Refilling at the Pump - Vapor Displacement
2501012011	Storage and Transport; Petroleum and Petroleum Product Storage; Commercial Portable Gas Cans; Permeation
2501012012	Storage and Transport; Petroleum and Petroleum Product Storage; Commercial Portable Gas Cans; Evaporation (includes Diurnal losses)
2501012014	Storage and Transport; Petroleum and Petroleum Product Storage; Commercial Portable Gas Cans; Refilling at the Pump - Vapor Displacement
2501013010	Storage and Transport; Petroleum and Petroleum Product Storage; Residential/Commercial Portable Gas Cans; Total: All Types
2535000000	Storage and Transport; Bulk Materials Transport; All Transport Types; Total: All Products

SCC	Description
2601010000	Waste Disposal, Treatment, and Recovery; On-site Incineration; Industrial; Total
2610000100	Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Yard Waste - Leaf Species Unspecified
2610000300	Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Yard Waste - Weed Species Unspecified (incl Grass)
2610000400	Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Yard Waste - Brush Species Unspecified
2610000500	Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)
2610030000	Waste Disposal, Treatment, and Recovery; Open Burning; Residential; Household Waste (use 26-10-000-xxx for Yard Wastes)
2635000000	Waste Disposal, Treatment, and Recovery; Soil and Groundwater Remediation; All Categories; Total
2660000000	Waste Disposal, Treatment, and Recovery; Leaking Underground Storage Tanks; Leaking Underground Storage Tanks; Total: All Storage Types
2701200000	Natural Sources; Biogenic; Vegetation; Total
2701220000	Natural Sources; Biogenic; Vegetation/Agriculture; Total
2805035000	Miscellaneous Area Sources; Agriculture Production - Livestock; Horses and Ponies Waste Emissions; Not Elsewhere Classified
2805040000	Miscellaneous Area Sources; Agriculture Production - Livestock; Sheep and Lambs Waste Emissions; Total
2805045000	Miscellaneous Area Sources; Agriculture Production - Livestock; Goats Waste Emissions; Not Elsewhere Classified
2806010000	Miscellaneous Area Sources; Domestic Animals Waste Emissions; Cats; Total
2806015000	Miscellaneous Area Sources; Domestic Animals Waste Emissions; Dogs; Total
2810005000	Miscellaneous Area Sources; Other Combustion; Managed Burning, Slash (Logging Debris); Unspecified Burn Method (use 2610000500 for non-logging debris)
2810035000	Miscellaneous Area Sources; Other Combustion; Firefighting Training; Total
2810040000	Miscellaneous Area Sources; Other Combustion; Aircraft/Rocket Engine Firing and Testing; Total

Human Population Growth

For SCCs that were projected based on human population growth, population projection data were available from the Benefits Mapping and Analysis Program (BenMAP) model by county for several years, including 2022 and 2026. Population data for Populations for DE, NJ, and NC were state-provided. These human population data were used to create modified county-specific projection factors. The impacted SCCs are shown in Table 4-15. Growth factors were limited to 10% cumulative annual growth (e.g., four times 10% growth compounded over four years), but none of the factors fell outside that range. The state totals used for human population are shown in Table 4-16.

Table 4-15. SCCs in nonpt that use Human Population Growth for Projections

SCC	Description
2302002000	Industrial Processes;Food and Kindred Products: SIC 20;Commercial Cooking - Charbroiling;Charbroiling Total

SCC	Description
2302002100	Industrial Processes;Food and Kindred Products: SIC 20;Commercial Cooking - Charbroiling;Conveyorized Charbroiling
2302002200	Industrial Processes;Food and Kindred Products: SIC 20;Commercial Cooking - Charbroiling;Under-fired Charbroiling
2302003000	Industrial Processes;Food and Kindred Products: SIC 20;Commercial Cooking - Frying;Deep Fat Frying
2302003100	Industrial Processes;Food and Kindred Products: SIC 20;Commercial Cooking - Frying;Flat Griddle Frying
2302003200	Industrial Processes;Food and Kindred Products: SIC 20;Commercial Cooking - Frying;Clamshell Griddle Frying
2601020000	Waste Disposal, Treatment, and Recovery;On-site Incineration;Commercial/Institutional;Total
2620000000	Waste Disposal, Treatment, and Recovery;Landfills;All Categories;Total
2620010000	Waste Disposal, Treatment, and Recovery;Landfills;Industrial;Total
2620020000	Waste Disposal, Treatment, and Recovery;Landfills;Commercial/Institutional;Total
2620030000	Waste Disposal, Treatment, and Recovery;Landfills;Municipal;Total
2620030001	Waste Disposal, Treatment, and Recovery;Landfills;Municipal;Dumping/Crushing/Spreading of New Materials (working face)
2630010000	Waste Disposal, Treatment, and Recovery;Wastewater Treatment;Industrial;Total Processed
2630020000	Waste Disposal, Treatment, and Recovery;Wastewater Treatment;Public Owned;Total Processed
2630020010	Waste Disposal, Treatment, and Recovery;Wastewater Treatment;Public Owned;Wastewater Treatment Processes Total
2640000000	Waste Disposal, Treatment, and Recovery;TSDFs;All TSDF Types;Total: All Processes
2650000000	Waste Disposal, Treatment, and Recovery;Scrap and Waste Materials;Scrap and Waste Materials;Total: All Processes
2650000002	Waste Disposal, Treatment, and Recovery;Scrap and Waste Materials;Scrap and Waste Materials;Shredding
2680001000	Waste Disposal, Treatment, and Recovery;Composting;100% Biosolids (e.g., sewage sludge, manure, mixtures of these matls);All Processes
2680002000	Waste Disposal, Treatment, and Recovery;Composting;Mixed Waste (e.g., a 50:50 mixture of biosolids and green wastes);All Processes
2680003000	Waste Disposal, Treatment, and Recovery;Composting;100% Green Waste (e.g., residential or municipal yard wastes);All Processes
2810025000	Miscellaneous Area Sources;Other Combustion;Residential Grilling (see 23-02-002-xxx for Commercial);Total
2810060100	Miscellaneous Area Sources;Other Combustion;Cremation;Humans
2810060200	Miscellaneous Area Sources;Other Combustion;Cremation;Animals
2850000000	Miscellaneous Area Sources;Health Services;Hospitals;Total: All Operations
2850001000	Miscellaneous Area Sources;Health Services;Dental Alloy Production;Overall Process
2851001000	Miscellaneous Area Sources;Laboratories;Bench Scale Reagents;Total
2861000000	Miscellaneous Area Sources;Fluorescent Lamp Breakage;Fluorescent Lamp Breakage;Non-recycling Related Emissions: Total
2861000010	Miscellaneous Area Sources;Fluorescent Lamp Breakage;Fluorescent Lamp Breakage;Recycling Related Emissions: Total

Table 4-16. Human population projections by state

State	2022	2026
Alabama	5,092,444	5,224,148
Arizona	7,622,773	8,128,142
Arkansas	3,172,493	3,287,089
California	41,761,812	43,390,150
Colorado	5,912,984	6,230,097
Connecticut	3,721,597	3,790,209
Delaware	1,015,140	1,055,460
District of Columbia	691,095	709,826
Florida	22,123,665	23,374,209
Georgia	11,100,196	11,665,279
Idaho	1,803,013	1,897,210
Illinois	13,312,931	13,546,464
Indiana	6,897,517	7,059,224
Iowa	3,193,365	3,242,193
Kansas	3,041,479	3,119,802
Kentucky	4,654,934	4,788,804
Louisiana	4,890,790	5,025,848
Maine	1,397,624	1,432,823
Maryland	6,434,564	6,685,708
Massachusetts	6,982,317	7,116,327
Michigan	10,119,130	10,228,231
Minnesota	5,834,058	6,040,297
Mississippi	3,149,156	3,235,500
Missouri	6,358,501	6,519,480
Montana	1,095,591	1,136,131
Nebraska	1,977,983	2,032,652
Nevada	3,201,664	3,403,943
New Hampshire	1,406,100	1,448,565
New Jersey	9,135,956	9,244,588
New Mexico	2,296,905	2,415,541
New York	20,274,542	20,567,411
North Carolina	10,705,403	11,241,251
North Dakota	802,775	839,955
Ohio	11,879,937	12,036,028
Oklahoma	4,134,219	4,274,562
Oregon	4,296,405	4,475,608
Pennsylvania	13,127,695	13,315,053
Rhode Island	1,082,808	1,097,899
South Carolina	5,278,020	5,525,359
South Dakota	904,319	934,348
Tennessee	7,091,037	7,387,966

State	2022	2026
Texas	30,436,322	32,427,324
Utah	3,291,357	3,489,464
Vermont	663,235	682,819
Virginia	9,095,464	9,532,252
Washington	7,761,429	8,154,313
West Virginia	1,898,285	1,926,027
Wisconsin	6,043,228	6,195,531
Wyoming	636,149	665,384

EIA's Annual Energy Outlook (AEO) Reference Case Projections

Many of the nonpoint emissions were projected using the 2023 EIA's AEO (U.S. Energy Information Administration, 2023). The AEO is an assessment of the outlook for energy markets through 2050. These economic projections and energy consumption projections were mapped based on emissions processes. For economic based projections, an average of the projected change in employment and the project change in revenue was used for the growth indicator. These SCCs are shown in Table 4-17. For more in-depth details on the indicators see the NP_AnalyticYr_Crosswalk spreadsheet in the reports / nonpoint folder on the FTP site

Table 4-17. Cs in nonpt that use EIA's AE for Projections

SCC	SCC description	Growth Indicator
2102001000	Stationary Source Fuel Combustion; Industrial; Anthracite Coal; Total: All Boiler Types	Industrial/Other Industrial Coal
2102002000	Stationary Source Fuel Combustion; Industrial; Bituminous/Subbituminous Coal; Total: All Boiler Types	Industrial/Other Industrial Coal
2102004000	Stationary Source Fuel Combustion; Industrial; Distillate Oil; Total: Boilers and IC Engines	Industrial/Distillate Fuel Oil
2102004001	Stationary Source Fuel Combustion; Industrial; Distillate Oil; All Boiler Types	Industrial/Distillate Fuel Oil
2102004002	Stationary Source Fuel Combustion; Industrial; Distillate Oil; All IC Engine Types	Industrial/Distillate Fuel Oil
2102005000	Stationary Source Fuel Combustion; Industrial; Residual Oil; Total: All Boiler Types	Industrial/Residual Fuel Oil
2102006000	Stationary Source Fuel Combustion; Industrial; Natural Gas; Total: Boilers and IC Engines	Industrial/Natural Gas
2102007000	Stationary Source Fuel Combustion; Industrial; Liquified Petroleum Gas (LPG); Total: All Boiler Types	Industrial/Hydrocarbon Gas Liquids
2102008000	Stationary Source Fuel Combustion; Industrial; Wood; Total: All Boiler Types	Industrial/Renewable Energy
2102010000	Stationary Source Fuel Combustion; Industrial; Process Gas; Total: All Boiler Types	Industrial/Total Energy
2102011000	Stationary Source Fuel Combustion; Industrial; Kerosene; Total: All Boiler Types	Industrial/Other Petroleum

SCC	SCC description	Growth Indicator
2103001000	Stationary Source Fuel Combustion; Commercial/Institutional; Anthracite Coal; Total: All Boiler Types	Commercial/Coal
2103002000	Stationary Source Fuel Combustion; Commercial/Institutional; Bituminous/Subbituminous Coal; Total: All Boiler Types	Commercial/Coal
2103004000	Stationary Source Fuel Combustion; Commercial/Institutional; Distillate Oil; Total: Boilers and IC Engines	Commercial/Distillate Fuel Oil
2103004001	Stationary Source Fuel Combustion; Commercial/Institutional; Distillate Oil; Boilers	Commercial/Distillate Fuel Oil
2103004002	Stationary Source Fuel Combustion; Commercial/Institutional; Distillate Oil; IC Engines	Commercial/Distillate Fuel Oil
2103005000	Stationary Source Fuel Combustion; Commercial/Institutional; Residual Oil; Total: All Boiler Types	Commercial/Residual Fuel Oil
2103006000	Stationary Source Fuel Combustion; Commercial/Institutional; Natural Gas; Total: Boilers and IC Engines	Commercial/Natural Gas
2103007000	Stationary Source Fuel Combustion; Commercial/Institutional; Liquified Petroleum Gas (LPG); Total: All Combustor Types	Commercial/Propane
2103008000	Stationary Source Fuel Combustion; Commercial/Institutional; Wood; Total: All Boiler Types	Commercial/Renewable Energy
2103010000	Stationary Source Fuel Combustion; Commercial/Institutional; Process Gas; POTW Digester Gas-fired Boilers	Commercial/Total Energy
2103011000	Stationary Source Fuel Combustion; Commercial/Institutional; Kerosene; Total: All Combustor Types	Commercial/Kerosene
2104001000	Stationary Source Fuel Combustion; Residential; Anthracite Coal; Total: All Combustor Types	Residential/Coal
2104002000	Stationary Source Fuel Combustion; Residential; Bituminous/Subbituminous Coal; Total: All Combustor Types	Residential/Coal
2104004000	Stationary Source Fuel Combustion; Residential; Distillate Oil; Total: All Combustor Types	Residential/Distillate Fuel Oil
2104006000	Stationary Source Fuel Combustion; Residential; Natural Gas; Total: All Combustor Types	Residential/Natural Gas
2104007000	Stationary Source Fuel Combustion; Residential; Liquified Petroleum Gas (LPG); Total: All Combustor Types	Residential/Propane
2104011000	Stationary Source Fuel Combustion; Residential; Kerosene; Total: All Heater Types	Residential/Distillate Fuel Oil
2301000000	Industrial Processes; Chemical Manufacturing: SIC 28; All Processes; Total	EMPIND8-9 (Bulk Chemicals; Other Chemical Products); REVIND 15-24
2301010000	Industrial Processes; Chemical Manufacturing: SIC 28; Industrial Inorganic Chemical Manufacturing; Total	EMPIND8 (Bulk Chemicals); REVIND15
2301020000	Industrial Processes; Chemical Manufacturing: SIC 28; Process Emissions from Synthetic Fibers Manuf (NAPAP cat. 107); Total	EMPIND8 (Bulk Chemicals); REVIND18

SCC	SCC description	Growth Indicator
2302000000	Industrial Processes; Food and Kindred Products: SIC 20; All Processes; Total	EMPIND1-2 (Food Products; Beverage & Tobacco Products); REVIND2-6
2302010000	Industrial Processes; Food and Kindred Products: SIC 20; Meat Products; Total	EMPIND1 (Food Products); REVIND4
2302040000	Industrial Processes; Food and Kindred Products: SIC 20; Grain Mill Products; Total	EMPIND1 (Food Products); REVIND2
2302050000	Industrial Processes; Food and Kindred Products: SIC 20; Bakery Products; Total	EMPIND1 (Food Products); REVIND5
2302070000	Industrial Processes; Food and Kindred Products: SIC 20; Fermentation/Beverages; Total	EMPIND2 (Beverage & Tobacco Products); REVIND6
2302070001	Industrial Processes; Food and Kindred Products: SIC 20; Fermentation/Beverages; Breweries	EMPIND2 (Beverage & Tobacco Products); REVIND6
2302070005	Industrial Processes; Food and Kindred Products: SIC 20; Fermentation/Beverages; Wineries	EMPIND2 (Beverage & Tobacco Products); REVIND6
2302070010	Industrial Processes; Food and Kindred Products: SIC 20; Fermentation/Beverages; Distilleries	EMPIND2 (Beverage & Tobacco Products); REVIND6
2302080000	Industrial Processes; Food and Kindred Products: SIC 20; Miscellaneous Food and Kindred Products; Total	EMPIND1 (Food Products); REVIND5
2302080002	Industrial Processes; Food and Kindred Products: SIC 20; Miscellaneous Food and Kindred Products; Refrigeration	EMPIND1 (Food Products); REVIND5
2304000000	Industrial Processes; Secondary Metal Production: SIC 33; All Processes; Total	EMPIND13 (Primary Metals); REVIND33-35
2305000000	Industrial Processes; Mineral Processes: SIC 32; All Processes; Total	EMPIND12 (Nonmetallic Minerals); REVIND28-32
2306000000	Industrial Processes; Petroleum Refining: SIC 29; All Processes; Total	EMPIND10 (Petroleum and Coal Products); REVIND25-26
2306010000	Industrial Processes; Petroleum Refining: SIC 29; Asphalt Mixing Plants and Paving/Roofing Materials; Asphalt Paving/Roofing Materials: Total	EMPIND10 (Petroleum and Coal Products); REVIND25-26
2306010100	Industrial Processes; Petroleum Refining: SIC 29; Asphalt Mixing Plants and Paving/Roofing Materials; Asphalt Mixing Plants: Total	EMPIND10 (Petroleum and Coal Products); REVIND25-26
2307000000	Industrial Processes; Wood Products: SIC 24; All Processes; Total	EMPIND4 (Wood Products); REVIND8
2307020000	Industrial Processes; Wood Products: SIC 24; Sawmills/Planing Mills; Total	EMPIND4 (Wood Products); REVIND8
2308000000	Industrial Processes; Rubber/Plastics: SIC 30; All Processes; Total	EMPIND11 (Plastics and Rubber Products); REVIND27
2309000000	Industrial Processes; Fabricated Metals: SIC 34; All Processes; Total	EMPIND14 (Fabricated Metal Products); REVIND36

SCC	SCC description	Growth Indicator
2311010000	Industrial Processes; Construction: SIC 15 - 17; Residential; Total	EMPIND25-27 (Construction: Building, Heavy/Civil Engineering, Speciality Trade); REVIND48
2311020000	Industrial Processes; Construction: SIC 15 - 17; Industrial/Commercial/Institutional; Total	EMPIND25-27 (Construction: Building, Heavy/Civil Engineering, Speciality Trade); REVIND48
2312000000	Industrial Processes; Machinery: SIC 35; All Processes; Total	EMPIND15 (Machinery); REVIND37
2325000000	Industrial Processes; Mining and Quarrying: SIC 10 and SIC 14; All Processes; Total	EMPIND24 (Other Mining and Quarrying); REVIND47
2325020000	Industrial Processes; Mining and Quarrying: SIC 10 and SIC 14; Crushed and Broken Stone; Total	EMPIND24 (Other Mining and Quarrying); REVIND47
2325030000	Industrial Processes; Mining and Quarrying: SIC 10 and SIC 14; Sand and Gravel; Total	EMPIND24 (Other Mining and Quarrying); REVIND47
2325060000	Industrial Processes; Mining and Quarrying: SIC 10 and SIC 14; Lead Ore Mining and Milling; Total	EMPIND24 (Other Mining and Quarrying); REVIND47
2399000000	Industrial Processes; Industrial Processes: NEC; Industrial Processes: NEC; Total	EMPIND19 (Miscellaneous Manufacturing); REVIND41
2401010000	Solvent Utilization; Surface Coating; Textile Products: SIC 22; Total: All Solvent Types	EMPIND3 (Textiles, Apparel, and Leather); REVIND7
2401015000	Solvent Utilization; Surface Coating; Factory Finished Wood: SIC 2426 thru 242; Total: All Solvent Types	EMPIND4 (Wood Products); REVIND8
2401020000	Solvent Utilization; Surface Coating; Wood Furniture: SIC 25; Total: All Solvent Types	EMPIND5 (Furniture and Related Products); REVIND9
2401025000	Solvent Utilization; Surface Coating; Metal Furniture: SIC 25; Total: All Solvent Types	EMPIND5 (Furniture and Related Products); REVIND9
2401030000	Solvent Utilization; Surface Coating; Paper: SIC 26; Total: All Solvent Types	EMPIND6 (Paper Products); REVIND10
2401035000	Solvent Utilization; Surface Coating; Plastic Products: SIC 308; Total: All Solvent Types	EMPIND11 (Plastics and Rubber Products); REVIND27
2401040000	Solvent Utilization; Surface Coating; Metal Cans: SIC 341; Total: All Solvent Types	EMPIND14 (Fabricated Metal Products); REVIND36
2401045000	Solvent Utilization; Surface Coating; Metal Coils: SIC 3498; Total: All Solvent Types	EMPIND14 (Fabricated Metal Products); REVIND36
2401050000	Solvent Utilization; Surface Coating; Miscellaneous Finished Metals: SIC 34 - (341 + 3498); Total: All Solvent Types	EMPIND14 (Fabricated Metal Products); REVIND36
2401055000	Solvent Utilization; Surface Coating; Machinery and Equipment: SIC 35; Total: All Solvent Types	EMPIND15 (Machinery); REVIND37
2401060000	Solvent Utilization; Surface Coating; Large Appliances: SIC 363; Total: All Solvent Types	EMPIND18 (Appliance and Electrical Equipment); REVIND40

SCC	SCC description	Growth Indicator
2401065000	Solvent Utilization; Surface Coating; Electronic and Other Electrical: SIC 36 - 363; Total: All Solvent Types	EMPIND18 (Appliance and Electrical Equipment); REVIND40
2401070000	Solvent Utilization; Surface Coating; Motor Vehicles: SIC 371; Total: All Solvent Types	EMPIND17 (Transportation Equipment); REVIND39
2401075000	Solvent Utilization; Surface Coating; Aircraft: SIC 372; Total: All Solvent Types	EMPIND17 (Transportation Equipment); REVIND39
2401080000	Solvent Utilization; Surface Coating; Marine: SIC 373; Total: All Solvent Types	EMPIND17 (Transportation Equipment); REVIND39
2401085000	Solvent Utilization; Surface Coating; Railroad: SIC 374; Total: All Solvent Types	EMPIND17 (Transportation Equipment); REVIND39
2401090000	Solvent Utilization; Surface Coating; Miscellaneous Manufacturing; Total: All Solvent Types	EMPIND19 (Miscellaneous Manufacturing); REVIND41
2415000000	Solvent Utilization; Degreasing; All Processes/All Industries; Total: All Solvent Types	EMPIND19 (Miscellaneous Manufacturing); REVIND41
2440000000	Solvent Utilization; Miscellaneous Industrial; All Processes; Total: All Solvent Types	EMPIND19 (Miscellaneous Manufacturing); REVIND41
2461850000	Solvent Utilization; Miscellaneous Non-industrial: Commercial; Pesticide Application: Agricultural; All Processes	EMPIND20 (Crop Production); REVIND42
2501000000	Storage and Transport; Petroleum and Petroleum Product Storage; All Storage Types: Breathing Loss; Total: All Products	Total Energy/Petroleum and Other Liquids Subtotal
2501000120	Storage and Transport; Petroleum and Petroleum Product Storage; All Storage Types: Breathing Loss; Gasoline	Total Energy/Motor Gasoline
2501050000	Storage and Transport; Petroleum and Petroleum Product Storage; Bulk Terminals: All Evaporative Losses; Total: All Products	Total Energy/Petroleum and Other Liquids Subtotal
2501050120	Storage and Transport; Petroleum and Petroleum Product Storage; Bulk Terminals: All Evaporative Losses; Gasoline	Total Energy/Motor Gasoline
2501055120	Storage and Transport; Petroleum and Petroleum Product Storage; Bulk Plants: All Evaporative Losses; Gasoline	Total Energy/Motor Gasoline
2501060051	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Submerged Filling	Total Energy/Motor Gasoline
2501060052	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Splash Filling	Total Energy/Motor Gasoline
2501060053	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Balanced Submerged Filling	Total Energy/Motor Gasoline
2501060201	Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Underground Tank: Breathing and Emptying	Total Energy/Motor Gasoline
2501070053	Storage and Transport; Petroleum and Petroleum Product Storage; Diesel Service Stations; Stage 1: Balanced Submerged Filling	Transportation/Distillate Fuel Oil

SCC	SCC description	Growth Indicator
2501080050	Storage and Transport; Petroleum and Petroleum Product Storage; Airports : Aviation Gasoline; Stage 1: Total	Transportation/Other Petroleum
2501080100	Storage and Transport; Petroleum and Petroleum Product Storage; Airports : Aviation Gasoline; Stage 2: Total	Transportation/Other Petroleum
2501080201	Storage and Transport; Petroleum and Petroleum Product Storage; Airports : Aviation Gasoline; Underground Tank: Breathing and Emptying	Transportation/Other Petroleum
2501995120	Storage and Transport; Petroleum and Petroleum Product Storage; All Storage Types: Working Loss; Gasoline	Total Energy/Motor Gasoline
2505000030	Storage and Transport; Petroleum and Petroleum Product Transport; All Transport Types; Crude Oil	Total Energy/Petroleum and Other Liquids Subtotal
2505010000	Storage and Transport; Petroleum and Petroleum Product Transport; Rail Tank Car; Total: All Products	Total Energy/Petroleum and Other Liquids Subtotal
2505020000	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Total: All Products	Total Energy/Petroleum and Other Liquids Subtotal
2505020030	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Crude Oil	Total Energy/Petroleum and Other Liquids Subtotal
2505020060	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Residual Oil	Total Energy/Residual Fuel Oil
2505020090	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Distillate Oil	Total Energy/Distillate Fuel Oil
2505020120	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Gasoline	Total Energy/Motor Gasoline
2505020150	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Jet Naphtha	Total Energy/Jet Fuel
2505020180	Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Kerosene	Total Energy/Kerosene
2505030120	Storage and Transport; Petroleum and Petroleum Product Transport; Truck; Gasoline	Transportation/Motor Gasoline
2505040000	Storage and Transport; Petroleum and Petroleum Product Transport; Pipeline; Total: All Products	Total Energy/Petroleum and Other Liquids Subtotal
2505040120	Storage and Transport; Petroleum and Petroleum Product Transport; Pipeline; Gasoline	Total Energy/Motor Gasoline
2510000000	Storage and Transport; Organic Chemical Storage; All Storage Types: Breathing Loss; Total: All Products	EMPIND8 (Bulk Chemicals); REVIND16
2510050000	Storage and Transport; Organic Chemical Storage; Bulk Stations/Terminals: Breathing Loss; Total: All Products	EMPIND8 (Bulk Chemicals); REVIND16
2515040000	Storage and Transport; Organic Chemical Transport; Pipeline; Total: All Products	EMPIND8 (Bulk Chemicals); REVIND16
2520010000	Storage and Transport; Inorganic Chemical Storage; Commercial/Industrial: Breathing Loss; Total: All Products	EMPIND8 (Bulk Chemicals); REVIND15
2801000000	Miscellaneous Area Sources; Agriculture Production - Crops; Agriculture - Crops; Total	EMPIND20 (Crop Production); REVIND42

SCC	SCC description	Growth Indicator
2801000003	Miscellaneous Area Sources; Agriculture Production - Crops; Agriculture - Crops; Tilling	EMPIND20 (Crop Production); REVIND42
2801000005	Miscellaneous Area Sources; Agriculture Production - Crops; Agriculture - Crops; Harvesting	EMPIND20 (Crop Production); REVIND42
2801000008	Miscellaneous Area Sources; Agriculture Production - Crops; Agriculture - Crops; Transport	EMPIND20 (Crop Production); REVIND42
2801520000	Miscellaneous Area Sources; Agriculture Production - Crops; Orchard Heaters; Total, all fuels	EMPIND21 (Other Agriculture); REVIND44
2801530000	Miscellaneous Area Sources; Agriculture Production - Crops; Country Grain Elevators; Total	EMPIND21 (Other Agriculture); REVIND44
2802004001	Miscellaneous Area Sources; Agricultural Crop Usage; Agriculture Silage; Storage	EMPIND21 (Other Agriculture); REVIND44
2802004002	Miscellaneous Area Sources; Agricultural Crop Usage; Agriculture Silage; Mixing	EMPIND21 (Other Agriculture); REVIND44
2802004003	Miscellaneous Area Sources; Agricultural Crop Usage; Agriculture Silage; Feeding	EMPIND21 (Other Agriculture); REVIND44

4.2.3.7 Solvents (np_solvents)

Packets:

nonpoint_projection_packet_2022_platform_2022hc_to_2026_updates_24dec2024_csv_24dec2024_v0

Solvent emissions were projected in a way similar to how the nonpt sector was projected. Many SCCs in np_solvents that are projected using human population growth are shown in Table 4-18. For a complete list of solvent growth surrogates by SCC, see the NP_AnalyticYr_Crosswalk spreadsheet in the reports / nonpoint folder on the FTP site.

Table 4-18. SCCs in np_solvents that use Human Population Growth for Projections

SCC	SCC Descriptions
2401001000	Solvent Utilization;Surface Coating;Architectural Coatings;Total: All Solvent Types
2401005000	Solvent Utilization;Surface Coating;Auto Refinishing: SIC 7532;Total: All Solvent Types
2401005700	Solvent Utilization;Surface Coating;Auto Refinishing: SIC 7532;Top Coats
2401005800	Solvent Utilization;Surface Coating;Auto Refinishing: SIC 7532;Clean-up Solvents
2401100000	Solvent Utilization;Surface Coating;Industrial Maintenance Coatings;Total: All Solvent Types
2401200000	Solvent Utilization;Surface Coating;Other Special Purpose Coatings;Total: All Solvent Types
2420000000	Solvent Utilization;Dry Cleaning;All Processes;Total: All Solvent Types
2420000055	Solvent Utilization;Dry Cleaning;All Processes;Perchloroethylene
2420000999	Solvent Utilization;Dry Cleaning;All Processes;Solvents: NEC
2425000000	Solvent Utilization;Graphic Arts;All Processes;Total: All Solvent Types
2440000000	Solvent Utilization;Miscellaneous Industrial;All Processes;Total: All Solvent Types
2460030999	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;Lighter Fluid, Fire Starter, Other Fuels;Total: All Volatile Chemical Product Types

SCC	SCC Descriptions
2460100000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All Personal Care Products;Total: All Solvent Types
2460200000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All Household Products;Total: All Solvent Types
2460400000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All Automotive Aftermarket Products;Total: All Solvent Types
2460500000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All Coatings and Related Products;Total: All Solvent Types
2460600000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All Adhesives and Sealants;Total: All Solvent Types
2460800000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All FIFRA Related Products;Total: All Solvent Types
2460900000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;Miscellaneous Products (Not Otherwise Covered);Total: All Solvent Types
2461023000	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Asphalt Roofing;Total: All Solvent Types
2461100000	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Solvent Reclamation: All Processes;Total: All Solvent Types
2461800001	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Pesticide Application: All Processes;Surface Application

Table 4-19. Impact of projection factors on np_solvents emissions

Year	Pollutant	Inventory Emissions	Final Emissions	Emissions Change	Emissions % Change
2026	VOC	2,634,832	2,712,204	77,371	2.9%

4.2.3.8 Oil and Gas Sources (np_oilgas, pt_oilgas)

Packets:

np_oilgas_projection_packet_2026hc_KSappend_csv_11sep2024_v0
pt_oilgas_projection_packet_2026hc_KSappend_csv_21feb2025_v1

Analytic year projections for the 2022v1 platform were generated for point and nonpoint oil and gas sources for 2026. This projection consisted of three components: (1) applying facility closures to the pt_oilgas sector using the CoST CLOSURE packet (see Section 4.2.4); (2) using historical and/or forecast activity data to generate analytic-year emissions before applicable control technologies are applied using the CoST PROJECTION packet; and (3) estimating impacts of applicable control technologies on analytic-year emissions using the CoST CONTROL packet. Applying the CLOSURE packet to the pt_oilgas sector resulted in small emissions changes to the national summary shown in Table 4-5.

For pt_oilgas growth, the oil and gas sources were separated into production-related and pipeline-related sources by NAICS and SCC. These sources were further subdivided by fuel-type and by NAICS and SCC into either OIL, natural gas (NGAS), or BOTH (where oil or natural gas fuels are possible). The next two subsections describe the growth component of the process.

For np_oilgas growth oil and gas sources were separated into production-related and exploration-related sources. These sources were further separated into oil, natural gas or coal bed methane production related.

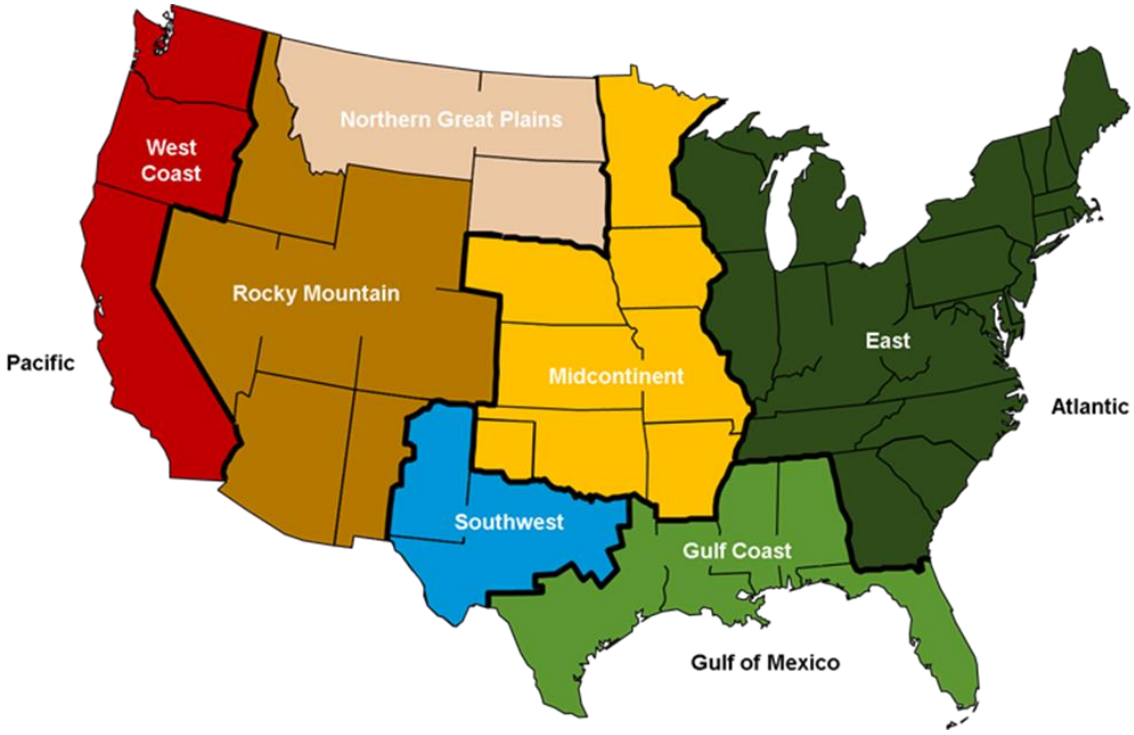
Production-related Sources (pt_oilgas, np_oilgas)

The growth factors for the production-related NAICS-SCC combinations were generated in a two-step process. The first step used historical production data at the state-level to get state-level short-term trends or factors from 2022 to year 2023. These historical data were acquired from EIA from the following links:

- Historical Natural Gas: http://www.eia.gov/dnav/ng/ng_sum_lsum_a_epg0_fgw_mmcf_a.htm
- Historical Crude Oil: http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm
- Historical CBM: https://www.eia.gov/dnav/ng/ng_prod_coalbed_s1_a.htm

The second step involved using the Annual Energy Outlook (AEO) 2023 reference case for the Lower 48 forecast production tables to project from the year 2023 to the desired analytic year. Specifically, *AEO 2023 Table 58 "Lower 48 Crude Oil Production and Wellhead Prices by Supply Region"* and *AEO 2023 Table 59 "Lower 48 Natural Gas Production and Supply Prices by Supply Region"* were used in this projection process. The AEO2023 forecast production is supplied for each EIA Oil and Gas Supply region shown in Figure 4-1.

Figure 4-1. EIA Oil and Gas Supply Regions as of AEO2023



The result of this second step is a growth factor for each Supply Region from 2023 to 2026. A Supply Region mapping to FIPS cross-walk was developed so the regional growth factors could be applied for each FIPS (for pt_oilgas) or to the county-level np_oilgas inventories. Note that portions of Texas are in

three different Supply Regions and portions of New Mexico are in two different supply regions. The state-level historical factor (from 2022 to 2023) was then multiplied by the Supply Region factor to produce a state-level or FIPS-level factor to grow from 2023 to 2026. This process was done using crude production forecast information to generate a factor to apply to oil-production related SCCs or NAICS-SCC combinations and it was also done using natural gas production forecast information to generate a factor to apply to natural gas-production related NAICS-SCC combinations. For the SCC and NAICS-SCC combinations that are designated "BOTH" the average of the oil-production and natural-gas production factors was calculated and applied to these specific combinations.

Texas provided updated basin specific production for 2022 and 2023 to allow for a better calculation of the estimated growth for this three-year period (http://webapps.rrc.texas.gov/PDQ/generalReportAction.do). The AEO2023 was used as described above for the three AEO Oil and Gas Supply Regions that include Texas counties to grow from 2023 to analytic year.

The state of New Mexico is broken up into two AEO Oil and Gas Supply Regions. County production data for New Mexico was obtained from their state website (https://wwwapps.emnrd.nm.gov/ocd/ocdpermitting/Reporting/Production/CountyProductionInjectionSummary.aspx) so that a better estimate of growth from 2022 to 2023 for the AEO Supply Regions in New Mexico could be calculated.

The state of Kansas provided county specific growth factors for production-related sources. Kansas used historical well information to derive their growth factors for oil and gas SCCs.

Transmission-related Sources (pt_oilgas)

Projection factors for transmissions-related sources were generated using the same AEO2023 tables used for production sources. These growth factors sources were developed solely using AEO 2023 data for the entire lower 48 states. For each analytic year, one national factor was used for oil transmission and another national factor was used for natural gas transmission. The 2022 to 2026 growth for oil transmissions is 9.3% and for natural gas transmission is -0.5%. The impact of the projection factors on the pt_oilgas emissions is shown in Table 4-20.

Table 4-20. Impact of projections on pt_oilgas emissions

Year	Pollutant	Inventory Emissions	Final Emissions	Emissions Change	Emissions % Change
2026	CO	164,139	169,414	5,275	3.2%
2026	NH3	322	305	-17	-5.3%
2026	NOX	330,214	338,671	8,457	2.6%
2026	PM10-PRI	12,959	13,456	497	3.8%
2026	PM25-PRI	11,477	11,841	364	3.2%
2026	SO2	29,576	31,308	1,732	5.9%
2026	VOC	194,885	207,653	12,767	6.6%

Exploration-related Sources (np_oilgas)

Years 2018, 2019 and 2022 exploration activity were averaged and the resulting 3-year average activity used in the 2020NEI version of the Oil and Gas Tool to generate exploration emissions for 2026. Table 4-21 provides a high-level national summary of the emissions data for the three year-average. This three-year averaged-activity derived emissions data were used in 2022v1 because they reflected the most recent average of exploration activity and emissions. Note that CoST was not used to perform this projection step for exploration sources, but is used to apply controls to exploration sources for each analytic year. The change in emissions from 2022 to 2026 due to the impact of the projections is shown in Table 4-22.

Table 4-21. Three year average of national oil and gas exploration emissions

Pollutant	Emissions (tons)
CO	14,809
NH3	15
NOX	52,611
PM10-PRI	1,075
PM25-PRI	1,039
SO2	6,383
VOC	106,427

Table 4-22. Impact of projections on np_oilgas emissions

Year	Pollutant	Inventory Emissions	Final Emissions	Emissions Change	Emissions % Change
2026	CO	680,698	717,896	37,198	5.5%
2026	NH3	3,771	4,287	516	13.7%
2026	NOX	543,771	579,378	35,607	6.5%
2026	PM10-PRI	9,481	9,856	375	4.0%
2026	PM25-PRI	9,465	9,841	376	4.0%
2026	SO2	278,368	305,846	27,478	9.9%
2026	VOC	2,501,145	2,710,839	209,694	8.4%

4.2.3.9 Non-EGU point sources (ptnonipm)

Packets:

ptnonipm_projection_packet_2022v1_revision_2022hc_to_2026_02jan2025_21feb2025_v1
Projection_2022_2026_for_2022v1_ptnonipm_NJ_overrides_20dec2024_v0

Projection factors for ptnonipm were developed by industrial sector from AEO 2023 to project emissions from 2022 to 2026. Emissions were mapped to AEO categories by NAICS and SCC (combination of NAICS and SCC first, SCC only after that) and projection factors were created using a ratio between the base year and projection year estimates from each specific AEO category. SCC/NAICS combinations with emissions >100tons/year for any CAP were mapped to AEO sector and fuel. Table 4-23 details the AEO2023 tables used to map SCCs to AEO categories for the projections of industrial sources. The impact of the projection packets other than the refinery adjustments from 2022 to 2026 is shown in Table 4-24.

The NJ override packets act to hold facilities flat which would have otherwise been decreased (state comment) so a table for that really isn't applicable. The computation of the refinery adjustments is described in the latter part of this subsection.

Table 4-23. Annual Energy Outlook (AEO) 2023 tables used to project industrial sources

AEO 2023 Table #	AEO Table name
2	Energy Consumption by Sector and Source
24	Refining Industry Energy Consumption
25	Food Industry Energy Consumption
26	Paper Industry Energy Consumption
27	Bulk Chemical Industry Energy Consumption
28	Glass Industry Energy Consumption
29	Cement Industry Energy Consumption
30	Iron and Steel Industries Energy Consumption
31	Aluminum Industry Energy Consumption
32	Metal Based Durables Energy Consumption
33	Other Manufacturing Sector Energy Consumption
34	Nonmanufacturing Sector Energy Consumption

Table 4-24. Impact of projections other than refinery adjustments on ptnonipm emissions

Year	Pollutant	Inventory Emissions	Final Emissions	Emissions Change	Emissions % Change
2026	CO	1,191,726	1,161,131	-30,595	-2.6%
2026	NH3	60,624	60,081	-544	-0.9%
2026	NOX	733,122	715,388	-17,734	-2.4%
2026	PM10-PRI	341,507	337,484	-4,023	-1.2%
2026	PM25-PRI	220,869	217,184	-3,684	-1.7%
2026	SO2	429,542	418,997	-10,545	-2.5%
2026	VOC	720,157	700,431	-19,726	-2.7%

4.2.3.10 Railroads (rail)

Packets:

Projection_rail_2022hc_to_2026_future_year_16aug2024_v0

Rail projection factors are relatively flat. Rail emissions were projected based on factors derived for categories of locomotives based on AEO (fuel use) growth rates including some adjustments. Table 4-25 shows the projection factors used for the various locomotive categories.

Table 4-25. Projection factors for Rail SCCs from the 2022 Base Year

STB R-1 Fuel Use Data Trends 2005-2023	Passenger Rail SCCs: 2285002008, 2285002009	2022 Switcher & class 2/3 SCCs: 28500201, 2285002007	Line Haul 2022 Projection Factors SCCs: 2285002006
2022	1.000	1.000	1.000
2023	1.038	0.986	0.986
2024	1.060	1.026	1.045
2025	1.075	1.002	1.027
2026	**1.091**	**0.959**	**0.991**

4.2.3.11 Residential Wood Combustion (rwc)

For residential wood combustion emissions in the 2022v1 platform, it was determined to hold the emissions flat at the base year levels for 2026.

4.2.4 CoST CONTROL Packets (nonpt, np_oilgas, ptnonipm, pt_oilgas, np_solvents)

The final step in the projection of emissions to an analytic year is the application of any control technologies or programs. For analytic-year New Source Performance Standards (NSPS) controls (e.g., oil and gas, Reciprocating Internal Combustion Engines (RICE), Natural Gas Turbines, and Process Heaters), we attempted to control only new sources/equipment using the following equation to account for growth and retirement of existing sources and the differences between the new and existing source emission rates.

$$Qn = Qo\{[(1+Pf)t-1]Fn + (1-Ri)t\ Fe + [1-(1-Ri)t]Fn\}$$ **Equation 4-1**

where:

Qn = emissions in projection year
Qo = emissions in base year
Pf = growth rate expressed as ratio (e.g., 1.5=50 percent cumulative growth)
t = number of years between base and analytic years
Fn = emission factor ratio for new sources
Ri = retirement rate, expressed as whole number (e.g., 3.3 percent=0.033)
Fe = emission factor ratio for existing sources

The first term in Equation 4-1 represents new source growth and controls, the second term accounts for retirement and controls for existing sources, and the third term accounts for replacement source controls. For computing the CoST % reductions (Control Efficiency) for nonpt and ptnonipm sectors, the simplified Equation 4-2 was used for analytic year projections:

$$\text{Control Efficiency}_{202x}(\%) = 100 \times \left(1 - \frac{[(Pf_{202x}-1)\times Fn + (1-Ri)^{12} + (1-(1-Ri)^{12})\times Fn]}{Pf_{202x}}\right)$$ **Equation 4-2**

For example, to compute the control efficiency for 2026 from a base year of 2022 the existing source emissions factor (Fe) is set to 1.0; 2026 (the analytic year) minus 2022 (the base year) is 4, and the new source emission factor (Fn) is the ratio of the NSPS emission factor to the existing emission factor. Note for the np_oilgas and pt_oilgas sectors the Fe is *not* assumed to be 1.0 for the Oil and Gas NSPS.

The NSPS are applied to sectors and with the specified retirement rates (R) as follows:

- The Oil and Gas NSPS from 2024 is applied to the np_oilgas and pt_oilgas sectors with no assumed retirement rate.
- The RICE NSPS for Compression Ignition (CI) engines that originated in 2006 but was amended as recently as 2024 is applied to the np_oilgas, pt_oilgas, nonpt, and ptnonipm sectors with an assumed retirement rate of 40 years (2.5%). The same retirement rate was used for the RICE NSPS for spark ignition engines that originated in 2008 and was amended as recently as 2024.
- The Gas Turbines NSPS that originated as subpart GG I 1979 but for subpart KKKK originated in 2006 is applied to the pt_oilgas and ptnonipm sectors with an assumed retirement rate of 45 years (2.2%).
- The Process Heaters NSPS with origination date around 2006-2010 is applied to the pt_oilgas and ptnonipm sectors with an assumed retirement rate of 30 years (3.3%).

Table 4-26 shows the values for the emission factors for new sources (Fn) with respect to each NSPS regulation and other conditions within. Further information about the application of NSPS controls can be found in Section 4 of the *Additional Updates to Emissions Inventories for the Version 6.3, 2011 Emissions Modeling Platform for the Year 2023* technical support document (EPA, 2017).

Table 4-26. Assumed new source emission factor ratios for NSPS rules

NSPS	Pollutants	Applied where?	New Source Emission Factor (Fn)
Oil and Gas	VOC	Storage Tanks	Varies by state-SCC
Oil and Gas	VOC	Gas Well Completions: 95% control (regardless)	0.05
Oil and Gas	VOC	Pneumatic controllers, not high-bleed >6scfm or low-bleed	Varies by state-SCC
Oil and Gas	VOC	Pneumatic controllers, high-bleed >6scfm or low-bleed	Varies by state-SCC
Oil and Gas	VOC	Compressor Seals	Varies by state-SCC
Oil and Gas	VOC	Fugitive Emissions: 60% Valves, flanges, connections, pumps, open-ended lines, and other	Varies by state-SCC
RICE	NOx	Lean burn: PA, all other states	0.25, 0.606
RICE	NOx	Rich Burn: PA, all other states	0.1, 0.069
RICE	NOx	Combined (average) LB/RB: PA, other states	0.175, 0.338
RICE	CO	Lean burn: PA, all other states	1.0 (n/a), 0.889
RICE	CO	Rich Burn: PA, all other states	0.15, 0.25
RICE	CO	Combined (average) LB/RB: PA, other states	0.575, 0.569
RICE	VOC	Lean burn: PA, all other states	0.125, n/a
RICE	VOC	Rich Burn: PA, all other states	0.1, n/a
RICE	VOC	Combined (average) LB/RB: PA, other states	0.1125, n/a

NSPS	Pollutants	Applied where?	New Source Emission Factor (Fn)
Gas Turbines	NOx	California and NO_X SIP Call states	0.595
Gas Turbines	NOx	All other states	0.238
Process Heaters	NO_X	Nationally to Process Heater SCCs	0.41

4.2.4.1 Oil and Gas NSPS (np_oilgas, pt_oilgas)

Packets:

Control_2022_2026_OilGas_NSPS_np_oilgas_2022v1platform_03dec2024_v0
Control_2022_2026_OilGas_NSPS_np_oilgas_2022v1platform_KSupdate_03dec2024_v0
Control_2022_2026_OilGas_NSPS_pt_oilgas_2022v1platform_03dec2024_v0
Control_2022_2026_OilGas_NSPS_pt_oilgas_2022v1platform_KSupdate_03dec2024_v0

New packets to reflect the Oil and Gas NSPS were developed for the 2022 platform. For oil and gas NSPS controls, except for gas well completions (a 95 percent control), the assumption of no equipment retirements through year 2032 dictates that NSPS controls are applied to the growth component only of any PROJECTION factors. For example, if a growth factor is 1.5 for storage tanks (indicating a 50 percent increase activity), then, using Table 4-26, the 70.3 percent VOC NSPS control to this new growth will result in a 23.4 percent control: 100 *(70.3 * (1.5 -1) / 1.5); this yields an "effective" growth rate (combined PROJECTION and CONTROL) of 1.1485, or a 70.3 percent reduction from 1.5 to 1.0. The impacts of all non-drilling completion VOC NSPS controls are therefore greater where growth in oil and gas production is assumed highest.

Conversely, for oil and gas basins with assumed negative growth in activity/production, VOC NSPS controls will be limited to well completions only. These reductions are year-specific because projection factors for these sources are year-specific. Note that Fe and Fn emissions factor ratios for oil and gas emissions vary by state and by SCC in this emissions modeling platform. In some cases, pneumatic devices/pumps emissions are estimated to reach 100% control based on information available at the time, thus emissions are zero.

The packets with KSupdate in their names cover only the state of Kansas, while the other packets cover all other states. For details on growth and control factors used in CoST see https://gaftp.epa.gov/Air/emismod/2022/v1/reports/projection_controls/final_analytic/ for report summaries.

Table 4-27 shows the emission reductions for the oil and gas sectors as a result of applying the oil and gas NSPS. Table 4-28 and Table 4-29 list the SCCs in the np_oilgas and pt_oilgas sectors for which the Oil and Gas NSPS controls were. Note that controls are applied to both production and exploration-related SCCs.) For np_oilgas, the exploration-related pre-CoST emissions for 2022 are computed using an average across multiple years and are different than the 2022hc emissions. Thus, the two sets of emissions are shown in different columns.

Table 4-27. Emissions reductions for the oil and gas sectors due to applying the Oil and Gas NSPS

Sector	Year	Pollutant	2022hc	2022 pre-CoST emissions	Emissions change from 2022	% change
np_oilgas	2026	VOC	2,767,230	2,788,266	-892,682	-32.0%
pt_oilgas	2026	VOC	211,419	211,419	-14,701	-7.0%

Table 4-28. SCCs in np_oilgas for which the Oil and Gas NSPS controls were applied

SCC	PRODUCT	OG_NSPS_SCC	TOOL OR STATE	Source category	SCC Description*
2310010200	OIL	1. Storage Tanks	TOOL	PRODUCTION	Crude Petroleum;Oil Well Tanks - Flashing & Standing/Working/Breathing
2310010300	OIL	3. Pneumatic Devices	TOOL	PRODUCTION	Crude Petroleum;Oil Well Pneumatic Devices
2310011001	OIL	5a. Associated Gas Venting	TOOL	PRODUCTION	On-Shore Oil Production;Associated Gas Venting
2310011020	OIL	1. Storage Tanks	STATE	PRODUCTION	On-Shore Oil Production;Storage Tanks: Crude Oil
2310011450	OIL	4. Fugitives	STATE	PRODUCTION	On-Shore Oil Production;Wellhead
2310011500	OIL	4. Fugitives	STATE	PRODUCTION	On-Shore Oil Production;Fugitives: All Processes
2310011501	OIL	4. Fugitives	TOOL	PRODUCTION	On-Shore Oil Production;Fugitives: Connectors
2310011502	OIL	4. Fugitives	TOOL	PRODUCTION	On-Shore Oil Production;Fugitives: Flanges
2310011503	OIL	4. Fugitives	TOOL	PRODUCTION	On-Shore Oil Production;Fugitives: Open Ended Lines
2310011505	OIL	4. Fugitives	TOOL	PRODUCTION	On-Shore Oil Production;Fugitives: Valves
2310021010	NGAS	1. Storage Tanks	TOOL	PRODUCTION	On-Shore Gas Production;Storage Tanks: Condensate
2310021300	NGAS	3. Pneumatic Devices	TOOL	PRODUCTION	On-Shore Gas Production;Gas Well Pneumatic Devices
2310021310	NGAS	3. Pneumatic Devices	STATE	PRODUCTION	On-Shore Gas Production;Gas Well Pneumatic Pumps
2310021501	NGAS	4. Fugitives	TOOL	PRODUCTION	On-Shore Gas Production;Fugitives: Connectors
2310021502	NGAS	4. Fugitives	TOOL	PRODUCTION	On-Shore Gas Production;Fugitives: Flanges
2310021503	NGAS	4. Fugitives	TOOL	PRODUCTION	On-Shore Gas Production;Fugitives: Open Ended Lines
2310021505	NGAS	4. Fugitives	TOOL	PRODUCTION	On-Shore Gas Production;Fugitives: Valves
2310021506	NGAS	4. Fugitives	TOOL	PRODUCTION	On-Shore Gas Production;Fugitives: Other
2310021509	NGAS	4. Fugitives	STATE	PRODUCTION	On-Shore Gas Production;Fugitives: All Processes
2310021602	NGAS	2. Well Completions	STATE	EXPLORATION	On-Shore Gas Production;Gas Well Venting - Recompletions
2310023010	CBM	1. Storage Tanks	TOOL	PRODUCTION	Coal Bed Methane Natural Gas;Storage Tanks: Condensate

SCC	PRODUCT	OG_NSPS_SCC	TOOL OR STATE	Source category	SCC Description*
2310023300	CBM	3. Pneumatic Devices	TOOL	PRODUCTION	Coal Bed Methane Natural Gas;Pneumatic Devices
2310023310	CBM	3. Pneumatic Devices	TOOL	PRODUCTION	Coal Bed Methane Natural Gas;Pneumatic Pumps
2310023509	CBM	4. Fugitives	STATE	PRODUCTION	Coal Bed Methane Natural Gas;Fugitives
2310023511	CBM	4. Fugitives	TOOL	PRODUCTION	Coal Bed Methane Natural Gas;Fugitives: Connectors
2310023512	CBM	4. Fugitives	TOOL	PRODUCTION	Coal Bed Methane Natural Gas;Fugitives: Flanges
2310023513	CBM	4. Fugitives	TOOL	PRODUCTION	Coal Bed Methane Natural Gas;Fugitives: Open Ended Lines
2310023515	CBM	4. Fugitives	TOOL	PRODUCTION	Coal Bed Methane Natural Gas;Fugitives: Valves
2310023516	CBM	4. Fugitives	TOOL	PRODUCTION	Coal Bed Methane Natural Gas;Fugitives: Other
2310023600	CBM	2. Well Completions	TOOL	EXPLORATION	Coal Bed Methane Natural Gas;CBM Well Completion: All Processes
2310111401	OIL	3. Pneumatic Devices	TOOL	PRODUCTION	On-Shore Oil Exploration;Oil Well Pneumatic Pumps
2310111700	OIL	2. Well Completions	TOOL	EXPLORATION	On-Shore Oil Exploration;Oil Well Completion: All Processes
2310121401	NGAS	3. Pneumatic Devices	TOOL	PRODUCTION	On-Shore Gas Exploration;Gas Well Pneumatic Pumps
2310121700	NGAS	2. Well Completions	TOOL	EXPLORATION	On-Shore Gas Exploration;Gas Well Completion: All Processes
2310121702	NGAS	2. Well Completions	STATE	EXPLORATION	On-Shore Gas Exploration;Gas Well Completion: Venting
2310321010	NGAS	1. Storage Tanks	STATE	PRODUCTION	On-Shore Gas Production - Conventional;Storage Tanks: Condensate
2310421010	NGAS	1. Storage Tanks	STATE	PRODUCTION	On-Shore Gas Production - Unconventional;Storage Tanks: Condensate

* All SCC descriptions in this table start with “Industrial Processes;Oil and Gas Exploration and Production;”

Table 4-29. SCCs in pt_oilgas for which the Oil and Gas NSPS controls were applied

SCC	Fuel	OG_NSPS_ SCC	SCC Description*
31000101	OIL	2. Well Completions	Industrial Processes;Oil and Gas Production;Crude Oil Production;Well Completion;;
31000124	OIL	4. Fugitives	Industrial Processes;Oil and Gas Production;Crude Oil Production;Valves: General;;
31000125	OIL	4. Fugitives	Industrial Processes;Oil and Gas Production;Crude Oil Production;Relief Valves;;
31000126	OIL	4. Fugitives	Industrial Processes;Oil and Gas Production;Crude Oil Production;Pump Seals;;
31000127	OIL	4. Fugitives	Industrial Processes;Oil and Gas Production;Crude Oil Production;Flanges and Connections;;
31000133	OIL	1. Storage Tanks	Industrial Processes;Oil and Gas Production;Crude Oil Production;Storage Tank;;

SCC	Fuel	OG_NSPS_ SCC	SCC Description*
31000151	OIL	3. Pneumatic Devices	Industrial Processes;Oil and Gas Production;Crude Oil Production;Pneumatic Controllers, Low Bleed;;
31000152	OIL	3. Pneumatic Devices	Industrial Processes;Oil and Gas Production;Crude Oil Production;Pneumatic Controllers High Bleed >6 scfh;;
31000153	OIL	3. Pneumatic Devices	Industrial Processes;Oil and Gas Production;Crude Oil Production;Pneumatic Controllers Intermittent Bleed;;
31000207	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Production;Valves: Fugitive Emissions;;
31000212	NGAS	1. Storage Tanks	Industrial Processes;Oil and Gas Production;Natural Gas Production;Condensate Storage Tank;;
31000213	NGAS	1. Storage Tanks	Industrial Processes;Oil and Gas Production;Natural Gas Production;Produced Water Storage Tank;;
31000214	NGAS	1. Storage Tanks	Industrial Processes;Oil and Gas Production;Natural Gas Production;Natural Gas Liquids Storage Tank;;
31000220	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Production;All Equipt Leak Fugitives (Valves, Flanges, Connections, Seals, Drains;;
31000222	NGAS	2. Well Completions	Industrial Processes;Oil and Gas Production;Natural Gas Production;Well Completions;;
31000223	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Production;Relief Valves;;
31000224	NGAS	3. Pneumatic Devices	Industrial Processes;Oil and Gas Production;Natural Gas Production;Pump Seals;;
31000225	NGAS	6. Compressors	Industrial Processes;Oil and Gas Production;Natural Gas Production;Compressor Seals;;
31000226	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Production;Flanges and Connections;;
31000231	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Production;Fugitives: Drains;;
31000233	NGAS	3. Pneumatic Devices	Industrial Processes;Oil and Gas Production;Natural Gas Production;Pneumatic Controllers, Low Bleed;;
31000234	NGAS	3. Pneumatic Devices	Industrial Processes;Oil and Gas Production;Natural Gas Production;Pneumatic Controllers, High Bleed >6 scfh;;
31000235	NGAS	3. Pneumatic Devices	Industrial Processes;Oil and Gas Production;Natural Gas Production;Pneumatic Controllers Intermittent Bleed;;
31000306	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Processing;Process Valves;;
31000307	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Processing;Relief Valves;;
31000308	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Processing;Open-ended Lines;;
31000309	NGAS	6. Compressors	Industrial Processes;Oil and Gas Production;Natural Gas Processing;Compressor Seals;;
31000311	NGAS	4. Fugitives	Industrial Processes;Oil and Gas Production;Natural Gas Processing;Flanges and Connections;;
31000312	NGAS	6a. Centrifugal Compressors	Industrial Processes;Oil and Gas Production;Natural Gas Processing;Centrifugal Compressor;;
31000313	NGAS	6b. Reciprocating Compressors	Industrial Processes;Oil and Gas Production;Natural Gas Processing;Reciprocating Compressor;;
31000506	OIL	1. Storage Tanks	Industrial Processes;Oil and Gas Production;Liquid Waste Treatment;Oil-Water Separation Wastewater Holding Tanks;;

SCC	Fuel	OG_NSPS_ SCC	SCC Description*
31088801	BOTH	4. Fugitives	Industrial Processes;Oil and Gas Production;Fugitive Emissions;Specify in Comments Field;;
31088811	BOTH	4. Fugitives	Industrial Processes;Oil and Gas Production;Fugitive Emissions;Fugitive Emissions;;
31700101	NGAS	3. Pneumatic Devices	Industrial Processes;NGTS;Natural Gas Transmission and Storage Facilities;Pneumatic Controllers Low Bleed;;
31700103	NGAS	3. Pneumatic Devices	Industrial Processes;NGTS;Natural Gas Transmission and Storage Facilities;Pneumatic Controllers Intermittent Bleed;;

* For all entries in this table, TOOL OR STATE = STATE and SRC_CAT = PRODUCTION; In the SCC description, IP is an abbreviation for Industrial Processes and CE is an abbreviation for Chemical Evaporation

4.2.4.2 RICE NSPS (nonpt, ptnonipm, np_oilgas, pt_oilgas)

Packets:

Control_2022_2026_RICE_NSPS_np_oilgas_2022v1platform_09sep2024_v0
Control_2022_2026_RICE_NSPS_np_oilgas_2022v1platform_KSupdate_16oct2024_v0
Control_2022_2026_RICE_NSPS_pt_oilgas_2022v1platform_09sep2024_v0
Control_2022_2026_RICE_NSPS_pt_oilgas_2022v1platform_KSupdate_16oct2024_v0
Control_2022_2026_RICE_NSPS_nonpt_ptnonipm_2022v1platform_07oct2024_v1

Multiple sectors are affected by the RICE NSPS controls (https://www.epa.gov/stationary-engines/compliance-requirements-stationary-engines). For the pt_oilgas and np_oilgas sectors, year-specific RICE NSPS factors were generated for 2026. New growth factors based on AEO2023 and state-specific production data were calculated for the oil and gas sectors which were included in the calculation of the new RICE NSPS control factors. Note that Kansas specific county growth factors were used and therefore, the packets with KSupdate in their names are used in addition to the other packets that contain data used for the rest of the states. For RICE NSPS controls, the EPA emission requirements for stationary engines differ according to whether the engine is new or existing, whether the engine is located at an area source or major source, and whether the engine is a compression ignition or a spark ignition engine. Spark ignition engines are further subdivided by power cycle, two-stroke versus four-stroke, and whether the engine is rich burn or lean burn. The NSPS reduction was applied to lean burn, rich burn and "combined" engines using Equation 4-2 and information listed in Table 4-26.

Table 4-30, Table 4-31, Table 4-32 and Table 4-33 show the reductions in emissions in the nonpt, ptnonipm, and np_oilgas and pt_oilgas sectors after the application of the RICE NSPS CONTROL packet. Note that for nonpoint oil and gas, VOC reductions were only appropriate in the state of Pennsylvania. For np_oilgas, the exploration-related pre-CoST emissions for 2022 are computed using an average across multiple years and are different than the 2022hc emissions. Thus, the two sets of emissions are shown in different columns in Table 4-32. Table 4-34, Table 4-35, and Table 4-36 show the SCCs to which the NSPS controls are applied in the nonpt, ptnonipm, np_oilgas, and pt_oilgas sectors.

Table 4-30. Emissions reductions in nonpt due to RICE NSPS

year	Poll	2022hc (tons)	Emissions changes (tons)	% change
2026	CO	842,395	-5,684	-0.7%
2026	NOX	741,248	-10,601	-1.4%
2026	VOC	949,760	-55	0.0%

Table 4-31. Emissions reductions in ptnonipm due to the RICE NSPS

year	poll	2022hc (tons)	Emissions changes (tons)	% change
2026	CO	1,207,678	-107	-0.01%
2026	NOX	780,504	-226	-0.03%
2026	VOC	732,606	-1	0.00%

Table 4-32. Emissions reductions in np_oilgas due to the RICE NSPS

Year	Poll	2022hc (tons)	2022 pre-CoST emissions	Emissions change	% change
2026	CO	705,089	695,507	-26,585	-3.8%
2026	NOX	679,016	596,382	-45,346	-7.6%
2026	VOC	2,767,230	2,788,266	-31	0.00%

Table 4-33. Emissions reductions in pt_oilgas due to the RICE NSPS

Year	Pollutant	2022hc (tons)	Emissions change (tons)	% change
2026	CO	188,876	-4,942	-2.6%
2026	NOX	365,805	-11,614	-3.2%
2026	VOC	211,419	-45	-0.02%

Table 4-34. SCCs and Engine Types where RICE NSPS controls applied for nonpt and ptnonipm

SCC	Lean, Rich, or Combined	SCCDESC
20200202	Combined	Internal Combustion Engines; Industrial; Natural Gas; Reciprocating
20200253	Rich	Internal Combustion Engines; Industrial; Natural Gas; 4-cycle Rich Burn
20200254	Lean	Internal Combustion Engines; Industrial; Natural Gas; 4-cycle Lean Burn
20200256	Lean	Internal Combustion Engines; Industrial; Natural Gas; 4-cycle Clean Burn
20300201	Combined	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Reciprocating
31000203	Combined	Industrial Processes;Oil and Gas Production;Natural Gas Production;Compressors (See also 310003-12 and -13)
2102006000	Combined	Stationary Source Fuel Combustion; Industrial; Natural Gas; Total: Boilers and IC Engines
2103006000	Combined	Stationary Source Fuel Combustion; Commercial/Institutional; Natural Gas; Total: Boilers and IC Engines

Table 4-35. Non-point Oil and Gas SCCs where RICE NSPS controls are applied

SCC	Lean/ Rich/ Combined	Product	Source Category	SCC Description
2310020600	Combined	NGAS	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Compressor Engines
2310021202	Lean	NGAS	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
2310021209	Lean	NGAS	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Total: All Natural Gas Fired 4Cycle Lean Burn Compressor Engines
2310021251	Lean	NGAS	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Lateral Compressors 4 Cycle Lean Burn
2310021302	Rich	NGAS	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
2310021309	Rich	NGAS	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Total: All Natural Gas Fired 4Cycle Rich Burn Compressor Engines
2310021351	Rich	NGAS	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Lateral Compressors 4 Cycle Rich Burn
2310023202	Lean	CBM	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
2310023251	Lean	CBM	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Lateral Compressors 4 Cycle Lean Burn
2310023302	Rich	CBM	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
2310023351	Rich	CBM	PRODUCTION	Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Lateral Compressors 4 Cycle Rich Burn

Table 4-36. Point source SCCs in pt_oilgas sector where RICE NSPS controls applied

SCC	Lean, Rich, or Combined	SCCDESC
20100202	Combined	Internal Combustion Engines;Electric Generation;Natural Gas;Reciprocating
20200202	Combined	Internal Combustion Engines;Industrial;Natural Gas;Reciprocating
20200204	Combined	Internal Combustion Engines;Industrial;Natural Gas;Reciprocating: Cogeneration
20200253	Rich	Internal Combustion Engines;Industrial;Natural Gas;4-cycle Rich Burn
20200254	Lean	Internal Combustion Engines;Industrial;Natural Gas;4-cycle Lean Burn
20200256	Combined	Internal Combustion Engines;Industrial;Natural Gas;4-cycle Clean Burn

SCC	Lean, Rich, or Combined	SCCDESC
20201702	Combined	Internal Combustion Engines;Industrial;Gasoline;Reciprocating Engine
20300201	Combined	Internal Combustion Engines;Commercial/Institutional;Natural Gas;Reciprocating
26500320	Combined	Internal Combustion Engines;Off-highway 4-stroke Gasoline Engines;Industrial Equipment;Industrial Fork Lift: Gasoline Engine (4-stroke)
31000203	Combined	Industrial Processes;Oil and Gas Production;Natural Gas Production;Compressors (See also 310003-12 and -13)
31000313	Combined	Industrial Processes;Oil and Gas Production;Natural Gas Processing;Reciprocating Compressor

4.2.4.3 Organic Liquids Distribution NESHAP (ptnonipm)

Packets:

Control_2022_2026_Organic_Liquids_Distribution_NESHAP_2022v1platform_02oct2024_v1
Control_2022_203X_Organic_Liquids_Distribution_NESHAP_2022v1platform_02oct2024_nf_v3

The Organic Liquids Distribution National Emissions Standards for Hazardous Air Pollutants (NESHAP) is an EPA rule to reduce emissions of toxic air pollutants from facilities that distribute organic liquids other than gasoline. Affected facilities were listed in Appendix A of the Review of the RACT/BACT/LAER Clearinghouse Database for the Organic Liquids Distribution Source Category memo found in the regulatory docket. Facility information was pulled from EIS to check control information. If no VOC controls existed at a facility, an 8% VOC emissions reduction was applied. Table 4-37 summarizes the impact of the organic liquids distribution NESHAP on VOC emissions in the ptnonipm sector.

Table 4-37. Summary of Organic Liquids Distribution NESHAP controls on ptnonipm emissions

Year	Pollutant	2022hc (tons)	Emissions Change (tons)	% change
2026	VOC	732,606	-2,244	-0.3%

4.2.4.4 Natural Gas Turbines NO_x NSPS (ptnonipm, pt_oilgas)

Packets:

Control_2022_2026_NG_Turbines_NSPS_ptnonipm_2022v1platform_30sep2024_v0
Control_2022_2026_NG_Turbines_pt_oilgas_2022v1platform_05sep2024_v0
Control_2022_2026_NG_Turbines_pt_oilgas_2022v1platform_KSupdate_16oct2024_v0

For ptnonipm, the Natural Gas Turbines NSPS packet was reused from the 2016v2 platform because the last finalized regulation was dated March 20, 2009. For pt_oilgas, packets are based on updated growth information for that sector from state-historical production data and the AEO2023 production forecast database. The new growth factors were to calculate the new control efficiencies for 2026. The control efficiency calculation methodology did not change from the 2016v3 modeling platform.

Natural Gas Turbines NSPS controls were generated based on examination of emission limits for stationary combustion turbines that are not in the power sector. In 2006, the EPA promulgated standards of performance for new stationary combustion turbines in 40 CFR part 60, subpart KKKK. The standards reflect changes in NOx emission control technologies and turbine design since standards for

these units were originally promulgated in 40 CFR part 60, subpart GG. The 2006 NSPSs affecting NO_x and SO_2 were established at levels that bring the emission limits up-to-date with the performance of current combustion turbines. Stationary combustion turbines were also regulated by the NOx State Implementation Plan (SIP) Call, which required affected gas turbines to reduce their NOx emissions by 60 percent. Table 4-38 compares the federal 2006 NSPS NO_x emission limits for new stationary combustion turbines with the NO_x Reasonably Available Control Technology (RACT) regulations in selected states within the NO_x SIP Call region. More information on the NOx SIP call is available at https://www.epa.gov/power-sector/final-update-nox-sip-call-regulations (84 FR 8422). The state NO_x RACT regulations summary (Pechan, 2001) is from a year 2001 analysis, so some states may have updated their rules since that time.

Table 4-38. Stationary gas turbines NSPS analysis and RACT regulations in selected states

Firing Natural Gas limits:	<50 MMBTU/hr	50-850 MMBTU/hr	>850 MMBTU/hr	
Federal NSPS	100	25	15	Ppm
State	5-100 MMBTU/hr	100-250 MMBTU/hr	>250 MMBTU/hr	
Connecticut	225	75	75	Ppm
Delaware	42	42	42	Ppm
Massachusetts	65*	65	65	Ppm
New Jersey	50*	50	50	Ppm
New York	50	50	50	Ppm
New Hampshire	55	55	55	ppm

* Only applies to 25-100 MMBTU/hr

The above state RACT table is from a 2001 analysis. Note that the current New York State regulations use the same emission limits. The resulting new source NOx ratio (Fn) for NOx SIP call state and California = 0.595 or 40.5% control (as computed by dividing 25 by 42). For other states Fn = 0.238 or 76.2% control (as computed by dividing 25 by 105).

For control factor development, the existing source emission ratio was set to 1.0 for combustion turbines. The new source emission ratio for the NOx SIP Call states and California is the ratio of state NOx emission limit to the Federal NSPS. A complicating factor in the above is the lack of size information in the stationary source SCCs. Plus, the size classifications in the NSPS do not match the size differentiation used in state air emission regulations. We accepted a simplifying assumption that most industrial applications of combustion turbines are in the 100-250 MMBtu/hr size range and computed the new source emission rates as the NSPS emission limit for 50-850 MMBtu/hr units divided by the state emission limits. We used a conservative new source emission ratio by using the lowest state emission limit of 42 ppmv (Delaware). This yields a new source emission ratio of 25/42, or 0.595 (40.5 percent reduction) for states with existing combustion turbine emission limits. States without existing turbine NOx limits would have a lower new source emission ratio: the uncontrolled emission rate (105 ppmv via AP-42) divided into 25 ppmv = 0.238 (76.2 percent reduction). This control was then plugged into Equation 4-2 as a function of the year-specific projection factor. The Natural Gas Turbines control packet for pt_oilgas also includes additional controls for the EPNG Williams facility in Arizona, in order to reduce the post-control facility total of 584.77 tons/yr NOx.

Table 4-39 shows the reduction in NOx emissions after the application of the Natural Gas Turbines NSPS CONTROL. Table 4-40 and Table 4-41 list the point source SCCs for which Natural Gas Turbines NSPS controls were applied in ptnonipm and pt_oilgas, respectively.

Table 4-39. Emissions reductions due to the Natural Gas Turbines NSPS

Sector	Year	Pollutant	2022hc (tons)	Emissions change (tons)	% change
pt_oilgas	2026	NOX	365,805	-7,531	-2.1%
ptnonipm	2026	NOX	780,504	-846	-0.1%

Table 4-40. SCCs in ptnonipm for which Natural Gas Turbines NSPS controls were applied

SCC	SCC Description
20200201	Internal Combustion Engines; Industrial; Natural Gas; Turbine
20200203	Internal Combustion Engines; Industrial; Natural Gas; Turbine: Cogeneration
20200209	Internal Combustion Engines; Industrial; Natural Gas; Turbine: Exhaust
20200701	Internal Combustion Engines; Industrial; Process Gas; Turbine
20200714	Internal Combustion Engines; Industrial; Process Gas; Turbine: Exhaust
20300203	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Turbine: Cogeneration

Table 4-41. SCCs in pt_oilgas for which Natural Gas Turbines NSPS controls were applied

SCC	**SCC description**
20100201	Internal Combustion Engines;Electric Generation;Natural Gas;Turbine
20100209	Internal Combustion Engines;Electric Generation;Natural Gas;Turbine: Exhaust
20200201	Internal Combustion Engines;Industrial;Natural Gas;Turbine
20200203	Internal Combustion Engines;Industrial;Natural Gas;Turbine: Cogeneration
20200209	Internal Combustion Engines;Industrial;Natural Gas;Turbine: Exhaust
20300202	Internal Combustion Engines;Commercial/Institutional;Natural Gas;Turbine
20300203	Internal Combustion Engines;Commercial/Institutional;Natural Gas;Turbine: Cogeneration
20300209	Internal Combustion Engines;Commercial/Institutional;Natural Gas;Turbine: Exhaust

4.2.4.5 Process Heaters NO_x NSPS (ptnonipm, pt_oilgas)

Packets:

Control_2022_2026_Process_Heaters_NSPS_ptnonipm_2022v1platform_30sep2024_v0
Control_2022_2026_Process_Heaters_pt_oilgas_2022v1platform_06sep2024_v0
Control_2022_2026_Process_Heaters_pt_oilgas_2022v1platform_KSupdate_16oct2024_v0

For ptnonipm, the packet was reused from the 2016v2 platform. For pt_oilgas, the packets were newly developed for 2022v2 based on updated information including the AEO2023 forecast oil and gas production.

Process heaters are used throughout refineries and chemical plants to raise the temperature of feed materials to meet reaction or distillation requirements. Fuels are typically residual oil, distillate oil, refinery gas, or natural gas. In some sense, process heaters can be considered as emission control devices because they can be used to control process streams by recovering the fuel value while

destroying the VOC. The criteria pollutants of most concern for process heaters are NO_x and SO_2. In 2022, it is assumed that process heaters have not been subject to regional control programs like the NOx SIP Call, so most of the emission controls put in-place at refineries and chemical plants have resulted from RACT regulations that were implemented as part of SIPs to achieve ozone NAAQS in specific areas, and refinery consent decrees. The boiler/process heater NSPS established NOx emission limits for new and modified process heaters. These emission limits are displayed in Table 4-42.

Table 4-42. Process Heaters NSPS analysis emission rates used to estimate controls

NO_X emission rate Existing PPMV (=Fe)	**Natural Draft (fraction)**	**Forced Draft (fraction)**	**Average**
80	0.4	0	
100	0.4	0.5	
150	0.15	0.35	
200	0.05	0.1	
240	0	0.05	
Cumulative, weighted (=Fe)	104.5	134.5	119.5
NSPS Standard	40	60	
New Source NO_X ratio (=Fn)	0.383	0.446	**0.414**
NSPS Control (%)	61.7	55.4	58.6

For computations, the existing source emission ratio (Fe) was set to 1.0. The computed (average) NO_x emission factor ratio used for new sources (Fn) is 0.41 (59 percent control). The retirement rate is the inverse of the expected unit lifetime. There is limited information in the literature about process heater lifetimes. This information was reviewed at the time that the Western Regional Air Partnership (WRAP) developed its initial regional haze program emission projections, and energy technology models used a 20-year lifetime for most refinery equipment. However, it was noted that in practice, heaters would probably have a lifetime that was on the order of 50 percent above that estimate. Therefore, a 30-year lifetime was used to estimate the effects of process heater growth and retirement. This yields a 3.3 percent retirement rate. This control was then plugged into Equation 4-2 as a function of the year-specific projection factor.

The impact on emissions from applying the process heaters NSPS is shown in Table 4-43. Table 4-44 and Table 4-45 list the point source SCCs for which the Process Heaters NSPS controls were applied in the ptnonipm and pt_oilgas sectors, respectively.

Table 4-43. Emissions reductions due to the application of the Process Heaters NSPS

Sector	**Year**	**Pollutant**	**2022hc (tons)**	**Emissions change (tons)**	**% change**
pt_oilgas	2026	NOX	365,805	-1,398	-0.4%
ptnonipm	2026	NOX	780,504	-3,888	-0.5%

Table 4-44. SCCs in ptnonipm for which Process Heaters NSPS controls were applied

SCC	SCC Description*
30190003	IP;Chemical Manufacturing;Fuel Fired Equipment;Process Heater: Natural Gas
30190004	IP;Chemical Manufacturing;Fuel Fired Equipment;Process Heater: Process Gas
30590002	IP;Mineral Products;Fuel Fired Equipment;Residual Oil: Process Heaters
30590003	IP;Mineral Products;Fuel Fired Equipment;Natural Gas: Process Heaters
30600103	IP;Petroleum Industry;Process Heaters;Oil
30600104	IP;Petroleum Industry;Process Heaters;Gas
30600105	IP;Petroleum Industry;Process Heaters;Natural Gas
30600106	IP;Petroleum Industry;Process Heaters;Process Gas
30600107	IP;Petroleum Industry;Process Heaters;Liquified Petroleum Gas (LPG)
30600199	IP;Petroleum Industry;Process Heaters;Other Not Elsewhere Classified
30990003	IP;Fabricated Metal Products;Fuel Fired Equipment;Natural Gas: Process Heaters
31000401	IP;Oil and Gas Production;Process Heaters;Distillate Oil (No. 2)
31000403	IP;Oil and Gas Production;Process Heaters;Crude Oil
31000404	IP;Oil and Gas Production;Process Heaters;Natural Gas
31000405	IP;Oil and Gas Production;Process Heaters;Process Gas
31000406	IP;Oil and Gas Production;Process Heaters;Propane/Butane
31000414	IP;Oil and Gas Production;Process Heaters;Natural Gas: Steam Generators
31000415	IP;Oil and Gas Production;Process Heaters;Process Gas: Steam Generators
39900501	IP;Miscellaneous Manufacturing Industries;Process Heater/Furnace;Distillate Oil
39900601	IP;Miscellaneous Manufacturing Industries;Process Heater/Furnace;Natural Gas
39990003	IP;Miscellaneous Manufacturing Industries;Miscellaneous Manufacturing Industries;Natural Gas: Process Heaters

* IP = Industrial Processes

Table 4-45. SCCs in pt_oilgas for which Process Heaters NSPS controls were applied

SCC	SCC Description
30190001	Industrial Processes;Chemical Manufacturing;Fuel Fired Equipment;Process Heater: Distillate Oil (No. 2)
30190003	Industrial Processes;Chemical Manufacturing;Fuel Fired Equipment;Process Heater: Natural Gas
30190004	Industrial Processes;Chemical Manufacturing;Fuel Fired Equipment;Process Heater: Process Gas
30290003	Industrial Processes;Food and Agriculture;Fuel Fired Equipment;Natural Gas: Process Heaters
30390003	Industrial Processes;Primary Metal Production;Fuel Fired Equipment;Natural Gas: Process Heaters
30590003	Industrial Processes;Mineral Products;Fuel Fired Equipment;Natural Gas: Process Heaters
30600103	Industrial Processes;Petroleum Industry;Process Heaters;Oil
30600104	Industrial Processes;Petroleum Industry;Process Heaters;Gas
30600105	Industrial Processes;Petroleum Industry;Process Heaters;Natural Gas
30600106	Industrial Processes;Petroleum Industry;Process Heaters;Process Gas
30600107	Industrial Processes;Petroleum Industry;Process Heaters;Liquified Petroleum Gas (LPG)
30600199	Industrial Processes;Petroleum Industry;Process Heaters;Other Not Elsewhere Classified
30990003	Industrial Processes;Fabricated Metal Products;Fuel Fired Equipment;Natural Gas: Process Heaters
31000401	Industrial Processes;Oil and Gas Production;Process Heaters;Distillate Oil (No. 2)

SCC	SCC Description
31000402	Industrial Processes;Oil and Gas Production;Process Heaters;Residual Oil
31000403	Industrial Processes;Oil and Gas Production;Process Heaters;Crude Oil
31000404	Industrial Processes;Oil and Gas Production;Process Heaters;Natural Gas
31000405	Industrial Processes;Oil and Gas Production;Process Heaters;Process Gas
31000406	Industrial Processes;Oil and Gas Production;Process Heaters;Propane/Butane
31000411	Industrial Processes;Oil and Gas Production;Process Heaters;Distillate Oil (No. 2): Steam Generators
31000414	Industrial Processes;Oil and Gas Production;Process Heaters;Natural Gas: Steam Generators
31000415	Industrial Processes;Oil and Gas Production;Process Heaters;Process Gas: Steam Generators
31390001	Industrial Processes;Electrical Equipment;Process Heaters;Distillate Oil (No. 2)
31390003	Industrial Processes;Electrical Equipment;Process Heaters;Natural Gas
39900601	Industrial Processes;Miscellaneous Manufacturing Industries;Process Heater/Furnace;Natural Gas
39900701	Industrial Processes;Miscellaneous Manufacturing Industries;Process Heater/Furnace;Process Gas
39990003	Industrial Processes;Miscellaneous Manufacturing Industries;Miscellaneous Manufacturing Industries;Natural Gas: Process Heaters

4.2.4.6 State-specific controls (nonpt, np_solvents, ptnonipm)

Packets:

Control_2022_20XX_2022v1_point_nonpoint_SLT_controls_07oct2024_v1

A few states submitted state-specific controls for the nonpt, np_solvents, and ptnonipm sectors. For nonpt sectors, Utah and Delaware both submitted controls that were applied to their state emissions for the years 2026. Table 4-46 shows which SCCs and pollutants in nonpt these controls were applied. Table 4-47 shows the impacts of the controls on the three sectors.

Table 4-46. SCCs in nonpt, np_solvents, and ptnonipm for which state-specific controls were applied

State	Pollutant	SCC	SCC Description
Utah	NOX	2102006000	Stationary Source Fuel Combustion;Industrial;Natural Gas;Total: Boilers and IC Engines
Utah	NOX	2103006000	Stationary Source Fuel Combustion;Commercial/Institutional;Natural Gas;Total: Boilers and IC Engines
Delaware	VOC	2501060053	Storage and Transport;Petroleum and Petroleum Product Storage;Gasoline Service Stations;Stage 1: Bal
Delaware	VOC	2501060201	Storage and Transport;Petroleum and Petroleum Product Storage;Gasoline Service Stations;Underground
Delaware	Many	Many	Delaware submitted population projections for all counties within their State and requested all relevant SCC to use this provided data in making emissions projections.
New Jersey	Many	Many	New Jersey submitted population projections for all counties within their State and requested all relevant SCC to use this provided data in making emissions projections.

For ptnonipm, several states submitted emission reductions and controls due to fuel switching, consent decrees, or state or local rules that would reduce emissions in the future. Iowa submitted NO_x and SO_2

reductions for Iowa State University (EIS Facility ID: 18936211) due to a fuel switch from coal to natural gas that occurred in 2023. Iowa reduced SO_2 at ADM - Des Moines Soybean facility (EIS Facility ID: 3163611) due to an Iowa State consent order and Polk County local program that required a coal fired boiler to be decommissioned in 2023 and replaced with a natural gas boiler. In Washington State, Cardinal FG Company Winlock (EIS Facility ID: 1262611) installed a silicon controlled rectifier (SCR) on its glass furnace in 2024, reducing NO_x emissions. In Texas, the Streetman Lightweight Agregate Plant (EIS Facility ID: 4946511) installed SO_2 controls in late 2022.

Table 4-47. Summary of SLT-provided controls on 2022 emissions

Sector	Year	Pollutant	2022hc (tons)	Emissions change (tons)	% change
nonpt	2026	NOX	741,248	-240	-0.03%
nonpt	2026	VOC	949,760	-84	-0.01%
np_solvents	2026	VOC	2,634,832	-34	-0.001%
ptnonipm	2026	NOX	780,504	-771	-0.10%
ptnonipm	2026	SO2	438,306	-2,864	-0.65%

4.3 Sectors with Projections Computed Outside of CoST

Projections for sectors not calculated using CoST are discussed in this section.

4.3.1 Nonroad Mobile Equipment Sources (nonroad)

Outside of California, the MOVES4 model was run for 2026. The fuels used are specific to the analytic year, but the meteorological data represented the year 2022. The analytic year nonroad emissions include all nonroad control programs finalized as of the date of the MOVES4 release.
The resulting analytic year inventories were processed into the format needed by SMOKE in the same way as the base year emissions.

From the data review: North Carolina commented that growth relative to 2022 of industrial SCCs was too aggressive, and suggested we cap growth of nonroad industrial emissions in NC as follows:

2026 = 1.096

We adjusted the MOVES outputs so that growth of NC industrial never exceeds the above limits, resulting in a notable decrease in emissions. For example, if 2026/2022 = 1.2, then we reduced the 2026 emissions by a factor of 0.9133 (1.096 / 1.2) so that 2026/2022 = 1.096. If the existing growth was under the cap, then no change was made. When doing this, we preserved VOC and PM speciation, such that growth of a particular species, VOC HAP, or NONHAPTOG or PM2.5 component may exceed the cap, but growth of overall VOC or PM2.5 will not.

In California, California Air Resources Board (CARB) provided inventories were used for 2026.

4.3.2 Onroad Mobile Sources (onroad)

For 2022v1, MOVES4 was run to obtain onroad emission factors that account for the impact of on-the-books rules that are implemented into MOVES4. These include regulations such as:

- Revised 2023 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions Standards, 86 FR 74434 (December 30, 2021);
- Safer Affordable Fuel Efficient (SAFE) Vehicles Final Rule for Model Years 2021-2026 (March 2020);
- Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 (October 2016);
- Tier 3 Vehicle Emission and Fuel Standards Program (March 2014) (https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-air-pollution-motor-vehicles-tier-3);
- 2017 and Later Model Year Light-Duty Vehicle GHG Emissions and Corporate Average Fuel Economy Standards (October 2012);
- Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (September 2011);
- Regulation of Fuels and Fuel Additives: Modifications to Renewable Fuel Standard Program (RFS2) (December 2010); and
- Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards Final Rule for Model-Year 2012-2016 (May 2010).

State-level adjustment factors were developed to account for California and other Section 177 states that have adopted California's Advanced Clean Trucks regulation. This regulation requires greater sales of zero-emission heavy-duty trucks than EPA's Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3 rule, especially prior to 2030. Adjustment factors by calendar year, state, pollutant, and SCC are calculated as the ratio of MOVES5 output to MOVES4 output.

Adjustment factors for the year 2022 were developed for states that have decommissioned Stage II refueling programs, where their decommissioning is accounted for in MOVES5 but not in MOVES4.

Local inspection and maintenance (I/M) and other onroad mobile programs are included such as: California LEVIII, the National Low Emissions Vehicle (LEV) and Ozone Transport Commission (OTC); LEV regulations, local fuel programs, and Stage II refueling control programs. Note that MOVES3 emission rates for model years 2017 and beyond are equivalent to CA LEVIII rates for NOx and VOC. Therefore, it was not necessary to update the rates used for states that have adopted the rules in 2020 or later years. The most recent California rules passed after 2020 are not reflected in this platform. Onroad emissions in California were based on emissions provided by CARB for 2026. In a similar fashion to the adjustments applied in other states to reflect rules not included in MOVES4, adjustment factors were also developed and applied to California emissions to estimate the impact of the federal rules not reflected in CARB's EMFAC2017 model. No attempt was made to account for recent California regulations other than Advanced Clean Trucks.

VMT data were projected from 2022 to 2026 using projection factors based on AEO2023 projections and applied nationally by fuel type and broad vehicle type (light duty, medium duty for buses and single unit trucks, and heavy duty for combination trucks). Diesel light duty cars were held flat in projections, but diesel light duty trucks were projected using the AEO. Light duty VMT projections also incorporated a county-level adjustment based on projected human population trends, so that counties expected to grow more than the national average in population receive a corresponding increase in VMT for those counties, and vice versa. The AEO2023-based VMT projection factors are shown in Table 4-48. Four states (NJ, NY, NC, and WI) provided VMT for each analytic year. Massachusetts gave us VMT for 2026 as well, but it was not in time to be incorporated into the draft version of the emissions. Thus since the VMT they gave us was higher than that used in the draft version, there are increases in onroad emissions in the final version of the 2026 emissions.

Table 4-48. Projection factors for VMT by Fuel and Vehicle Class

	2022-to-2026
Gas light duty	1.036
Gas medium duty	1.108
Gas heavy duty	1.103
Diesel light duty cars	1.000
Diesel light duty trucks	1.252
Diesel medium duty	1.008
Diesel heavy duty	1.018
CNG medium duty	1.073
CNG heavy duty	1.080
E-85 light duty	0.900
Electric light duty	3.339

In addition, a small, negligible amount of VMT was created for CNG combination long haul trucks, and for all electric heavy duty vehicle types, for the analytic years. These fuel and source type combinations are newly supported in MOVES4, and activity for these SCCs was created to support future considerations. For the moment, activity for these new MOVES4 SCCs is very small and does not impact the results.

Vehicle population is computed as: analytic year VPOP = base year VPOP * (analytic year VMT / base year VMT) by county and SCC6 (fuel + vehicle type). Wisconsin provided VPOP for each analytic year.

Vehicle starts for analytic years are computed as:

analytic year starts = base year starts * (analytic year VPOP / base year VPOP).

Long haul hoteling hours are computed at the county level using the formula:

analytic year hoteling = base year hoteling * (analytic year VMT / base year VMT)

where only the VMT from combination long haul trucks on restricted roads are considered. Where hoteling exists in counties with zero combo-long-haul-restricted-road VMT, hoteling from the base year was projected using the national diesel heavy duty projection factors for VMT from AEO2023. Year-specific APU fractions were used to split county-level hoteling to individual SCCs as follows: 17.0% for 2026.

On-network idling hours (ONI) activity data were calculated based on VMT. For each representative county, the ratio of ONI hours to onroad VMT (on all road types) was calculated using the MOVES ONI Tool by source type, fuel type, and month. These ratios were then multiplied by each county's total VMT (aggregated by source type, fuel type, and month) to get hours of ONI activity.

In comments received DE, DC, LA, NJ, and WA were noted to have unrealistic increases in refueling emissions between the base and analytic years. OTAQ-provided adjustment factors for refueling were originally applied to 2026. Future years then reflected the elimination of Stage II controls in those five states. This resulted in an artificial increase in refueling emissions in the five states in analytic years versus 2022hc (in which the Stage II updates were not accounted for). In response to the state comments, we took away adjustment factors to refueling in those five states.

4.3.3 Sources Outside of the United States (canada_onroad, mexico_onroad, canmex_point, canmex_ag, canada_og2D, ptfire_othna, canmex_area, canada_afdust, canada_ptdust)

This section discusses the projection of emissions from Canada and Mexico. Information about the base year inventory used for these projections or the naming conventions can be found in Section 2.7. The Canada projections for 2026 are based on ECCC-provided inventories, while most Mexico emissions are not projected to 2026 from the base year. Fire emissions in Canada and Mexico in the ptfire_othna sector were not projected.

4.3.3.1 Canadian fugitive dust sources (canada_afdust, canada_ptdust)

For Canadian area and point source dust sectors, emissions were provided by ECCC for 2026 and follow a methodology consistent with their 2022 inventory. As with the base year, the analytic year dust emissions are pre-adjusted, so analytic year dust follows the same emissions processing methodology as the base year with respect to the transportable fraction and meteorological adjustments.

4.3.3.2 Point Sources in Canada and Mexico (canmex_point, canada_og2D)

Canadian point source inventories were provided by ECCC for 2026 and follow a methodology consistent with their 2022 inventory.

Mexico point source inventories from 2022 were held flat through 2026.

4.3.3.3 Nonpoint sources in Canada and Mexico (canmex_area, canmex_ag)

Canadian area source inventories, including nonpoint, nonroad, and agricultural sources, were provided by ECCC for 2026 and follow a methodology consistent with their 2022 inventory.

Mexico area source inventories from 2022 were held flat to 2026.

4.3.3.4 Onroad sources in Canada and Mexico (canada_onroad, canada_onroad)

For Canadian mobile onroad sources, ECCC provided the year 2026 emissions.

For Mexican mobile onroad sources, monthly onroad mobile inventories for 2026 were developed at municipio resolution based on an interpolation of 2023 and 2027 runs of MOVES-Mexico done for the 2016 platform.

5 Emission Summaries

Table 5-1 and Table 5-2 summarize base year emissions by sector for CAPs and key HAPs for the year 2022 in this platform. Similarly, Table 5-3 and Table 5-4 show emissions for the year 2026. These summaries are provided at the national level by sector for the contiguous U.S. and for the portions of Canada and Mexico inside the larger 12km domain (12US1) discussed in Section 3.1. Note that totals for the 12US2 domain are not available here, but the sum of the U.S. sectors would be essentially the same and only the Canadian and Mexican emissions would change according to the extent of the grids to the north and south of the continental United States. The afdust sector emissions here represent the emissions *after* application of both the land use (transport fraction) and meteorological adjustments; therefore, this sector is called "afdust_adj" in these summaries. The onroad sector totals are post-SMOKE-MOVES totals, representing air quality model-ready emission totals, and include CARB emissions for California. The cmv sectors include U.S. emissions within state waters only; these extend to roughly 3-5 miles offshore and include CMV emissions at U.S. ports. "Offshore" represents CMV emissions that are outside of U.S. state waters. Canadian CMV emissions are included in the other sector. The total of all US sectors is listed as "Con U.S. Total."

State totals and other summaries are available in the reports area on the FTP site for the 2022 platform (https://gaftp.epa.gov/Air/emismod/2022/v1).

Table 5-1. National by-sector CAP emissions for the 2022 platform, year 2022, 12US1 grid (tons/yr)

Sector	CO	NH3	NOX	PM10	PM2_5	SO2	VOC
afdust_adj				6,146,958	855,377		
Airports	369,923	0	116,884	9,098	8,077	11,956	43,850
cmv_c1c2	20,296	70	137,145	3,748	3,632	626	5,265
cmv_c3	10,207	32	84,352	1,833	1,686	4,141	4,676
Fertilizer		1,671,402					
Livestock		2,590,376					207,230
Nonpt	802,522	69,110	721,734	478,209	411,444	74,590	933,778
Nonroad	11,095,444	2,013	773,485	75,879	71,154	921	923,704
np_oilgas	700,012	3,823	676,201	12,366	12,248	280,038	2,757,565
np_solvents	0	0	0	0	0	0	2,590,493
Onroad	13,332,341	185,022	2,066,044	189,078	70,302	8,749	982,106
Openburn	1,394,786	79,167	45,645	231,930	212,185	13,867	104,784
Ptegu	466,676	17,913	851,055	106,981	91,801	879,719	26,332
Ptagfire	873,964	9,946	37,243	119,877	75,028	12,029	128,359
ptfire-rx	7,653,954	67,401	129,063	1,260,341	1,117,863	77,351	1,567,213
ptfire-wild	6,856,611	70,503	70,961	1,440,745	938,357	68,088	1,850,700
Ptnonipm	1,204,525	60,957	768,611	345,152	224,138	434,482	730,824
pt_oilgas	180,921	9,324	327,107	13,442	12,774	32,115	209,689
Rail	96,147	303	456,604	11,803	11,448	341	18,789
Rwc	2,944,487	22,597	44,594	450,210	448,814	11,893	450,881
Beis	3,376,155		964,950				30,694,065
CONUS w/ beis	**51,378,972**	**4,859,958**	**8,271,679**	**10,897,651**	**4,566,328**	**1,910,908**	**44,230,301**
Canada ag		506,067		6,564	1,875		124,234
Canada oil and gas 2D		8					293,600
Canada afdust				975,005	183,021		
Canada ptdust				3,980	510		
Canada area	2,061,247	5,978	312,938	184,538	133,031	14,092	712,989
Canada onroad	1,715,237	7,135	357,211	25,404	13,469	955	120,229
Canada point	1,034,599	19,020	521,418	113,269	43,293	440,207	150,300
Canada fires	2,650,916	24,845	30,977	590,473	332,539	13,904	633,450
Canada cmv_c1c2	3,193	10	20,631	545	529	66	726
Canada cmv_c3	8,394	22	66,152	1,255	1,155	2,625	4,082
Mexico ag		137,454		54,305	11,689		
Mexico area	97,707	26,199	57,912	41,688	21,073	21,910	412,170
Mexico onroad	1,594,936	2,887	389,027	15,190	10,549	6,665	144,126
Mexico point	158,096	979	199,363	90,722	53,873	341,028	32,822
Mexico fires	297,069	4,862	13,226	43,610	34,575	2,574	62,461
Mexico cmv_c1c2	199	1	1,296	35	34	7	50
Mexico cmv_c3	9,626	95	95,412	5,362	4,933	14,099	4,777
Offshore cmv_c1c2	4,864	15	31,122	822	797	123	1,148
Offshore cmv_c3	52,623	313	470,598	17,673	16,259	44,675	25,782
Offshore pt_oilgas	28,551	5	34,660	422	416	321	31,406

Table 5-2. National by-sector VOC HAP emissions for the 2022 platform, year 2022, 12US1 grid (tons/yr)

Sector	Acetaldehyde	Benzene	Formaldehyde	Methanol	Naphthalene	Acrolein	1,3-Butadiene
airports	1,559	614	4,448	651	470	928	660
cmv_c1c2	22	11	97	0	10	10	5
cmv_c3	20	10	86	0	9	9	5
livestock	1,478	473	0	13,661	0		
nonpt	9,460	3,357	5,357	14,606	451	9,460	336
nonroad	8,056	25,536	19,848	1,157	1,411	1,180	4,333
np_oilgas	2,912	35,872	50,849	3,820	112	1,941	458
np_solvents	73	336	10	13,780	8,117		
onroad	8,324	17,172	10,319	1,407	1,324	750	2,263
openburn	2,143	4,626	2,218	0	57	134	701
ptegu	14	883	8,253	189	4	202	2
ptagfire	10,074	9,493	7,502	0	0		988
ptfire-rx	65,156	21,017	126,604	89,682	18,170	25,708	16,273
ptfire-wild	54,041	15,732	97,891	99,573	18,453	16,382	8,331
ptnonipm	3,902	21,465	11,487	23,589	730	853	653
pt_oilgas	1,261	2,153	9,418	298	56	1,857	262
rail	1,471	423	4,190	0	51	301	35
rwc	51,243	13,303	35,899	0	6,945	1,949	3,615
beis	374,228		513,183	2,110,685			
CONUS w/ beis	**595,436**	**172,476**	**907,658**	**2,373,098**	**56,368**	**61,661**	**38,922**
Can. ag	1,398	159	0	32,657	0		
Can. oil & gas 2D	0	877	0	0	0		
Can. Area	15,252	12,725	12,871	4,082	2,589		
Can. Onroad	2,170	5,247	2,997	0	40		
Can. Point	1,543	1,986	5,262	10,627	26		
Can. Fires	22,127	5,988	44,383	49,869	7,330	6,739	3,566
Can. cmv_c1c2	3	1	13	0	1	1	1
Can. cmv_c3	17	8	75	0	8	8	4
Mex. Area	3,085	1,742	2,539	2,666	469		
Mex. Onroad	591	3,376	1,438	665	200	102	494
Mex. Point	65	1,208	2,587	519	11		
Mex. Fires	3,406	892	3,772	1,386	168	0	0
Mex. cmv_c1c2	0	0	1	0	0	0	0
Mex. cmv_c3	15	7	67	0	23	9	5
Off. cmv_c1c2	5	2	21	0	2	2	1
Off. cmv_c3	97	47	423	0	80	48	26
Off. pt_oilgas	631	121	1,070	41	0	0	0

Table 5-3. National by-sector CAP emissions for the 2022 platform, year 2026, 12US1 grid (tons/yr)

Sector	CO	NH3	NOX	PM10	PM2_5	SO2	VOC
afdust_adj				6,203,842	866,327		
Airports	403,009	0	135,130	9,619	8,554	13,768	47,811
cmv_c1c2	20,967	72	141,595	3,872	3,752	662	5,428
cmv_c3	10,743	34	83,629	1,929	1,775	4,360	4,928
Fertilizer		1,671,402					
Livestock		2,595,138					207,785
Nonpt	800,002	67,631	685,799	488,859	422,715	61,902	956,983
Nonroad	11,377,186	2,074	651,041	63,282	59,036	942	862,143
np_oilgas	701,014	15	583,910	10,892	10,841	308,766	2,095,720
np_solvents	0	0	0	0	0	0	2,667,432
onroad	10,973,776	169,669	1,398,945	184,377	62,516	11,452	786,425
openburn	1,394,786	79,167	45,645	231,930	212,185	13,867	104,784
ptegu	411,310	32,477	665,673	102,988	89,934	603,941	27,277
ptagfire	873,964	9,946	37,243	119,877	75,028	12,029	128,359
ptfire-rx	7,653,954	67,401	129,063	1,260,341	1,117,863	77,351	1,567,213
ptfire-wild	6,856,611	70,503	70,961	1,440,745	938,357	68,088	1,850,700
ptnonipm	1,166,259	60,185	733,559	338,082	217,959	412,759	702,269
pt_oilgas	179,652	9,307	314,246	13,773	13,052	33,717	207,331
rail	95,644	302	454,085	11,744	11,391	339	18,694
rwc	2,944,487	22,597	44,594	450,210	448,814	11,893	450,881
beis	3,376,155		964,950				30,694,065
CONUS w/ beis	**49,239,521**	**4,857,919**	**7,140,070**	**10,936,362**	**4,560,100**	**1,635,837**	**43,386,227**
Canada ag		537,399		6,579	1,880		124,415
Canada oil and gas 2D		7					244,808
Canada afdust				1,065,831	197,478		
Canada ptdust				4,392	561		
Canada area	2,057,231	5,918	293,945	177,603	123,038	13,389	721,003
Canada onroad	1,775,762	7,169	344,288	26,593	13,354	1,203	119,545
Canada point	1,036,019	20,345	403,929	117,450	46,201	438,599	158,061
Canada fires	2,650,916	24,845	30,977	590,473	332,539	13,904	633,450
Canada cmv_c1c2	3,193	10	20,631	545	529	66	726
Canada cmv_c3	8,394	22	66,152	1,255	1,155	2,625	4,082
Mexico ag		137,454		54,305	11,689		
Mexico area	97,707	26,199	57,912	41,688	21,073	21,910	412,170
Mexico onroad	1,677,654	3,544	407,007	18,039	12,301	8,138	163,294
Mexico point	158,096	979	199,363	90,722	53,873	341,028	32,822
Mexico fires	297,069	4,862	13,226	43,610	34,575	2,574	62,461
Mexico cmv_c1c2	199	1	1,296	35	34	7	50
Mexico cmv_c3	9,626	95	95,412	5,362	4,933	14,099	4,777
Offshore cmv_c1c2	5,043	16	32,268	853	826	128	1,191
Offshore cmv_c3	54,783	320	471,623	18,061	16,616	45,527	26,892
Offshore pt_oilgas	28,543	5	34,654	422	416	321	31,396

Table 5-4. National by-sector VOC HAP emissions for the 2022 platform, year 2026, 12US1 grid (tons/yr)

Sector	Acetaldehyde	Benzene	Formaldehyde	Methanol	Naphthalene	Acrolein	1,3-Butadiene
airports	1,700	670	4,841	708	511	1,000	711
cmv_c1c2	23	11	100	0	10	10	5
cmv_c3	21	10	90	0	9	0	0
livestock	1,514	481	0	13,711	0		
nonpt	10,053	3,373	5,437	15,673	461	10,053	348
nonroad	6,753	24,622	16,374	1,064	1,281	888	4,261
np_oilgas	2,747	29,342	47,162	3,993	100	2,057	487
np_solvents	75	334	11	14,074	8,428		
onroad	5,971	12,726	6,532	1,162	857	473	1,570
openburn	2,143	4,626	2,218	0	57	134	701
ptegu	13	967	10,516	183	3		
ptagfire	10,074	9,493	7,502	0	0		988
ptfire-rx	65,156	21,017	126,604	89,682	18,170	25,708	16,273
ptfire-wild	54,041	15,732	97,891	99,573	18,453	16,382	8,331
ptnonipm	3,681	21,168	11,201	21,828	694	821	615
pt_oilgas	1,388	2,197	9,779	300	58	1,922	269
rail	1,464	421	4,169	0	51	299	35
rwc	51,243	13,303	35,899	0	6,945	1,949	3,615
beis	374,228		513,183	2,110,685			
CONUS w/ beis	**592,287**	**160,490**	**899,508**	**2,372,636**	**56,089**	**61,695**	**38,209**
Can. ag	1,400	160	0	32,704	0		
Can. oil & gas 2D	0	727	0	0	0		
Can. Area	13,737	12,419	11,796	4,302	2,426		
Can. Onroad	2,124	5,207	2,931	0	40		
Can. Point	1,555	1,971	5,336	11,488	33		
Can. Fires	22,127	5,988	44,383	49,869	7,330	6,739	3,566
Can. cmv_c1c2	3	1	13	0	1	1	1
Can. cmv_c3	17	8	75	0	8	8	4
Mex. Area	3,085	1,742	2,539	2,666	469		
Mex. Onroad	646	3,502	1,612	720	213	111	493
Mex. Point	65	1,208	2,587	519	11		
Mex. Fires	3,406	892	3,772	1,386	168	0	0
Mex. cmv_c1c2	0	0	1	0	0	0	0
Mex. cmv_c3	15	7	67	0	23	9	5
Off. cmv_c1c2	5	2	22	0	2	2	1
Off. cmv_c3	102	49	443	0	83	50	27
Off. pt_oilgas	631	121	1,070	41	0	0	0

6 References

Adelman, Z. 2012. *Memorandum: Fugitive Dust Modeling for the 2008 Emissions Modeling Platform*. UNC Institute for the Environment, Chapel Hill, NC. September 28, 2012.

Adelman, Z. 2016. *2014 Emissions Modeling Platform Spatial Surrogate Documentation*. UNC Institute for the Environment, Chapel Hill, NC. October 1, 2016. Available at https://gaftp.epa.gov/Air/emismod/2014/v1/spatial_surrogates/.

Adelman, Z., M. Omary, Q. He, J. Zhao and D. Yang, J. Boylan, 2012. "A Detailed Approach for Improving Continuous Emissions Monitoring Data for Regulatory Air Quality Modeling." Presented at the 2012 International Emission Inventory Conference, Tampa, Florida.

Appel, K.W., Napelenok, S., Hogrefe, C., Pouliot, G., Foley, K.M., Roselle, S.J., Pleim, J.E., Bash, J., Pye, H.O.T., Heath, N., Murphy, B., Mathur, R., 2018. Overview and evaluation of the Community Multiscale Air Quality Model (CMAQ) modeling system version 5.2. In Mensink C., Kallos G. (eds), Air Pollution Modeling and its Application XXV. ITM 2016. Springer Proceedings in Complexity. Springer, Cham. Available at https://doi.org/10.1007/978-3-319-57645-9_11.

Bash, J.O., Baker, K.R., Beaver, M.R., Park, J.-H., Goldstein, A.H., 2016. Evaluation of improved land use and canopy representation in BEIS with biogenic VOC measurements in California. Available from http://www.geosci-model-dev.net/9/2191/2016/.

Bullock Jr., R, and K. A. Brehme (2002) "Atmospheric mercury simulation using the CMAQ model: formulation description and analysis of wet deposition results." Atmospheric Environment 36, pp 2135–2146. Available at https://doi.org/10.1016/S1352-2310(02)00220-0.

California Air Resources Board (CARB): Final 2015 Consumer & Commercial Product Survey Data Summaries, 2019.

Coordinating Research Council (CRC), 2017. Report A-100. Improvement of Default Inputs for MOVES and SMOKE-MOVES. Final Report. February 2017. Available at http://crcsite.wpengine.com/wp-content/uploads/2019/05/ERG_FinalReport_CRCA100_28Feb2017.pdf.

Coordinating Research Council (CRC), 2019. Report A-115. Developing Improved Vehicle Population Inputs for the 2017 National Emissions Inventory. Final Report. April 2019. Available at http://crcsite.wpengine.com/wp-content/uploads/2019/05/CRC-Project-A-115-Final-Report_20190411.pdf.

Drillinginfo, Inc. 2017. "DI Desktop Database powered by HPDI." Currently available from https://www.enverus.com/.

England, G., Watson, J., Chow, J., Zielenska, B., Chang, M., Loos, K., Hidy, G., 2007. "Dilution-Based Emissions Sampling from Stationary Sources: Part 2-- Gas-Fired Combustors Compared with Other Fuel-Fired Systems," Journal of the Air & Waste Management Association, 57:1, 65-78, DOI: 10.1080/10473289.2007.10465291. Available at https://www.tandfonline.com/doi/abs/10.1080/10473289.2007.10465291.

EPA. 2007a. Control of Hazardous Air Pollutants from Mobile Sources Regulatory Impact Analysis. EPA420-R-07-002. EPA Office of Transportation and Air Quality (OTAQ) Assessment and Standards Division, Ann Arbor, MI. Available online at https://nepis.epa.gov/Exe/ZyPdf.cgi?Dockey=P1004LNN.PDF.

EPA, 2015b. Draft Report Speciation Profiles and Toxic Emission Factors for Nonroad Engines. EPA-420-R-14-028. Available at https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=309339&CFID=83476290&CFTOKEN=35281617.

EPA, 2015c. Speciation of Total Organic Gas and Particulate Matter Emissions from On-road Vehicles in MOVES2014. EPA-420-R-15-022. Available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NOJG.pdf.

EPA, 2016. SPECIATE Version 4.5 Database Development Documentation, U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Research Triangle Park, NC 27711, EPA/600/R-16/294, September 2016. Available at https://www.epa.gov/sites/production/files/2016-09/documents/speciate_4.5.pdf.

EPA, 2018. AERMOD Model Formulation and Evaluation Document. EPA-454/R-18-003. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711. Available at https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100UT95.TXT.

EPA, 2019. Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988. Available at https://www.epa.gov/air-emissions-modeling/speciate-51-and-50-addendum-and-final-report.

EPA and National Emissions Inventory Collaborative (NEIC), 2019. Technical Support Document (TSD) Preparation of Emissions Inventories for the Version 7.2 North American Emissions Modeling Platform. Available at https://www.epa.gov/air-emissions-modeling/2016-version-72-technical-support-document.

EPA, 2020. Population and Activity of Onroad Vehicles in MOVES3. EPA-420-R-20-023. Office of Transportation and Air Quality. US Environmental Protection Agency. Ann Arbor, MI. November 2020. Available under the MOVES3 section at https://www.epa.gov/moves/moves-technical-reports.

EPA, 2020b. Technical Support document: “Development of Mercury Speciation Factors for EPA’s Air Emissions Modeling Programs, April 2020”. US EPA Office of Air Quality Planning and Standards.

EPA, 2021. 2017 National Emission Inventory: January 2021 Updated Release, Technical Support Document. U.S. Environmental Protection Agency, OAQPS, Research Triangle Park, NC 27711. Available at: https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-technical-support-document-tsd.

EPA, 2021. 2017 National Emissions Inventory (NEI) data, Research Triangle Park, NC, January 2021. https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data.

EPA and NEIC, 2021. Technical Support Document (TSD) Preparation of Emissions Inventories for the 2016v1 North American Emissions Modeling Platform. Available at: https://www.epa.gov/air-emissions-modeling/2016-version-1-technical-support-document.

EPA, 2022a. Technical Support Document EPA's Air Toxics Screening Assessment – 2018 AirToxScreen TSD (EPA-452/B-22-002). Available at: https://www.epa.gov/AirToxScreen/airtoxscreen-technical-support-document.

EPA, 2022b. Technical Support Document: Preparation of Emissions Inventories for the 2019 North American Emissions Modeling Platform. Available at: https://www.epa.gov/air-emissions-modeling/2019-emissions-modeling-platform-technical-support-document.

EPA, 2023. 2020 National Emission Inventory Technical Support Document. U.S. Environmental Protection Agency, OAQPS, Research Triangle Park, NC 27711. Available at: https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-technical-support-document-tsd.

EPA, 2024a. Category 3 Commercial Marine Vessel 2022 Emissions Inventory. U.S. Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory, Ann Arbor, MI 48105. Available at: https://gaftp.epa.gov/Air/emismod/2022/v1/reports/mobile/CMV/2022%20C3%20Marine%20Emissions%20Tool%20%20Documentation.pdf.

EPA, 2024b. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022. U.S. Environmental Protection Agency, EPA 430-R-24-004. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022.

ERG, 2016b. "Technical Memorandum: Modeling Allocation Factors for the 2014 Oil and Gas Nonpoint Tool." Available at https://gaftp.epa.gov/air/emismod/2014/v1/spatial_surrogates/oil_and_gas/.

ERG, 2017. "Technical Report: Development of Mexico Emission Inventories for the 2014 Modeling Platform." Available at https://gaftp.epa.gov/air/emismod/2016/v1/reports/EPA%205-18%20Report_Clean%20Final_01042017.pdf.

ERG, 2018. Technical Report: "2016 Nonpoint Oil and Gas Emission Estimation Tool Version 1.0". Available at https://gaftp.epa.gov/air/emismod/2016/v1/reports/2016%20Nonpoint%20Oil%20and%20Gas%20Emission%20Estimation%20Tool%20V1_0%20December_2018.pdf.

ERG, 2022. Technical Report: 2020 National Emissions Inventory Locomotive Methodology. Available at: https://gaftp.epa.gov/Air/nei/2020/doc/supporting_data/nonpoint/Rail/2020_NEI_Rail_062722.pdf.

ERG, 2024a. Technical Report: 2022 National Emissions Inventory: Aviation Component. Available at: https://gaftp.epa.gov/Air/emismod/2022/v1/reports/mobile/airports/Aviation2022%20Documentation%20v4.pdf.

ERG, 2024b. Technical Report: Category 1 and 2 Commercial Marine Vessel 2022 Emissions Inventory. Available at: https://gaftp.epa.gov/Air/emismod/2022/v1/reports/mobile/CMV/C1C2_Documentation_2022Platform_08012024.pdf.

ERG, 2024c. Technical Report: Category 1 and 2 Commercial Marine Vessel 2022 Emissions Inventory. Available at: https://gaftp.epa.gov/Air/emismod/2022/v1/reports/mobile/CMV/C1C2_Documentation_2022P

latform_08012024.pdf.Khare, P., and Gentner, D. R.: Considering the future of anthropogenic gas-phase organic compound emissions and the increasing influence of non-combustion sources on urban air quality, Atmos Chem Phys, 18, 5391-5413, 10.5194/acp-18-5391-2018, 2018.

Luecken D., Yarwood G, Hutzell WT, 2019. Multipollutant modeling of ozone, reactive nitrogen and HAPs across the continental US with CMAQ-CB6. Atmospheric environment. 2019 Mar 15;201:62-72.

MANE-VU, 2004. Open Burning in Residential Areas, Emissions Inventory Development Report". Available from: https://s3.amazonaws.com/marama.org/wp-content/uploads/2019/11/26123253/Open_Burning_Residential_Areas_Emissions_Report-2004.pdf

Mansouri, K., Grulke, C. M., Judson, R. S., and Williams, A. J.: OPERA models for predicting physicochemical properties and environmental fate endpoints, J Cheminformatics, 10, 10.1186/s13321-018-0263-1, 2018.

McCarty, J.L., Korontzi, S., Jutice, C.O., and T. Loboda. 2009. The spatial and temporal distribution of crop residue burning in the contiguous United States. Science of the Total Environment, 407 (21): 5701-5712. Available at https://doi.org/10.1016/j.scitotenv.2009.07.009.

MDNR, 2008. "A Minnesota 2008 Residential Fuelwood Assessment Survey of individual household responses". Minnesota Department of Natural Resources. Available from http://files.dnr.state.mn.us/forestry/um/residentialfuelwoodassessment07_08.pdf.

NCAR, 2016. FIRE EMISSION FACTORS AND EMISSION INVENTORIES, FINN Data. Downloaded 2014 SAPRC99 version from https://www.acom.ucar.edu/Data/fire/.

NEIC, 2019. Specification sheets for the 2016v1 platform. Available from http://views.cira.colostate.edu/wiki/wiki/10202.

NESCAUM, 2006. "Assessment of Outdoor Wood-fired Boilers". Northeast States for Coordinated Air Use Management (NESCAUM) report. Available from http://www.nescaum.org/documents/assessment-of-outdoor-wood-fired-boilers/2006-1031-owb-report_revised-june2006-appendix.pdf.

NYSERDA, 2012. "Environmental, Energy Market, and Health Characterization of Wood-Fired Hydronic Heater Technologies, Final Report". New York State Energy Research and Development Authority (NYSERDA). Available from: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Environmental/Wood-Fired-Hydronic-Heater-Tech.pdf.

Pouliot, G., H. Simon, P. Bhave, D. Tong, D. Mobley, T. Pace, and T. Pierce. 2010. "Assessing the Anthropogenic Fugitive Dust Emission Inventory and Temporal Allocation Using an Updated Speciation of Particulate Matter." International Emission Inventory Conference, San Antonio, TX. Available at http://www3.epa.gov/ttn/chief/conference/ei19/session9/pouliot_pres.pdf.

Pouliot, G. and J. Bash, 2015. Updates to Version 3.61 of the Biogenic Emission Inventory System (BEIS). Presented at Air and Waste Management Association conference, Raleigh, NC, 2015.

Pouliot G, Rao V, McCarty JL, Soja A. Development of the crop residue and rangeland burning in the 2014 National Emissions Inventory using information from multiple sources. Journal of the Air & Waste Management Association. 2017 Apr 27;67(5):613-22.

Reichle, L., R. Cook, C. Yanca, D. Sonntag, 2015. "Development of organic gas exhaust speciation profiles for nonroad spark-ignition and compression-ignition engines and equipment", Journal of the Air & Waste Management Association, 65:10, 1185-1193, DOI: 10.1080/10962247.2015.1020118. Available at https://doi.org/10.1080/10962247.2015.1020118.

Reff, A., Bhave, P., Simon, H., Pace, T., Pouliot, G., Mobley, J., Houyoux. M. "Emissions Inventory of PM2.5 Trace Elements across the United States", Environmental Science & Technology 2009 43 (15), 5790-5796, DOI: 10.1021/es802930x. Available at https://doi.org/10.1021/es802930x.

Sarwar, G., S. Roselle, R. Mathur, W. Appel, R. Dennis, "A Comparison of CMAQ HONO predictions with observations from the Northeast Oxidant and Particle Study", Atmospheric Environment 42 (2008) 5760–5770). Available at https://doi.org/10.1016/j.atmosenv.2007.12.065.

Schauer, J., G. Lough, M. Shafer, W. Christensen, M. Arndt, J. DeMinter, J. Park, "Characterization of Metals Emitted from Motor Vehicles," Health Effects Institute, Research Report 133, March 2006. Available at https://pubmed.ncbi.nlm.nih.gov/16669575/.

Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T., 2021: "Reactive organic carbon emissions from volatile chemical products", Atmos. Chem. Phys. 21, 5079–5100, 2021. https://doi.org/10.5194/acp-21-5079-2021 and https://acp.copernicus.org/articles/21/5079/2021/.

Skamarock, W., J. Klemp, J. Dudhia, D. Gill, D. Barker, M. Duda, X. Huang, W. Wang, J. Powers, 2008. A Description of the Advanced Research WRF Version 3. NCAR Technical Note. National Center for Atmospheric Research, Mesoscale and Microscale Meteorology Division, Boulder, CO. June 2008. Available at: https://www.researchgate.net/publication/306154004_A_Description_of_the_Advanced_Research_WRF_Version_3.

Swedish Environmental Protection Agency, 2004. Swedish Methodology for Environmental Data; Methodology for Calculating Emissions from Ships: 1. Update of Emission Factors.

U.S. Bureau of Labor and Statistics, 2020. Producer Price Index by Industry, retrieved from FRED, Federal Reserve Bank of St. Louis, available at: https://fred.stlouisfed.org/categories/31, access date: 21 August 2020.

U.S. Census Bureau: Paint and Allied Products - 2010, MA325F(10), 2011. https://www.census.gov/data/tables/time-785 series/econ/cir/ma325f.html.

U.S. Census Bureau, Economy Wide Statistics Division: County Business Patterns, 2018. https://www.census.gov/programs-surveys/cbp/data/datasets.html.

U.S. Department of Transportation and the U.S. Department of Commerce, 2015. 2012 Commodity Flow Survey, EC12TCF-US. https://www.census.gov/library/publications/2015/econ/ec12tcf-us.html.

U.S. Energy Information Administration, 2019. The Distribution of U.S. Oil and Natural Gas Wells by Production Rate, Washington, DC. https://www.eia.gov/petroleum/wells/.

U.S. Energy Information Administration, 2023. Annual Energy Outlook 2023. https://www.eia.gov/outlooks/aeo/tables_ref.php

Wang, Y., P. Hopke, O. V. Rattigan, X. Xia, D. C. Chalupa, M. J. Utell. (2011) "Characterization of Residential Wood Combustion Particles Using the Two-Wavelength Aethalometer", Environ. Sci. Technol., 45 (17), pp 7387–7393. Available at https://doi.org/10.1021/es2013984.

Weschler, C. J., and Nazaroff, W. W.: Semivolatile organic compounds in indoor environments, Atmos Environ, 42, 9018-9040, 2008.

Wiedinmyer, C., Y. Kimura, E. C. McDonald-Buller, L. K. Emmons, R. R. Buchholz, W. Tang, K. Seto, M. B. Joseph, K. C. Barsanti, A. G. Carlton, and R. Yokelson, Volume 16, issue 13, GMD, 16, 3873–3891, 2023. https://gmd.copernicus.org/articles/16/3873/2023/.

Wiedinmyer, C., S.K. Akagi, R.J. Yokelson, L.K. Emmons, J.A. Al-Saadi, J. J. Orlando, and A. J. Soja. (2011) "The Fire INventory from NCAR (FINN): a high resolution global model to estimate the emissions from open burning", Geosci. Model Dev., 4, 625-641. http://www.geosci-model-dev.net/4/625/2011/ doi:10.5194/gmd-4-625-2011.

Yarwood, G., R. Beardsley, Y. Shi, and B. Czader: Revision 5 of the Carbon Bond 6 Mechanism (CB6r5). Presented at the Annual CMAS Conference, Chapel Hill, NC, 2020.

Zhu, Henze, et al, 2013. "Constraining U.S. Ammonia Emissions using TES Remote Sensing Observations and the GEOS-Chem adjoint model", Journal of Geophysical Research: Atmospheres, 118: 1-14. Available at https://doi.org/10.1002/jgrd.50166.

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AGRICULTURAL LIVESTOCK

A. Source Category Description

Animal waste from livestock results in emissions of both NH_3 (ammonia) and Volatile Organic Compounds (VOCs). VOCs emitted by livestock can be defined as any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) that may participate in atmospheric photochemical reactions and is emitted by livestock. Livestock are domesticated farm animals raised in an agricultural setting for home use or profit. The following livestock are included in the NEI: beef cattle, dairy cattle, swine, poultry (layers, broilers and turkeys), goats, horses, and sheep.

For this source category, the SCCs in Table 1 were assigned.

Table 1: Livestock Source Classification Codes

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2805002000	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified
2805018000	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified
2805025000	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified
2805007100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement
2805009100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Confinement
2805010100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Confinement
2805045000	Miscellaneous Area Sources	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified
2805035000	Miscellaneous Area Sources	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified
2805040000	Miscellaneous Area Sources	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total

B. Overview of Calculations

The general approach to calculating NH_3 emissions due to livestock is to multiply the emission factor (in kg per year per animal) by the number of animals in the county. The state-level NH_3 emissions factors are generated using the CMU Ammonia Model [18, 102]. VOC emissions were estimated by multiplying a national VOC/NH_3 emissions ratio by the county-level NH_3 emissions. HAP emissions were estimated by multiplying the county-level VOC emissions by HAP/VOC ratios.

C. Activity Data

The activity data for this source category is based on livestock counts (average annual number of standing head) and population information by state and county used to develop U.S. EPA's Greenhouse Gas Inventory [99]. This data set is derived from multiple data sets from the United States Department of Agriculture (USDA), particularly the National Agricultural Statistics Service (NASS) survey and census [100]. The USDA NASS survey dataset, which represents latest available, 2017 national livestock data, is used to obtain the livestock counts for as many counties as possible across the United States. For a full description of the GHG livestock population estimation methodology, refer to the above referenced citation for the EPA's GHG inventory document.

Generally, counties not specifically included in the NASS survey data set (e.g., due to business confidentially reasons) were gap-filled based on the difference in the reported state total animal counts and the sum of all county-level reported animal counts. State-level data on animal counts from the GHG inventory were distributed to counties based on the proportion of animal counts in those counties from the 2012 NASS census.

$$P_{a,c,2017} = P_{a,s,2017} \times r_{a,c,2012} \quad (1)$$

Where:

$P_{a,c,2017}$ = Estimated population of animal type *a* in county *c*
$P_{a,s,2017}$ = NASS survey reported state-level population of animal type *a* in state *s*
$r_{a,c,2012}$ = Ratio of animal county- to state-level animal counts from the 2012 NASS census for animal type *a* in county *c*

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D. Allocation Procedure

The USDA survey reports the livestock counts at the county level for many counties, so no allocation is necessary. The procedure for gap-filling missing county-level data using state-level data is described in section C.

E. Emissions Factors

CMU developed a model to estimate NH_3 emissions from livestock [18, 102]. This model produces daily-resolved, climate level emissions factors for a particular distribution of management practices for each county and animal type, as expressed as emissions/animal. These county level emissions factors are then combined together to create a state level emissions factor for each animal type. For the 2014 NEI v2, these state level emissions factors were back calculated from the CMU model using statewide emissions divided by statewide animal totals. Thus, the CMU model provides a state specific emission factor for each animal type (NH_3 emissions/head).

To develop emissions factors for the 2017 NEI, the CMU model was modified to use hourly meteorological data and two runs were performed using 2014 and 2017 meteorological data. The ratio of

the 2017 to 2014 CMU model values were then applied to the 2014 back calculated state-level emissions factors to develop emissions factors for the 2017 NEI. VOC emission factors come from the ratio of NH_3 to VOC emissions in counties which provided an estimate of both pollutants in NEI 2014 v1. There were 106 counties which provided emissions for both pollutants, and the average ratio was 0.08 tons of VOC for every ton of NH_3. This ratio is multiplied by all county level NH_3 emissions in NEI 2017 to estimate VOC emissions for each county. This ratio does not vary by state or animal type.

HAP emissions were estimated by multiplying county-specific VOC emissions by speciation factors that are animal-specific as shown in Table 2 below. All of the HAP VOC fractions were obtained from EPA's SPECIATE database [101]. As per the availability in SPECIATE, there are total of 6 VOC HAPs estimated for beef cattle, 5 VOC HAPs for dairy cattle, 4 VOC HAPs for swine, and 14 (same) VOC HAPs for layers and broilers (poultry).

Table 2: VOC speciation fractions used to estimate HAP Emissions for the Livestock Sector

SCC	Animal Type	HAP	Fraction of VOC	SPECIATE Profile Number
2805002000	Beef Cattle	1,4-Dichlorobenzene	0.0013	95240
2805002000	Beef Cattle	Methyl isobutyl Ketone	0.0008	
2805002000	Beef Cattle	Toluene	0.0110	
2805002000	Beef Cattle	Chlorobenzene	0.0001	
2805002000	Beef Cattle	Phenol	0.0006	
2805002000	Beef Cattle	Benzene	0.0001	
2805007100	Poultry---Layers	Methyl isobutyl ketone	0.0169	95223
2805007100	Poultry---Layers	Toluene	0.0018	
2805007100	Poultry---Layers	Phenol	0.0024	
2805007100	Poultry---Layers	N-hexane	0.0111	
2805007100	Poultry---Layers	Chloroform	0.0025	
2805007100	Poultry---Layers	Cresol/Cresylic Acid (mixed isomers)	0.0048	
2805007100	Poultry---Layers	Acetamide	0.0075	
2805007100	Poultry---Layers	Methanol	0.0608	
2805007100	Poultry---Layers	Benzene	0.0052	
2805007100	Poultry---Layers	Ethyl Chloride	0.0031	
2805007100	Poultry---Layers	Acetonitrile	0.0088	
2805007100	Poultry---Layers	Dichloromethane	0.0002	
2805007100	Poultry---Layers	Carbon Disulfide	0.0034	

2805007100	Poultry---Layers	2-Methyl Napthalene	0.0006	
2805009100	Poultry-Broilers	Methyl isobutyl ketone	0.0169	95223
2805009100	Poultry-Broilers	Toluene	0.0018	
2805009100	Poultry-Broilers	Phenol	0.0024	
2805009100	Poultry-Broilers	N-hexane	0.0111	
2805009100	Poultry-Broilers	Chloroform	0.0025	
2805009100	Poultry-Broilers	Cresol/Cresylic Acid (mixed isomers)	0.0048	
2805009100	Poultry-Broilers	Acetamide	0.0075	
2805009100	Poultry-Broilers	Methanol	0.0608	
2805009100	Poultry-Broilers	Benzene	0.0052	
2805009100	Poultry-Broilers	Ethyl Chloride	0.0031	
2805009100	Poultry-Broilers	Acetonitrile	0.0088	
2805009100	Poultry-Broilers	Dichloromethane	0.0002	
2805009100	Poultry-Broilers	Carbon Disulfide	0.0034	
2805009100	Poultry-Broilers	2-Methyl Napthalene	0.0006	
2805018000	Dairy Cattle	Toluene	0.0018	8897
2805018000	Dairy Cattle	Cresol/Cresylic Acid (mixed isomers)	0.0276	
2805018000	Dairy Cattle	Xylenes (mixed isomers)	0.0046	
2805018000	Dairy Cattle	Methanol	0.3542	
2805018000	Dairy Cattle	Acetaldehyde	0.0141	
2805025000	Swine	Toluene	0.0047	95241
2805025000	Swine	Phenol (Carbolic Acid)	0.0179	
2805025000	Swine	Benzene	0.0035	
2805025000	Swine	Acetaldehyde	0.0155	

For the non-CMU animals (goats, sheep, horses, and turkeys), animal-specific HAP speciation profiles were not available in the literature, so the following assignments were made:

Sheep and Goats	Same HAP fractions as Dairy Cattle
Turkeys	Same HAP fractions as Chicken-Broilers
Horses	Same HAP fractions as Beef Cattle

Meteorological Data Used in Adjusting FEM Emission Factors

The source code provided for FEM model contained weather data for 2014. It did not use standard identifiers (WBAN ID) and was limited to a small number of observations with an unknown source. The FEM weather data used a single monthly value for wind, temperature, and precipitation. FEM interpolated this data to hourly using different techniques. For temperature, a standard deviation was used to raise and lower the mean temperature in the month. For wind speed, the average monthly value was used for all hours. For precipitation, monthly amounts were divided into days (an hours) based upon a parameter defining the frequency of rain in a month.

The source code was modified to accommodate a true hourly processing of the met data. For the years 2014 and 2017, ISD (Integrated Surface Database) files from NOAA were processed into a yearly-hourly data file. Individual weather station files were retrieved from ftp://ftp.ncdc.noaa.gov/pub/data/noaa for all stations in the US.

This is an automated process whereby a year and certain inclusion criteria are set (country codes, missing value limits, etc.) and a direct indexed file is created of all passing stations. In the case of FEM, all stations in the US were included with a maximum of 4000 missing hours for temperature and wind speed and a maximum of 40 consecutive hours without temperature or wind speed. The system automatically fills in missing values using linear interpolation between missing hours.

To determine the weather characteristics for the year, the county centroid is matched to the nearest weather station in the yearly-hourly file. Emissions factors are calculated using every hour of the year for the county location and the model farm types located within the county.

Animal Practice Documentation

The animal practice documentation summarizes the information provided in A. McQulling's dissertation entitled, "Ammonia emissions from livestock in the United States: from farm-level models to a new national inventory" [102]. This work was funded by EPA grant number RD834549 [103].

Ammonia emissions from livestock depend on two major factors—the management practices employed by the producers (i.e. what housing, storage and application methods are used) and the environmental conditions of location where the farm is situated (i.e. temperatures, wind speeds, precipitation). All of these factors have significant impacts on the conditions of the manure and waste (e.g. water content, total ammoniacal nitrogen concentration) and as a result can enhance or reduce the emissions of ammonia from these sources.

The CMU model requires farm-type inputs which describe the type of animal housing, manure storage and application methods used for a particular location. Each location is expected to have some combination of practices; for example, in a single county, some of the swine farms may use deep-pit housing, lagoon storage, and irrigation application while other farms use shallow-pit housing with lagoon storage and injection application. In order to understand the differences in regional preferences for particular manure management strategies, information was extracted from the most recent National Animal Health Monitoring Surveys done by the USDA. The beef cattle NAHMS was completed in 2007 and feedlot beef in 2011; dairy cattle data was from 2002 and 2007; swine data were collected for 2006 and 2012, and the most recent poultry NAHMS was completed for 2010. The most recent data available had limited spatial resolution (compared to previous work [1], [2]), and so the model is only able to resolve large-scale regional differences in practices. For beef cow-calf systems, the United States was divided into four regions, but only two regions for beef housed on feedlots. For swine, the country was divided into three regions—Midwest, East, and South, and for layers, there were four regions—Northeast,

Southeast, Central and West. An additional limitation in the data available for the characterization of the farm practices was that for some of the questions asked by the study, results were only reported in terms of percent of operations which used a particular practice. This may give too much weight to the practices used on smaller farms which have a relatively small contribution to the overall level of ammonia emissions from a particular livestock type or practice. Thus, some uncertainty is expected as a result of the limited quantity of data available regarding manure management practices throughout the country.

As was previously discussed by Pinder et al. [3], one of the factors most limiting to the FEM's skill is the lack of information about manure managment practices throughout the country. It is unclear whether these uncertainties result in the overprediction or underprediction of total ammonia emissions from livestock in the United States.

Beef

Information regarding beef manure management practices was provided through the USDA National Animal Health Monitoring Study (NAHMS) with a regional distribution of practices. Beef data were provided for beef housed on feedlots as well as those that are a part of cow-calf systems. Cow-calf systems are those in which cattle are left on pasture or rangeland and the cows are kept with their calves, often until the calves are 1-2 years old and ready for sale. Feedlots are a much denser style of production in which large numbers of cattle are housed on concrete or packed earth lots and fed a mixture of corn and grains. Using the information from NAHMS and the animal numbers in the USDA 2012 agriculture census, the fraction of cattle in each state that were housed on feedlots as opposed those raised in a pasture-based farm system was discerned.

The distribution of manure management practices for the states included in the National Animal Health Monitoring System (NAHMS) (as split between feedlots and cow-calf systems) is based on liteature [4]–[8]. The regional distribution of cattle on feed can be seen in the Figure 1 below. There have been relatively few studies that have characterized the emissions from cow-calf or pasture-based systems in the United States, especially compared to the emissions characterization that has been done at a variety of Texas and Oklahoma feedlots. The grazing portion of the beef farm emission model is therefore less constrained and may result in the underprediction of emissions of ammonia from beef not housed on feedlots.

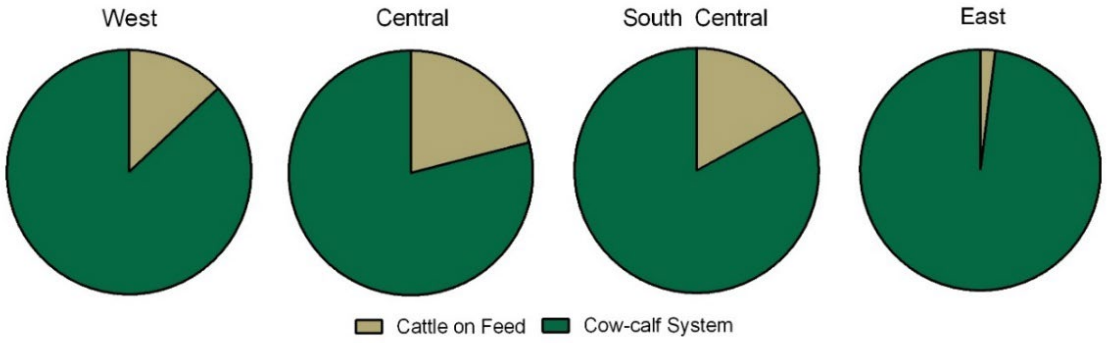


Figure 1. Regional distribution of beef cattle on feed. States in the West include: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The states in the Central region are: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin. Texas and Oklahoma are in the South Central region. The remaining states are in the East.

Based on the information provided by NAHMS and the USDA Agricultural census, two manure managment trains (MMTs) are considered. The first is an all grazing system where emissions are affected by the rate of manure infiltration and directly exposed to the elements (temperature, windspeed, precipitation). The alternative is a feedlot system with solid manure storage and broadcast application.

Dairy

The distribution of practices used in dairy cattle is unlikely to have changed substantially in the years following the work of Pinder et al. [1], [2], as seen when comparing the two most recent NAHMS results (from 2002 and 2007) to the 1996 NAHMS data used in the cited work. However, the data available for the 2002 and 2007 NAHMS was less regionally specific than was used in the previous work [9]–[13]. The manure management practice information received at that time included state-specific data, something not available for the current study years. Addtionally, storage and application data for 2002 and 2007 was only available by fraction of surveyed operations rather than by population which may give too much weight to practices employed primarily at smaller dairy farms. Manure management practices can be described regionally as either in the West or East; the distribution of practices is shown below in Figure 2a-b.

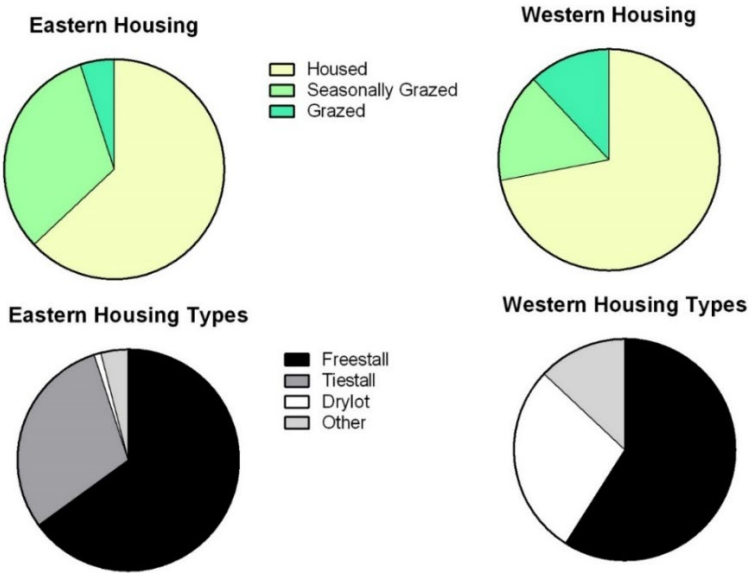


Figure 2a: Regional distribution of dairy housing practices from 2007 NAHMS for Eastern and Western United States. Eastern States include Minnesota, Iowa, Missouri, Arkansas, Louisiana and eastward. Western states are the rest of the continental US.

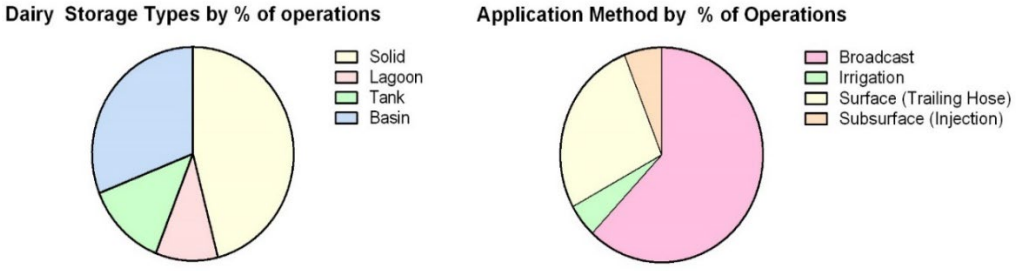


Figure 2b: Distribution of storage and application practices across the US. Regionally separated data was not available from the 2007 NAHMS, and results are presented in terms of percent of farming operations rather than percent of animal population, which may lead to over representation of minor practices.

Swine

There is significant regional variability in the housing types and manure management practices (in terms of storage and application) for swine production in the United States. Some of the management choices made are the result of meteorological limitations (i.e. deep-pit versus shallow-pit housing) while others are chosen for economic reasons (less expensive to use irrigation application rather than injection).

Using the information provided by NAHMS, regional distributions of management practices can be described [14]–[17]. The United States can be broken into three regions based on this data: the South, the Midwest, and the East. Each of these groups of states has a unique distribution of housing, storage, and application practices, seen in Figure 3.

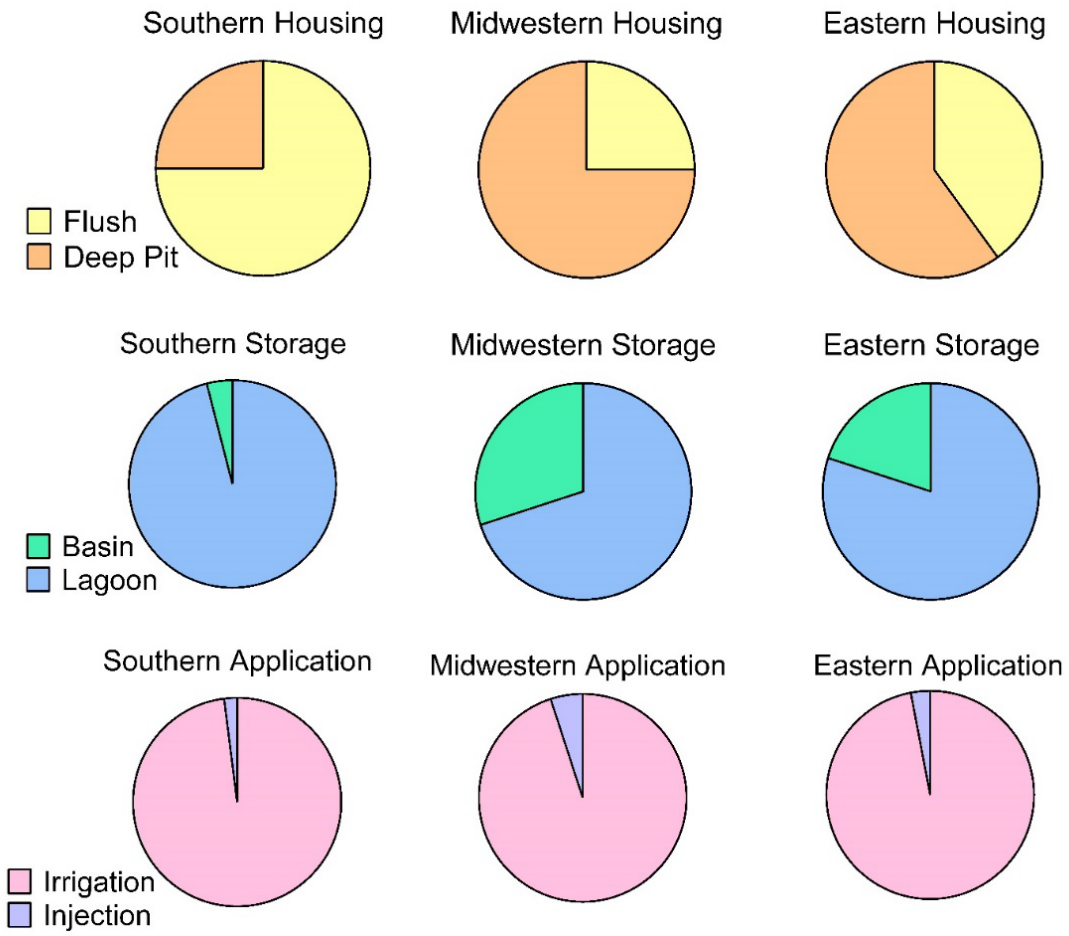


Figure 3: Regional Distribution of swine manure management practices. The Midwest includes: Idaho, Iowa, Minnesota, Montana, North Dakota, Nebraska, South Dakota, Wisconsin and Wyoming. The Eastern states include Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, and Vermont. The remainder of the states are included in the Southern region.

Poultry

Broilers

The major differences in broiler chicken production occur not in terms of farm type, but in the frequency with which barns are entirely cleaned out of their litter material; literature suggests that barns that are cleaned out more frequently have lower emissions than those in which litter material is built up and reused [19]–[22]. Additional factors that may alter the emissions from these facilities include what the bedding or litter material is made up of as well as how long each barn stays empty between flocks. There is not sufficient data to include either bedding material or the time between flocks within the emissions inventory. In fact, much of the variability that might be caused by these factors on a single farm will likely be averaged out as a result of short lifecycle of these birds, which take less than two months to reach market size. Additionally, pasture-raised or organic practices are not included as they make up a very small fraction of total bird population and the emissions from these farms has not been characterized in the literature. The limited data available regarding manure storage and application from broiler housing may result in the underestimation of ammonia emissions from this animal type.

Layers

There are two major housing types used in the production of layer chickens in the United States. These are high-rise layer houses and manure-belt layer houses. The chief difference between these two housing types is the frequency with which manure is removed; in high-rise barns, manure is removed 1-2 times each year, while manure is removed on a daily or weekly basis from manure-belt barns, which results in lower housing emissions and ammonia concentrations but leaves greater quantities in the manure that is headed toward storage and application or processing. High-rise housing operations are more prevalent than manure-belt houses throughout the United States (Figure 4), but manure-belt are somewhat more common in the western and central portions of the United States. There are some limitations on the abiility of the FEM for both the storage and application of poultry manure as there have been few studies to characterize these emissions. The majority of ammonia emissions from poultry are expected to be from housing (particularly for high-rise facilities).

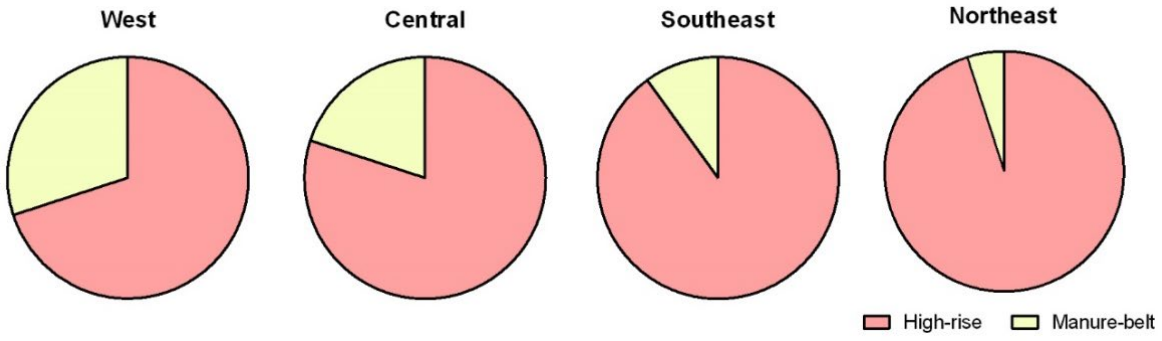


Figure 4. Regional distribution of layer housing types. The West includes: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming. The Central states are: Arkansas, Illinois, Indiana, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Southeastern states are: Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia. The remaining states are considered to be in the Northeast.

Additionally, the most recent NAHMS information does not capture the more recent trend towards cage-free housing or pasture-raised layer chickens [23]–[25]. Cage-free housing is a relatively minor housing practice currently (<10% of all layer chickens are raised on cage free farms, but state-specific data is unavailable so this may vary significantly by state, and this may not represent a similar fraction of total

eggs produced), but is poised to grow as a result of concerns about animal health and welfare and the demand for cage-free eggs increases. According to the most recently completed NAHMS, cage-free production occurs at approximately 3% of large layer operations (more than 100,000 layers), and approximately one-quarter of smaller farms. The data provided by NAHMS does not specify the fractions of total layer populations raised at particular farm sizes, but large farms have become increasingly common and it is expected that most eggs are produced from larger farms [25]. Cage-free and organic products are more likely to come from smaller farms whose emissions have not been well-characterized in the literature. Cage-free production is more common in Europe than the United States, so emissions studies from Europe could be used to better characterize cage-free housing emissions [26]–[28].

Model Parameters

The FEM is a tuned-model that applies adjustments to approximate observed data. However, the model evaluation does not reflect the ability of the FEM to predict completely independent measurements but the ability of a relatively simple process-based model, with a single set of mass transfer parameters for each manure management practice, to describe the full range of observed variability.

The NAEMS data and literature data are displayed in Figure 5 below. The range of temperatures studied is most extended for layer hens. With the additional NAEMS data, an apparent inverse relationship between temperature and ammonia emissions is observed, something that was not clear in the prior literature. It has been suggested that this inverse relationship (higher emissions factors for lower temperatures) is related to the drying out of manure in hot barns with high ventilation rates [30]. At lower temperatures, barn ventilation is reduced (to conserve heat) and manure dries slowly, and, therefore more manure urea can be broken down into ammonia, which is then available for volatilization. Additionally, for some practices, particularly for swine storage, emissions factors from NAEMS were uniformly higher than those previously reported in the literature, for both high and low temperatures. As a result of these differences, the FEM's tuned parameters were adjusted so that model emission factors fell between NAEMS and literature data, weighting the literature studies equally with the NAEMS observations so as not to over-tune to only the literature or NAEMS data. There is significant value in both previously published studies as well as in the values reported by NAEMS, so the re-tuning done is to ensure that this work takes advantage of all available data.

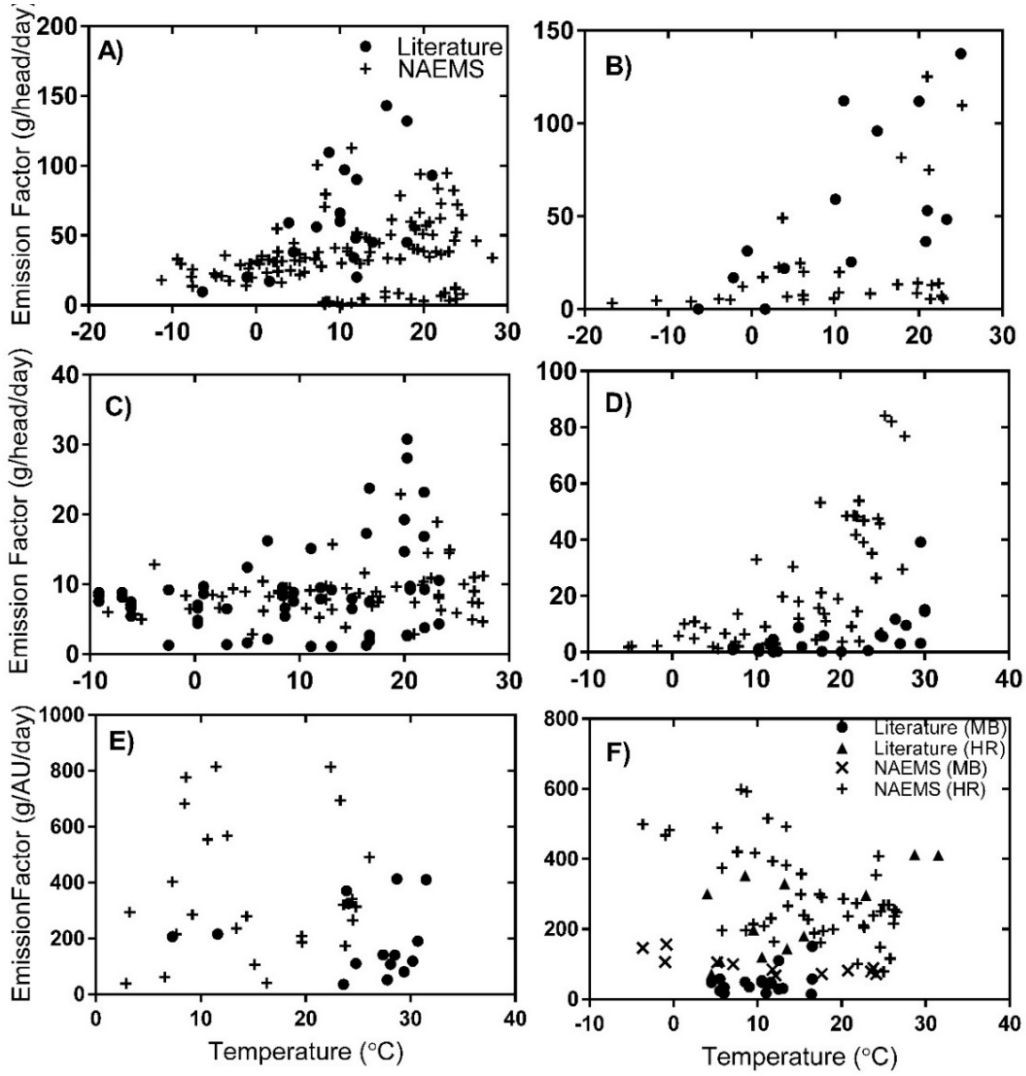


Figure 5: Emission factors as a function of temperature reported in the prior literature and from the National Air Emissions Monitoring Study (NAEMS). Results are displayed by animal type and management stage as follows: a) free-stall dairy housing emissions, b) dairy lagoon storage emissions, c) deep-pit and flush-type swine housing emissions, d) swine lagoon and basin storage emissions, e) litter-based broiler housing emissions, and f) manure-belt (MB) and high-rise (HR) layer housing emissions. (1 AU = animal unit = 500 kg live animal weight)

Manure characteristics

Manure characteristics are important input parameters to the model because they govern the amount of nitrogen available for emission, whether or not the nitrogen present is likely to be volatilized, and how well the waste can infiltrate into the soil during manure application. These parameters have been selected based on information extracted from published literature as well as reports from the National Air Emissions Monitoring study. Table 3 describes the types of parameters and inputs critical to the model and Table 4 presents information about manure volume, nitrogen concentration and pH levels in the waste from each type of animal included in the model.

Table 3. Description and sources of model inputs and parameters

Data Type	Description	Source of input or parameter	Input or Tuned Parameter?

Meteorology	Temperature (°C) Wind speed (m/s) Precipitation	From National Climate Data Center, based on farm location	Input value (monthly average for seasonal emissions, daily values for daily model run)
Manure Management Practice	Type of housing, storage, or application	Unique to each farm type; farm types have a unique set of inputs	Input value
Resistance Parameters	Surface mass transfer resistance from manure to atmosphere	Tuned based on literature and NAEMS observations to agree with previous work; constant for a particular management practice (for a particular animal type)	Tuned Parameters

Table 4. Model Input parameters related to manure characteristics

Parameter Name	Animal Type	Range of Values	Value Used in Model	Units	Source
Manure Volume	Beef	12-17	15	l animal^{-1} day^{-1}	[2], [31]
	Dairy			l animal^{-1} day^{-1}	[2]
	Swine	4-10	6	l animal^{-1} day^{-1}	[32]
	Poultry-Layer	0.088	0.088	l animal^{-1} day^{-1}	[33], [34]
	Poultry-Broiler	4.9	4.9	l finished animal^{-1}	[33]
Manure Urea Concentration	Beef	47-70		kg N animal^{-1} year^{-1}	[33]
	Dairy			kg N animal^{-1} year^{-1}	[2]
	Swine	11-35		kg N animal^{-1} year^{-1}	[34], [35]
	Poultry-Layer	0.5-0.6	0.55	kg N animal^{-1} year^{-1}	[33]
	Poultry-Broiler	0.05-0.06	0.055	kg N finished animal^{-1}	[33]
Housing pH	Beef	7.7	7.7		[36]
	Dairy	7.5-8.3	7.7		[2]
	Swine	6.5-7.5	7		[37]
	Poultry-Layer	7.1-7.6 (MB); 8.4-8.7	7.3		[38],[39]
	Poultry-Broiler	8	8		[40]
Storage pH	Dairy	7.0-8.0	7.5		[1]
	Swine	7.5-8	7.7		[35]
Application pH	Beef	7.5	7.5		[41]
	Dairy	7.0-7.7	7.3		[2]
	Swine	7.8-8.2	8		[42]
	Poultry-Layer	7.2	7.2		[43]
	Poultry-Broiler	8.8	8.8		[44]
Storage pH	Beef	7.7	7.7		[2]
	Dairy	7.5-8.3	7.7		[2]

There are a limited number of studies which describe the manure nitrogen and manure pH for each animal type. As a result there is considerable uncertainty in these input values which can result in significant uncertainty in predicted emissions from the model.

Tunable parameters

The FEM is a balance between an empirical approach and first-principles process-based model. A nitrogen mass balance and a process description of ammonia losses are used, but the FEM model parameters are tuned to reproduce measured emissions factors. Model complexity is limited to the most important emissions processes and to inputs that are typically available. The strategy pursued for developing process-based models is guided by the need to build emissions inventories, and the requirements and data limitations associated with this application. Previous measurement campaigns also

often sampled emissions from a single part of the production process. This means that information about the emissions process from the start to end of production might be lacking, making nitrogen mass balance in the system difficult. The lack of whole-farm measurements is one gap in much of the literature available and a benefit of the estimates of ammonia emissions produced by the FEM.

There are 2-3 tunable parameters associated with each submodel in the farm emissions model. These tunable parameters allow adjustment of model-predicted emissions and to correct for the unknowns and uncertainties of the input parameters and to ensure that the model-predicted values are consistent with those that have been reported in the literature and in the National Air Emissions monitoring study; they are constant for a particular farm type—tuning is not done for a particular farm—and as a result, there can be significant disagreement between model predictions and the measured emissions for a single farm. The goal of the FEM is not necessarily to capture the emissions of single farms perfectly, but rather to capture the effects of various parameters on emissions on a farm typical of a certain set of practices.

In the FEM, as previously described [29], [45], [46], ammonia emissions are estimated as a function of the nitrogen present in the waste and the mass transfer resistance. This resistance is made up of the following three parts: the aerodynamic (r_a), quasi-laminar (r_b), and surface resistances (r_s) [47]. Aerodynamic and quasi-laminar resistances are used to describe the resistance to transport in the gaseous layer above the animal wastes [45], [48], [49]. These parameters are based on widely used theoretical formulas and are not tuned. The third part of the resistance is the surface resistance from diffusion closest to the gas-liquid (manure) interface. Here, the surface resistance is a function of tuned parameters as well as temperature which ensures the modeled ammonia emission factors are consistent with observations; Table 5 lists which tunable parameters are used for each animal and each submodel.

These values are specific to a particular practice for a particular animal type. This means that a free stall dairy with lagoon storage and injection application would employ the same tuned parameters whether it was located in New York or California. Conversely, two farms in the same location but utilizing different manure management practices would have different tuned parameters in their submodels. The values that have been used for each of these parameters can be found in Table 6.

Table 5. Tuned model parameters for beef, swine, and poultry

Submodel	Animal Type	Description	Tuning/Evaluation Sources
Housing	Cattle: Beef & Dairy Swine Poultry: Broiler & Layer	Resistance parameters H_1, H_2	[50]–[67], [68]–[72], [73]–[78], [79]–[84]
Storage	Dairy Cattle Swine	Resistance parameters S_1, S_2	[85]–[90]
Application	Cattle: Beef & Dairy Swine Poultry: Broiler & Layer	Resistance parameters A_1,A_2, A_3	[91], [92], [93]–[95], [96], [97]
Grazing	Cattle: Dairy & Beef	Resistance parameters G_1, G_2	[98]

Table 6. Tuned Parameter Values by practice and animal type

Submodel	Animal Type	Description	Parameter Values
Housing	Beef cattle	Beef Feedlot	H_1=0.1 ($s \cdot m^{-1} \cdot °C^{-1}$), H_2=-0.01 ($s^2 m^{-2}$)
	Swine	Swine—shallow pit	H_1=0.08($s \cdot m^{-1}$), H_2=-0.004($s \cdot m^{-1} \cdot °C^{-1}$)
		Swine—deep pit	H_1=0.1($s \cdot m^{-1}$), H_2=-0.008($s \cdot m^{-1} \cdot °C^{-1}$)

	Poultry-Layer	Layer—Manure belt	$H_1=0.3(s•m^{-1})$, $H_2=-0.015(s•m^{-1}•°C^{-1})$
		Layer—High Rise	$H_1=0.22(s•m^{-1})$, $H_2=-0.02(s•m^{-1}•°C^{-1})$
	Poultry-Broiler	Broiler	$H_1=0.15(s•m^{-1})$, $H_2=-0.035(s•m^{-1}•°C^{-1})$
Storage	Swine	Swine lagoon	$S_1=0.20(s•m^{-1})$, $S_2=4.00(s•m^{-1}•°C^{-1})$
		Swine basin	$S_1=0.11(s•m^{-1})$, $S_2=2.24(s•m^{-1}•°C^{-1})$
Application	Beef cattle	Beef—broadcast	$A_1=0.0004$, $(s•m^{-1})A_2=0.88$, $A_3=-1.4$
	Swine	Swine—irrigation	$A_1=0.001(s•m^{-1})$, $A_2=-10$, $A_3=20$
		Swine—injection	$A_1=0.01(s•m^{-1})$, $A_2=-15$, $A_3=40$
Grazing	Beef Cattle	Beef Pasture	$G_1= 0.12(s•m^{-1})$, $G_2=5.4$

F. Controls

There are no controls assumed for this category.

G. Emissions

Back Calculating the 2014 NH_3 Emissions Factors from the CMU Model

The emissions estimates in NEI 2014 v1 came from the CMU model. These emissions were then divided by the model's animal population figures to estimate the statewide NH_3 emission factor.

$$EF_{s,a,2014} = E_{s,a,2014} \div A_{s,a,2014} \quad (2)$$

Where:

$EF_{s,a,2014}$ = 2014 NH_3 emissions factor from the CMU model for animal type *a* and state *s* (kg/head)

$E_{s,a,2014}$ = 2014 NH3 emissions from the CMU model for animal type *a* and state *s* (kg)

$A_{s,a2014}$ = 2014 animal count for animal type *a* and state *s* (head)

Calculating the 2017 NH_3 Emissions Factors

The 2017 NH_3 emissions factors are estimated by multiplying the NH_3 emissions factors from the 2014 NEI CMU model run with the ratio of the 2017 to 2014 CMU model runs performed with the updated hourly metrological data.

$$EF_{s,a,2017} = EF_{s,a,2014} \times EF_{CMU,s,a,2017} \div EF_{CMU,s,a,2014} \quad (3)$$

Where:

$EF_{s,a,2017}$ = 2017 NH_3 emissions factor for animal type *a* and state *s* (kg/head)

$EF_{s,a,2014}$ = 2014 NH_3 emissions factor from the 2014 NEI CMU model run for animal type *a* and state *s* (kg/head)

$E_{CMU,s,a,2017}$ = 2017 NH_3 emissions factor from the 2017 CMU model run for animal type *a* and state *s* (kg/head)

$E_{CMU,s,a,2014}$ = 2014 NH_3 emissions factor from the updated 2014 CMU model run for animal type *a* and state *s* (kg/head)

Calculating 2017NH_3 Emissions due to Livestock

Emissions are calculated by multiplying the state specific NH_3 emission factor (in NH_3/head) by the number of animals in a given county in that state.

$$E_{c,a,2017} = EF_{s,a,2017} \times A_{c,a,2017} \times 2.2/2000 \quad (4)$$

Where:

$E_{c,a,2017}$ = 2017 NH_3 emissions for animal type *a* and county *c* (ton)
$EF_{s,a,2017}$ = 2017 NH_3 emissions factor for animal type *a* and state *s* in which the county is located (kg/head)
$A_{c,a,2017}$ = 2017 animal count for animal type *a* and state *s* (head)
2.2/2000 = conversion factor from kg to tons

Calculating 2017 VOC Emissions due to Livestock

VOC emissions are calculated using the ratio of VOC to NH_3 emissions from livestock. That ratio is 0.08 kg of VOC for every kg of NH_3.

$$E_{VOC,c,a,2017} = VOC/NH_3 \times E_{c,a,2017} \quad (5)$$

Where:

$E_{VOC,c,a,2017}$ = 2017 VOC emissions for animal type *a* and county *c* (ton)
VOC/NH_3 = 0.08
$E_{c,a,2017}$ = 2017 NH_3 emissions for animal type *a* and county *c* (ton)

Calculating 2017 HAP Emissions due to Livestock

HAP emissions are calculated using the ratio of HAP to VOC emissions from livestock. These ratios are derived from the SPECIATE database as discussed above in Section E.

$$E_{HAP,c,a,2017} = \frac{HAP}{VOC} \times E_{VOC,c,a,2017} \times 2000 \quad (6)$$

Where:

$E_{HAP,c,a,2017}$ = 2017 HAP emissions for animal type *a* and county *c* (lb)
HAP/VOC = speciation factor derived from the SPECIATE database and listed in Table 2
$E_{VOC,c,a,2017}$ = 2017 VOC emissions for animal type *a* and county *c* (ton)
2000 = conversion factor from tons to pounds

Alaska and Hawaii

The CMU model does not cover Alaska or Hawaii (only the lower 48 states); however, the animal counts database does have values for Alaska and Hawaii. To estimate NH_3 (and other pollutant) emissions for Alaska and Hawaii, the state-level emissions factors from Idaho were used as a surrogate for Alaska and state-level emissions factors from Florida were used as a surrogate for Hawaii.

H. Point Source Subtraction

There are no point source-specific SCCs for livestock; therefore point source subtraction is not performed for this category.

I. Sample Calculations

Table 7 lists sample calculations to determine NH3, VOC and Toluene emissions from swine production in Cochise County, Arizona.

Table 7. Sample Calculations for NH3, VOC and Toluene emissions from swine in Cochise County, AZ.

Eq. #	Equation	Values for Cochise County, AZ	Result
2	$EF_{s,a,2014} = E_{s,a,2014} \div A_{s,a,2014}$	$= 9{,}370\ kg\ NH_3 \div 925$ swine	10.13 kg NH_3 per head of swine in Cochise County in 2014
3	$EF_{s,a,2017} = EF_{s,a,2014} \times EF_{CMU,s,a,2017} \div EF_{CMU,s,a,2014}$	$= 10.13\ kg\ NH_3\ per\ swine \times 1.019159$	10.32 kg NH_3 per head of swine in Cochise County in 2017
4	$E_{c,a,2017} = EF_{s,a,2017} \times A_{c,a,2017} \times 2.2/2000$	$= 10.32\ kg\ NH_3 \times 30{,}693\ swine \times 2.2\ /2000$	348.6 tons of NH_3 emissions from swine in Cochise County in 2017
5	$E_{VOC,c,a,2017} = VOC/NH_3 \times E_{c,a,2017}$	$= 0.08 \times$ 348.6 tons of NH_3	27.89 tons of VOC emissions from swine in Cochise County in 2017
6	$E_{HAP,c,a,2017} = \frac{HAP}{VOC} \times E_{VOC,c,a,2017} \times 2000$	$= 0.0047 \times 27.89\ tons\ VOC \times 2000$	262.1 lb of toluene from swine in Cochise County in 2017

J. Changes from 2014 Methodology

The methodology for estimating county-level animal counts is based on the U.S. EPA's Greenhouse Gas Inventory. This data set is derived from multiple data sets from the United States Department of Agriculture (USDA), particularly the National Agricultural Statistics Service (NASS) survey and census. In addition, the NH_3 emissions factors were updated to 2017 by growing 2014 emissions factors based on the ratio of 2017 to 2014 emission rates from CMU model runs with updated 2014 and 2017 hourly meteorological data from NOAA.

K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Due to the lack of animal counts in Puerto Rico and the U.S. Virgin Islands, emissions are not estimated for these territories.

L. References

[1] R. W. Pinder, N. J. Pekney, C. I. Davidson, and P. J. Adams, "A process-based model of ammonia emissions from dairy cows: improved temporal and spatial resolution," *Atmos. Environ.*, vol. 38, no. 9, pp. 1357–1365, Mar. 2004.

[2] R. W. Pinder, R. Strader, C. I. Davidson, and P. J. Adams, "A temporally and spatially resolved ammonia emission inventory for dairy cows in the United States," *Atmos. Environ.*, vol. 38, no. 23, pp. 3747–3756, Jul. 2004.

[3] R. W. Pinder, P. J. Adams, S. N. Pandis, and A. B. Gilliland, "Temporally resolved ammonia emission inventories: Current estimates, evaluation tools, and measurement needs," *J. Geophys. Res. Atmospheres*, vol. 111, no. D16, p. D16310, Aug. 2006.

[4] USDA-APHIS, "Feedlot 2011 -- Part I: Management Practices on US Feedlots with a Capacity of 1000 or More Head," 2013.

[5] USDA-APHIS, "Feedlot 2011 -- Part II: Management Practices on US Feedlots with a capacity of Fewer than 1000 Head," 2013.

[6] USDA-APHIS, "Beef 2007-2008 -- Part I: Reference of Beef Cow-calf Management Practices in the United States, 2007-08," 2009.

[7] USDA-APHIS, "Beef 2007-2008-- Part II: Reference of Beef Cow-calf Management Practices in the United States, 2007-08," 2009.

[8] USDA-APHIS, "Beef 2007-08 -- Part III: Changes in the US Beef Cow-calf Industry, 1993-2008," 2009.

[9] USDA-APHIS, "Dairy 2007-- Part V: Changes in Dairy Cattle Health and Management Practices in the United States, 1996-2007," 2007.

[10] USDA-APHIS, "Dairy 2007-- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007," 2007.

[11] USDA-APHIS, "Dairy 2007-- Part II: Changes in the US Dairy Cattle Industry, 1991-2007," 2007.

[12] USDA-APHIS, "Dairy 2002-- Part II: Changes in the United States Dairy Industry, 1991-2002," 2002.

[13] USDA-APHIS, "Dairy 2002-- Part 1: Reference of Dairy Health and Management in the United States, 2002," 2002.

[14] USDA-APHIS, "Swine 2006 -- Part I: Reference of Swine Health and Management Practices in the United States, 2006," 2007.

[15] USDA-APHIS, “Swine 2006 -- Part II: Reference of Swine Health and Health Management Practices in the United States, 2006,” 2008.

[16] USDA-APHIS, “Swine 2006 -- Part III: Reference of Swine Health, Productivity, and General Management in the United States, 2006,” 2008.

[17] USDA-APHIS, “Swine 2006 -- Part IV: Changes in the US Pork Industry, 1990-2006,” 2008.

[18] A. M. McQuilling and P. J. Adams, “Semi-empirical process-based models for ammonia emissions from beef, swine, and poultry operations in the United States,” *Atmos. Environ.*, vol. 120, pp. 127–136, Nov. 2015.

[19] USDA-APHIS, “Poultry ’04 -- Part II: Reference of Health and Management of Gamefowl Breeder Flocks in the United States, 2004,” 2005.

[20] USDA-APHIS, “Poultry ’04 -- Part III: Reference of Management Practices in Live-Poultry Markets in the United States, 2004,” 2005.

[21] USDA-APHIS, “Poultry 2010 -- Reference of Health and Management Practices on Breeder Chicken Farms in the United States, 2010,” 2005.

[22] USDA-APHIS, “Poultry 2010: Structure of the US Poultry Industry, 2010,” 2011.

[23] USDA-APHIS, “Part II: Reference of 1999 Table Egg Layer Management in the US,” 2000.

[24] USDA-APHIS, “Layers 2013--Part 1: Reference of Health and Management Practices on Table-Egg Farms in the United States 2013,” 2014.

[25] USDA-APHIS, “Layers 2013 -- Part III: Trends in Health and Management Practices on Table-Egg Farms in the United States, 1999-2013,” 2014.

[26] T. Shepherd, Y. Zhao, H. Li, J. Stinn, M. Hayes, and H. Xin, “Environmental assessment of three egg production systems--Part II. Ammonia, greenhouse gas, and particulate matter emissions,” *Poult. Sci.*, vol. 94 (3), pp. 534–543, 2015.

[27] D. Charles, “Most U.S. Egg Producers Are Now Choosing Cage-Free Houses,” *the salt (NPR)*, 2016. [Online]. Available: http://www.npr.org/sections/thesalt/2016/01/15/463190984/most-new-hen-houses-are-now-cage-free.

[28] Y. Zhao, T. Shepherd, H. Li, and H. Xin, “Environmental assessment of three egg production systems--Part I: Monitoring system and indoor air quality,” *Poult. Sci.*, vol. 94 (3), pp. 518–533, 2015.

[29] A. M. McQuilling and P. J. Adams, “Semi-empirical process-based models for ammonia emissions from beef, swine, and poultry operations in the United States,” *Atmos. Environ.*, vol. 120, pp. 127–136, Nov. 2015.

[30] R. Morgan, D. Wood, and B. Van Heyst, “The development of seasonal emission factors from a Canadian commercial laying hen facility,” *Atmos. Environ.*, vol. 86, pp. 1–8, 2014.

[31] H. Van Horn, “Factors affecting manure quantity, quality, and use,” in *Texas Animal Nutrition Council*, Texas, USA, 1998.

[32] J. P. Chastain, J. J. Camberato, J. E. Albrecht, and J. Adams, “Swine Manure Production and Nutrient Content.” .

[33] ASAE, “ASAE D384.1 FEB03: Manure Production and Characteristics,” 01-Feb-2003. [Online]. Available: http://large.stanford.edu/publications/coal/references/docs/ASAEStandard.pdf. [Accessed: 10-Oct-2016].

[34] A. D. Visscher *et al.*, “Ammonia Emissions from Anaerobic Swine Lagoons: Model Development,” *J. Appl. Meteorol.*, vol. 41, no. 4, pp. 426–433, Apr. 2002.

[35] J. Arogo, P. W. Westerman, and A. J. Heber, “A Review of Ammonia Emissions from Confined Swine Feeding Operations,” *Trans. ASAE*, vol. 46, no. 3, 2003.

[36] N. A. Cole, A. M. Mason, R. W. Todd, M. Rhoades, and D. B. Parker, “Chemical Composition of Pen Surface Layers of Beef Cattle Feedyards1,” *Prof. Anim. Sci.*, vol. 25, no. 5, pp. 541–552, Oct. 2009.

[37] T.-T. Lim, A. J. Heber, J.-Q. Ni, D. C. Kendall, and B. R. Richert, “Effects of Manure Removal Strategies on Odor and Gas Emission from Swine Finishing,” 2002.

[38] N. S. Bolan, A. A. Szogi, T. Chuasavathi, B. Seshadri, M. J. Rothrock, and P. Panneerselvam, “Uses and management of poultry litter,” *Worlds Poult. Sci. J.*, vol. 66, no. 4, pp. 673–698, Dec. 2010.

[39] Y. Liang *et al.*, “Ammonia Emissoins from U.S. Laying Hen Houses in Iowa and Pennsylvania,” *Trans. ASAE*, vol. 48, no. 5, pp. 1927–1941, 2005.

[40] N. S. Ferguson *et al.*, “The effect of dietary protein and phosphorus on ammonia concentration and litter composition in broilers,” *Poult. Sci.*, vol. 77, no. 8, pp. 1085–1093, Aug. 1998.

[41] C. A. Rotz and J. Oenema, “Predicting Management Effects on Ammonia Emissions from Dairy and Beef Farms,” *Trans. ASABE*, vol. 49, no. 4, pp. 1139–1149, 2006.

[42] L. M. Safley, J. C. Barker, and P. W. Westerman, “Loss of nitrogen during sprinkler irrigation of swine lagoon liquid,” *Bioresour. Technol.*, vol. 40, no. 1, pp. 7–15, Jan. 1992.

[43] S. G. Sommer and N. J. Hutchings, “Ammonia emission from field applied manure and its reduction—invited paper,” *Eur. J. Agron.*, vol. 15, no. 1, pp. 1–15, Sep. 2001.

[44] C. D. Coufal, C. Chavez, P. R. Niemeyer, and J. B. Carey, “Measurement of broiler litter production rates and nutrient content using recycled litter,” *Poult. Sci.*, vol. 85, no. 3, pp. 398–403, Mar. 2006.

[45] N. Hutchings, S. Sommer, and S. Jarvis, “A model of ammonia volatilization from a grazing livestock farm,” *Atmos. Environ.*, vol. 30.4, pp. 589–599, 1996.

[46] R. Pinder, N. Pekney, C. Davidson, and P. Adams, “A process-based model of ammonia emissions from dairy cows: improved temporal and spatial resolution,” *Atmos. Environ.*, vol. 38.9, pp. 1357–1365, 2004.

[47] M. Wesely and B. Hicks, “Some factors that affect the deposition rates of sulfur dioxide and similar gases on vegetation,” *J. Air Pollut. Control Assoc.*, vol. 27.11, pp. 1110–1116, 1977.

[48] S. Sommer and N. Hutchings, “Ammonia emission from field applied manure and its reduction—invited paper,” *Eur. J. Agron.*, vol. 15.1, pp. 1–15, 2001.

[49] J. Olesen and S. Sommer, “Modelling effects of wind speed and surface cover on ammonia volatilization from stored pig slurry,” *Atmos. Environ.*, vol. 27.16, pp. 2567–2574, 1993.

[50] N. Cole, P. Defoor, M. Galyean, G. Duff, and J. Gleghorn, “Effects of phase-feeding of crude protein on performance, carcass characteristics, serum urea nitrogen concentrations, and manure nitrogen of finishing beef steers,” *J. Anim. Sci.*, vol. 84.12, pp. 3421–3432, 2006.

[51] A. Hristov *et al.*, “Review: Ammonia emissions from dairy farms and beef feedlots,” *Can. J. Anim. Sci.*, vol. 91, no. 1, pp. 1–35, 2011.

[52] T. Klopfenstein and G. Erickson, “Effects of manipulating protein and phosphorus nutrition of feedlot cattle on nutrient management and the environment,” *J. Anim. Sci.*, vol. 80, pp. E106–E114, 2002.

[53] R. Todd, N. Cole, and L. Harper, “Ammonia and gaseous nitrogen emissions from a commercial beef cattle feedyard estimated using the flux-gradient method and N: P ratio analysis,” in *Proceedings of State of the Science: Animal Manure and Waste Management*, 2005, pp. 1–8.

[54] R. Todd, N. Cole, R. Clark, T. Flesch, L. Harper, and B. Baek, “Ammonia emissions from a beef cattle feedyard on the southern High Plains,” *Atmos. Environ.*, vol. 42.28, pp. 6797–6805, 2008.

[55] R. Todd, N. Cole, and R. Clark, “Ammonia emissions from open lot beef cattle feedyards on the southern High Plains,” in *Proc. 16th Annual International Emissions Inventory Conference--Emission Inventories: Integration, Analysis, Communication*, 2007, pp. 1–19.

[56] R. Todd, N. Cole, M. Rhoades, D. Parker, and K. Casey, “Daily, monthly, seasonal, and annual ammonia emissions from southern High Plains cattle feedyards,” *J. Environ. Qual.*, vol. 40.4, pp. 1090–1095, 2011.

[57] R. Todd, N. Cole, and R. Clark, “Reducing crude protein in beef cattle diet reduces ammonia emissions from artificial feedyard surfaces,” *J. Environ. Qual.*, vol. 35.2, pp. 404–411, 2006.

[58] E. L. Cortus, L. D. Jacobson, B. Hetchler, and A. J. Heber, “Emission Monitoring Methodology at a NAEMS Dairy Site, with an Assessment of the Uncertainty of Measured Ventilation Rates,” in *Proceedings of the IX International Livestock Environment Symposium (ILES IX)*, 2012.

[59] B. Bogan, A. Chandrasekar, S. McGlynn, C. Gooch, and A. J. Heber, “National air emissions monitoring study: data from Dairy Freestall Barn and Milking Center in New York, Site NY5B,” Purdue University, West Lafayette, IN, Jul. 2010.

[60] Y. Zhao *et al.*, “National Air Emissions Monitoring Study: Data from Two Dairy Freestall Barns in California - Site CA5B,” Purdue University, West Lafayette, IN, Final Report, 2010.

[61] J. Ramirez-Dorronsoro, H. Joo, P. M. Ndegwa, and A. J. Heber, “National Air Emissions Monitoring Study: Data from Two Dairy Freestall Barns in Washington WA5B,” Purdue University, West Lafayette, IN, Final Report, 2010.

[62] T. T. Lim, Y. Jin, J. Ha, and A. J. Heber, “National Air Emissions Monitoring Study: Emissions data from Two Freestall Barns and a Milking Center at a Dairy Farm in Indiana - Site IN5B,” Purdue University, West Lafayette, IN, Final Report, 2010.

[63] H. Joo *et al.*, “Ammonia and Hydrogen Sulfide Concentrations and Emissions for Naturally Ventilated Freestall Dairy Barns,” *Trans. ASABE*, pp. 1321–1331, Oct. 2015.

[64] B. Bogan, K. Wang, W. Robarge, J. Kang, and A. Heber, “National Air Emissions Monitoring Study: Emissions Data from Three Swine Finishing Barns in North Carolina - Site NC3B,” Purdue University, West Lafayette, IN, Technical Report, 2010.

[65] A. J. Heber, “Emission Data from Four Swine Finishing Rooms in India,” Final Report, 2010.

[66] A. J. Heber, “Emissions Data from Two SOW Barns and One Swine Farrowing Room in Oklahoma,” Final Report, 2010.

[67] W. Robarge, K. Wang, B. Bogan, J. Kang, and A. J. Heber, “National Air Emissions Monitoring Study: Emissions Data from Two Sow Gestation Barns and One Farrowing Room in North Carolina- Site NC4B,” Purdue University, West Lafayette, IN, Final Report, 2010.

[68] A. Aarnink, A. Keen, and J. Metz, “Ammonia emission patterns during the growing periods of pigs housed on partially slatted floors,” *J. Agric. Eng.*, vol. 62.2, pp. 105–116, 1995.

[69] J. Arogo, P. Westerman, and A. Heber, “A review of ammonia emissions from confined swine feeding operations,” *Trans. ASAE*, vol. 46, no. 3, pp. 805–817, 2003.

[70] A. Heber *et al.*, “Effect of a manure additive on ammonia emission from swine finishing buildings,” *Trans. ASAE*, vol. 43.6, pp. 1895–1902, 2000.

[71] S. Hoff *et al.*, “Emissions of ammonia, hydrogen sulfide, and odor before, during, and after slurry removal from a deep-pit swine finisher,” *J. Air Waste Manag. Assoc.*, vol. 56.5, pp. 581–590, 2006.

[72] L. Jacobson, B. Hetchler, V. Johnson, R. Nicolai, and D. Schmidt, “Seasonal variations in NH3, H2S and PM10 emissions from pig and poultry buildings from a multi-state project,” in *Symposium on the State of the Science of Animal Manure and Waste Management. American Society of Agricultural Engineers*, 2005, pp. 1–6.

[73] C. Fabbri, L. Valli, M. Guarino, A. Costa, and V. Mazzotta, “Ammonia, methane, nitrous oxide and particulate matter emissions from two different buildings for laying hens,” *Biosyst. Eng.*, vol. 97.4, pp. 441–455, 2007.

[74] Y. Liang *et al.*, “Ammonia emissions from US laying hen houses in Iowa and Pennsylvania,” *Trans. ASAE*, vol. 48.5, pp. 1927–1941, 2005.

[75] K. Nahm, “Evaluation of the nitrogen content in poultry manure,” *Worlds Poult. Sci. J.*, vol. 59.1, pp. 77–88, 2003.

[76] F. Nicholson, B. Chambers, and A. Walker, “Ammonia emissions from broiler litter and laying hen manure management systems,” *Biosyst. Eng.*, vol. 89.2, pp. 175–185, 2004.

[77] E. L. Cortus, X. Lin, R. Zhang, and A. J. Heber, “National Air Emissiosn Monitoring Study: Emissions Data form Two Broiler Chicken Houses in California - Site CA1B,” Purdue University, West Lafayette, IN, Final Report, 2010.

[78] X. J. Lin, E. L. Cortus, R. Zhang, S. Jiang, and A. J. Heber, “Air Emissions from Broiler Houses in California,” *Trans. ASABE*, vol. 55, no. 5, pp. 1895–1908, 2012.

[79] K. Casey *et al.*, “Ammonia emissions from broiler houses in Kentucky during winter,” in *International Symposium on Gaseous and Odour Emissions from Animal Production Facilities*, 2003, pp. 1–10.

[80] R. Gates, K. Casey, E. Wheeler, H. Xin, and A. Pescatore, “US broiler housing ammonia emissions inventory,” *Atmos. Environ.*, vol. 42.14, pp. 3342–3350, 2008.

[81] C. Coufal, C. Chavez, P. Niemeyer, and J. Carey, “Measurement of broiler litter production rates and nutrient content using recycled litter,” *Poult. Sci.*, vol. 85.3, pp. 398–403, 2006.

[82] R. Lacey, J. Redwine, and C. Parnell, “Particulate matter and ammonia emission factors for tunnel-ventilated broiler production houses in the southern US,” *Trans. ASAE*, vol. 46.4, pp. 1203–1214, 2003.

[83] J. Q. Ni *et al.*, “National Air Emissions Monitoring Study: Emissions data from Two Manure Belt Layer Houses in Indiana - Site IN2B,” Purdue University, West Lafayette, IN, Final Report, 2010.

[84] J.-Q. Ni *et al.*, “Characteristics of ammonia, hydrogen sulfide, carbon dioxide, and particulate matter concentrations in high-rise and manure-belt layer hen houses,” *Atmos. Environ.*, vol. 57, pp. 165–174, Sep. 2012.

[85] L. Harper and R. Sharpe, “Ammonia emissions from swine waste lagoons in the southeastern US coastal plains,” Raleigh, NC, 1998.

[86] T. Lim, A. Heber, J. Ni, A. Sutton, and P. Shao, “Odor and gas release from anaerobic treatment lagoons for swine manure,” *J. Environ. Qual.*, vol. 32.3, pp. 406–416, 2003.

[87] T. Osada, K. Kuroda, and M. Yonaga, “Determination of nitrous oxide, methane, and ammonia emissions from a swine waste composting process,” *J. Mater. Cycles Waste Manag.*, vol. 2.1, pp. 51–56, 2000.

[88] S. Portejoie, J. Martinez, F. Guiziou, and C. Coste, "Effect of covering pig slurry stores on the ammonia emission processes," *Bioresour. Technol.*, vol. 87.3, pp. 199–207, 2003.

[89] A. Visscher *et al.*, "Ammonia emissions from anaerobic swine lagoons: Model development," *J. Appl. Meteorol.*, vol. 41.4, pp. 426–433, 2002.

[90] J. Zahn, J. Hatfield, Y. Do, and A. DiSpirito, "Air pollution from swine production facilities differing in waste management practice," *Proc. Water Environ. Fed.*, vol. 3, pp. 609–634, 2000.

[91] K. James, "The development of US ammonia emission factors for use in process based modeling," North Carolina State University, 2008.

[92] S. McGinn and S. Sommer, "Ammonia emissions from land-applied beef cattle manure," *Can. J. Soil Sci.*, vol. 87.3, pp. 345–352, 2007.

[93] M. Chantigny, D. Angers, P. Rochette, G. Belanger, and D. Cote, "Gaseous nitrogen emissions and forage nitrogen uptake on soils fertilized with raw and treated swine manure," *J. Environ. Qual.*, vol. 36.6, pp. 1864–1872, 2007.

[94] R. Sharpe and L. Harper, "Ammonia and nitrous oxide emissions from sprinkler irrigation applications of swine effluent," *J. Environ. Qual.*, vol. 26.6, pp. 1703–1706, 1997.

[95] P. Westerman, R. Huffman, and J. Barker, "Environmental and agronomic evaluation of applying swine lagoon effluent to coastal bermudagrass for intensive grazing and hay," in *Proc. of the 7th Int. Symp. on Agricultural and Food Processing Wastes*, 1995, pp. 18–20.

[96] N. Pelletier, "Environmental performance in the US broiler poultry sector: Life cycle energy use and greenhouse gas, ozone depleting, acidifying and eutrophying emissions," *Agric. Syst.*, vol. 98.2, pp. 67–73, 2008.

[97] J. Redwine, R. Lacey, S. Mukhtar, and J. Carey, "Concentration and emissions of ammonia and particulate matter in tunnel-ventilated broiler houses under summer conditions in Texas," *Trans. ASAE*, vol. 45.4, pp. 1101–1109, 2002.

[98] D. Hatch, S. Jarvis, and G. Dollard, "Measurements of ammonia emission from grazed grassland," *Environ. Pollut.*, vol. 65.4, pp. 333–346, 1990.

[99] U.S. EPA. 2018. Inventory of Greenhouse Gas Emissions and Sinks, 1990-2016. Chapter 5.2, Manure Management. EPA 430-R-18-003.

[100] United States Department of Agriculture National Agricultural Statistics Service Quick Stats. https://quickstats.nass.usda.gov/

[101] EPA's SPECIATE Database, 2016, available at: https://www.epa.gov/air-emissions-modeling/speciate-version-45-through-40

[102] A. McQuilling, 2016, Ammonia Emissions from Livestock in the United States: From Farm-Level Models to a New National Inventory, Thesis, Carnegie Mellon University, available at: https://kilthub.cmu.edu/articles/Ammonia_Emissions_from_Livestock_in_the_United_States_From_Farm-Level_Models_to_a_New_National_Inventory/6714665

[103] EPA Grant Number RD834549, https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/9117/report/F

ARCHITECTUAL SURFACE COATING

A. Source Category Description

Architectural surface coatings are used by homeowners and contractors to coat the interior and exterior of buildings and other structures. The coatings are applied by spray, brush, or roller and dry cure at ambient conditions. The Volatile Organic Compound (VOC) emissions from this source category result from the evaporation of the paint and cleanup solvents.

Table 1: 2023 NEI Industrial Surface Coating – Architectural Surface Coating SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401002000	Solvent Utilization	Surface Coating	Architectural Surface Coating	Solvent-Based
2401003000	Solvent Utilization	Surface Coating	Architectural Surface Coating	Water-Based
2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types

B. Overview of Calculations

Architectural Surface Coating VOC emissions in the 2023 NEI are estimated using county population, gallons of water and solvent based coatings used, and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific national and county-level population data from the U.S. Census Bureau[2] and architectural solvent usage. Utilizing the U.S. Census Bureau's MA325F(10) Paints and Allied Products 2010 data, MDE calculated a linear trendline between the reported data and 2023. To get a national per capita consumption factor, MDE divided the estimated 2023 gallons of coatings used by the national population in 2023. To arrive at gallons used per county, MDE multiplied the county population by the per capita national consumption factor.

The 2023 NEI uses 2023 surface coating gallon estimates, as shown in Table 2.

Table 2: 2023 County Level Architectural Surface Coating Usage.

Linear Consumption Trend to Inventory Year										
U.S. Census form MA28F - Architectural Coatings (data in 1,000 gallons)										
	1985	1987	1998	1999	2006	2007	2008	2009	2011	2023
Solvent-Based	163,529	165,715	134,295	145,584	131,035	131,698	100,239	88,630	113,964	78,225
Water Based	311,658	359,436	496,028	530,161	649,077	636,619	396,056	372,907	510,560	618,346
2023 National Population										334,233,854

2023 Solvent-Based Consumption Factor	0.2340
2023 Water-Based Consumption Factor	1.8500

County Activity - Gallons Used

County Name	FIPS	2023 Population	Solvent-Based Gallons	Water-Based Gallons
Allegany	001	67,273	15,745	124,458
Anne Arundel	003	594,582	139,157	1,100,000
Baltimore	005	844,703	197,696	1,562,733
Calvert	009	94,728	22,170	175,250
Caroline	011	33,593	7,862	62,148
Carroll	013	176,639	41,341	326,789
Cecil	015	105,672	24,732	195,497
Charles	017	171,973	40,249	318,157
Dorchester	019	32,879	7,695	60,827
Frederick	021	293,391	68,666	542,785
Garrett	023	28,423	6,652	52,584
Harford	025	264,644	61,938	489,602
Howard	027	336,001	78,638	621,615
Kent	029	19,303	4,518	35,711
Montgomery	031	1,058,474	247,727	1,958,218
Prince Georges	033	947,430	221,738	1,752,782
Queen Annes	035	52,508	12,289	97,142
Saint Marys	037	115,281	26,981	213,274
Somerset	039	24,910	5,830	46,084
Talbot	041	37,823	8,852	69,974
Washington	043	155,813	36,467	288,260
Wicomico	045	104,800	24,528	193,884
Worcester	047	54,171	12,678	100,218
Baltimore City	510	565,239	132,290	1,045,714

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be unsuitable for adoption in Maryland. EPA uses a per capita emission factor for both solvent and water based products combined, while MDE utilizes a lb/gallon emission factor per product type – therefore they are not comparable and EPA's factor cannot be used in MDE's calculations.

MDE utilizes an uncontrolled emission factor of 3.87 lbs/gallon solvent-based and 0.74 lbs/gallon water-based, as demonstrated in Table 3 below.

Table 3. 2023 NEI VOC emissions factors for Architectural Surface Coating

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401002000	Architectural Coatings – Solvent Based	VOC	3.87	lb/gallon	[4]

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401003000	Architectural Coatings – Water Based	VOC	0.74	lb/gallon	

E. Controls

VOC emissions from cold clean degreasing are controlled through Code of Maryland Regulations (COMAR) 26.11.39: Architectural and Industrial Maintenance Coatings.[5] COMAR 26.11.39 established VOC content limits and standards for a variety of architectural and maintenance (AIM) coatings made available for sale and use in Maryland.

EPA's surface coating regulation allowed the state to take a 20% emissions reduction in 1999.[6] MDE then adopted The Ozone Transport Commission's (OTC) AIM rule Phase I[7] and II[8] in 2005 and 2017 respectively, allowing the state to take an additional 31% reduction in controls.

The final reduction from the uncontrolled emission factor of 3.87 solvent-based and 0.74 water-based lbs/gallon is 44.8%, yielding a final controlled emission factor of 2.14 lbs/gallon solvent-based and 0.41 lbs/gallon water-based.

F. Emissions

Total VOC emissions from architectural surface coatings are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)
RE = Rule Effectiveness with source category s
RP = Rule Penetration with source category s
CE = Control Efficiency with source category s

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

Note that EPA has retired the solvent-based and water-based SCCs. For the purposes of reporting emissions to the EPA, total VOC and HAP emissions are reported under the single aggregate SCC (2401001000).

G. Point Source Subtraction

There are no point source-specific SCCs for architectural surface coating; therefore, point source subtraction is not performed for this category

H. Sample Calculations

Sample calculations for VOC emissions from Architectural Surface Coatings in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Architectural Surface Coating (SCC 2401002000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1- Solvent	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$\left(139{,}157\ gallons \times 3.87 \frac{lb/gallon}{2000} \times [\mathbf{1} - \mathbf{1} \times \mathbf{1} \times \mathbf{0.448}\right)$	148.64 tons of VOC in 2023
2 - Water	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$\left(1{,}099{,}999\ gallons \times 0.74 \frac{lb/gallon}{2000} \times [\mathbf{1} - \mathbf{1} \times \mathbf{1} \times \mathbf{0.448}\right)$	224.66 tons of VOC in 2023
			373.30 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Eastern Research Group, Inc. Volume III: Chapter 5: Consumer and Commercial Solvent Use Final Report, November 1995. Retrieved October 21, 2024 from https://www.epa.gov/sites/default/files/2015-08/documents/archsfc.pdf

[5] COMAR 26.11.39: Architectural and Industrial Maintenance Coatings. https://mde.maryland.gov/programs/regulations/air/Documents/NPA_26-11-39_AIM_in_MD_Reg_01-22-2016.pdf

[6] EPA AIM Controls: 63 FR 48848, 1998: Federal Register, "National Volatile Organic Compound Emission Standards for Architectural Coatings, Final Rule, Volume 63, Number 176, September 11, 1998.

[7] COMAR 26.11.33: Architectural Coatings. [REPEALED & REPLACED WITH 26.11.39].

[8] COMAR 26.11.39: Architectural and Industrial Maintenance Coatings. https://mde.maryland.gov/programs/regulations/air/Documents/NPA_26-11-39_AIM_in_MD_Reg_01-22-2016.pdf.

APPENDIX

Table 1. HAP speciation factors for Architectural Surface Coating. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401001000	Architectural Coatings	107211	Ethylene glycol	2.87E-01	95816
2401001000	Architectural Coatings	171	Glycol Ethers	5.55E-02	95816
2401001000	Architectural Coatings	67561	Methanol	1.45E-02	95816
2401001000	Architectural Coatings	1330207	Xylenes	2.56E-03	95816
2401001000	Architectural Coatings	108883	Toluene	1.16E-03	95816
2401001000	Architectural Coatings	121448	Triethylamine	4.39E-04	95816
2401001000	Architectural Coatings	122996	Phenoxyethanol	4.27E-04	95816
2401001000	Architectural Coatings	75070	Acetaldehyde	3.07E-04	95816
2401001000	Architectural Coatings	75092	Dichloromethane	2.81E-04	95816
2401001000	Architectural Coatings	100414	Ethylbenzene	2.44E-04	95816
2401001000	Architectural Coatings	N590	Polycyclic Organic Matter	1.98E-04	95816
2401001000	Architectural Coatings	110543	N-hexane	1.94E-04	95816
2401001000	Architectural Coatings	95476	O-xylene	1.72E-04	95816
2401001000	Architectural Coatings	108101	Methyl isobutyl ketone	1.51E-04	95816
2401001000	Architectural Coatings	108383	M-xylene	1.42E-04	95816

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

ASPHALT PAVING AND ROOFING

A. Source Category Description

The two types of asphalt paving used for road paving and repair are cutback asphalt and emulsified asphalt. Cutback asphalt is a liquefied road surface prepared by blending (or "cutting back") asphalt cement with different petroleum distillates (or road oils). The second type, emulsified asphalt, is also a liquefied road surface, but is prepared with a water/soap mixture instead of petroleum distillates. Cutback asphalt emits more VOCs, and its use has been limited in Maryland to the non-ozone period of April 15 to October 15. Asphalt like tar is also used for roofing similar to rubberizing.

Table 1: 2023 NEI Asphalt Paving & Roofing SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2461022000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Emulsified Asphalt	Total: All Solvent Types
2461021000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Cutback Asphalt	Total: All Solvent Types
2461025100	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Asphalt Paving: Hot and Warm Mix	Hot Mix Total: All Solvent Types
2461025200	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Asphalt Paving: Hot and Warm Mix	Warm Mix Total: All Solvent Types
2461023000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Asphalt Roofing	Total: All Solvent Types

B. Overview of Calculations

Asphalt Paving and Roofing Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using barrels of asphalt apportioned to county by population, and controlled emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on 2023 county-level population data from the U.S. Census Bureau[2] and 2022 state-level consumption of Asphalt and Road Oil from the U.S. Energy Information Administration (EIA) [3]. State asphalt and road oil consumption is apportioned to the counties using county share of state population. Activity is further apportioned to the SCC's using a percentage of paving application usage, which is the lesser of the value from either (1) EPA's Asphalt Paving-Roofing Nonpoint Emissions Methodology and Operation (NEMO) instructions[4] or (2) the split for Maryland computed from the EPA Wagon Wheel Outputs[5]. The 2023 NEI uses population and paving-type apportioned barrels of asphalt and road oil (converted to tons assuming 350 cubic foot pounds per barrel) estimates, as shown in Table 2.

Table 2: 2023 County Level Asphalt Consumption for Paving and Roofing

County Name	State County FIPs	Population for Inventory Year	EIA Asphalt Consumption (Barrels)	County Barrels	Tons Emulsified - 5.22% (Tons)	Tons Cutback - 0.17% (Tons)	Tons Warm Mix - 24.03% (Tons)	Tons Hot Mix - 70.58% (Tons)	Tons Roofing - 9% (Tons)
Allegany	24001	67,273	1,854,000	20,181	168	5	772	2,268	318
Anne Arundel	24003	594,582		178,367	1,483	48	6,826	20,048	2,809
Baltimore	24005	844,703		253,401	2,106	69	9,697	28,482	3,991
Calvert	24009	94,728		28,417	236	8	1,087	3,194	448
Caroline	24011	33,593		10,077	84	3	386	1,133	159
Carroll	24013	176,639		52,990	440	14	2,028	5,956	835
Cecil	24015	105,672		31,700	264	9	1,213	3,563	499
Charles	24017	171,973		51,590	429	14	1,974	5,799	813
Dorchester	24019	32,879		9,863	82	3	377	1,109	155
Frederick	24021	293,391		88,014	732	24	3,368	9,893	1,386
Garrett	24023	28,423		8,527	71	2	326	958	134
Harford	24025	264,644		79,390	660	21	3,038	8,923	1,250
Howard	24027	336,001		100,796	838	27	3,857	11,329	1,588
Kent	24029	19,303		5,791	48	2	222	651	91
Montgomery	24031	1,058,474		317,529	2,640	86	12,151	35,690	5,001
Prince Georges	24033	947,430		284,217	2,363	77	10,876	31,946	4,476
Queen Annes	24035	52,508		15,752	131	4	603	1,770	248
Saint Mary's	24037	115,281		34,583	287	9	1,323	3,887	545
Somerset	24039	24,910		7,473	62	2	286	840	118
Talbot	24041	37,823		11,346	94	3	434	1,275	179
Washington	24043	155,813		46,742	389	13	1,789	5,254	736
Wicomico	24045	104,800		31,439	261	9	1,203	3,534	495
Worcester	24047	54,171		16,251	135	4	622	1,827	256
Baltimore City	24510	565,239		169,565	1,410	46	6,489	19,059	2,671
Total		6,180,253		1,854,000	151,412	502	70,948	208,387	29,201

D. Emissions Factors

Emission factors for all paving processes capture emission that occur during application and in-use. Both application and in-use emission factors for hot mix and warm mix asphalt, as well as the in-use emission factors for cutback and emulsified asphalt, are retrieved from Khare et al. [6]

VOC emission factors for asphalt paving and roofing SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Asphalt Paving and Roofing

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2461022000	Emulsified Asphalt	VOC	197.52	lb/ton asphalt	[7]
2461021000	Cutback Asphalt	VOC	815.97	lb/ton asphalt	
2461025100	Hot Mix	VOC	10.05	lb/ton asphalt	
2461025200	Warm Mix	VOC	6.33	lb/ton asphalt	
2461023000	Asphalt Roofing	VOC	12.72	lb/ton asphalt	

E. Controls

VOC emissions from asphalt paving and roofing are controlled through Code of Maryland Regulations (COMAR) 26.11.11: Control of Petroleum Products Installations, Including Asphalt Paving and Asphalt Concrete Plants. [8] COMAR26.11.11.02B Restricts the use of cutback asphalt unless certain provisions are necessary: (1) long-life stockpile storage; (2) the use or application between October 15-April 15 is necessary; or (3) sole use as a penetrating prime coat. Cutback assumes a control efficiency of 100%, rule effectiveness of 80%, and rule penetration of 100%. All other asphalts have no controls applied.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)
RE = Rule Effectiveness for source category *s*
RP = Rule Penetration for source category *s*
CE = Control Efficiency for source category *s*

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for asphalt paving and roofing therefore, point source subtraction is not performed for this category

H. Sample Calculations

Sample calculations for VOC emissions from asphalt paving and roofing in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Asphalt Paving and Roofing in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
Emulsified			
1	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}}$	$\left(1{,}482.7\ tons\ \times 197.52 \frac{lb/_{ton}}{2000}\right)$	146.4 tons of VOC in 2023
Cutback			
2	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$\left(48.3\ tons\ \times 815.97 \frac{lb/_{ton}}{2000} \times [1 - 0.8 \times 1 \times 1]\right)$	3.94 tons of VOC in 2023
Warm Mix			
3	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}}$	$\left(6{,}825.7\ tons\ \times 6.33 \frac{lb/_{ton}}{2000}\right)$	21.6 tons of VOC in 2023
Hot Mix			
4	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}}$	$\left(20{,}048\ tons\ \times 10.05 \frac{lb/_{ton}}{2000}\right)$	100.74 tons of VOC in 2023
Roofing			
5	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}}$	$\left(2{,}809.3\ tons\ \times 12.72 \frac{lb/_{ton}}{2000}\right)$	17.87 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] U.S. Energy Information Administration. Table F4: Asphalt and Road Oil Consumption, Price and Expenditure Estimates, 2022. November 20, 2024 https://www.eia.gov/state/seds/sep_fuel/html/fuel_ar.html.

[4] U.S. Environmental Protection Agency. *Asphalt NEMO 2023nei_26jul2024.* Table 2: Asphalt emission factors. Retrieved November 7, 2024. https://usepa.sharepoint.com/:w:/r/sites/NEI/_layouts/15/Doc.aspx?sourcedoc=%7BBA5AF7CA-5094-47A9-B51F-8E9455FDF764%7D&file=Asphalt%20NEMO%202023NEI_26jul2024.docx&action=default&mobileredirect=true.

[5] U.S. Environmental Protection Agency. Wagon Wheel 2020 v7.1 Final – SLT Input. Retrieved November 20, 2024. https://usepa.sharepoint.com/sites/NOMAD/Shared%20Documents/Forms/AllItems.aspx?csf=1&web=1&e=kyXPeE&sw=auth&CID=bb460a9b%2Dba4f%2D44fb%2D9d2a%2D29d02713cf31&FolderCTID=0x0120001B39A7DC83F463488F2958294EC6BC32&id=%2Fsites%2FNOMAD%2FShared%20Documents%2FWagon%20Wheel%2FWagon%20Wheel%202020%20v7%2E1%20Final&viewid=6f420189%2D05de%2D4f68%2Daebe%2D02cbe175fbb3.

[6] Khare, P., Machesky, J., Soto, R., He, M., Presto, A.A., Gentner, D.R., Asphalt-related emissions are a major missing nontraditional source of secondary organic aerosol precursors. Science Advances, 6, 35, doi:10.1126/sciadv.abb9785

[7] Khare, P., Machesky, J., Soto, R., He, M., Presto, A.A., Gentner, D.R., Asphalt-related emissions are a major missing nontraditional source of secondary organic aerosol precursors. Science Advances, 6, 35, doi:10.1126/sciadv.abb9785

[8] Code of Maryland Regulations (COMAR) 26.11.11: Control of Petroleum Products Installations, Including Asphalt Paving and Asphalt Concrete Plants. Retrieved January 8, 2025. https://dsd.maryland.gov/regulations/Pages/26.11.11.00.aspx

APPENDIX

Table 1. HAP speciation factors for Asphalt Paving and Roofing. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

Asphalt Type	SCC	Pollutant	WT.% VOC
Emulsified	2461022000	91203	0.06540
Cutback	2461021000	108883	0.04500
Cutback	2461021000	91203	0.06540
Cutback	2461021000	71432	0.11920
Cutback	2461021000	1330207	0.12200
Roofing	2461023000	108883	0.02592
Roofing	2461023000	71432	0.01910

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

AUTOMOTIVE REFINISHING

A. Source Category Description

Automobile refinishing is the repainting of worn or damaged automobiles, light trucks and other vehicles. Coating of new cars is not included in this category but falls under industrial coating. In automobile refinishing, lacquers and enamels are usually applied with hand-operated spray guns. Because the vehicles contain heat-sensitive plastics and rubber, the coatings are dried or cured in low-temperature ovens or at ambient conditions.

Table 1: 2023 NEI automotive refinishing SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401005000	Solvent Utilization	Surface Coating	Auto Refinishing	Total: All Solvent Types

B. Overview of Calculations

Automotive Refinishing Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and controlled emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized are 81112/, 4411//, and 4412//. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany	24001	538	33,000 Employees from State Business Patterns. Withheld Employment = State Employment – County Employment = 153. Midpoints = 0	538
Anne Arundel	24003	3,747		3,747
Baltimore	24005	5,913		5,913
Calvert	24009	287		287
Caroline	24011	108		108
Carroll	24013	1,007		1,007
Cecil	24015	312		312
Charles	24017	1,082		1,082
Dorchester	24019	246		246

Frederick	24021	1,746	Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	1,746
Garrett	24023	168		168
Harford	24025	1,699		1,699
Howard	24027	1,966		1,966
Kent	24029	0		0
Montgomery	24031	6,402		6,402
Prince Georges	24033	4,138		4,138
Queen Annes	24035	178		178
Saint Mary's	24037	449		449
Somerset	24039	0		0
Talbot	24041	340		340
Washington	24043	1,003		1,003
Wicomico	24045	971		971
Worcester	24047	186		186
Baltimore City	24510	667		667
Total		33,153		33,153

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

VOC emission factors for auto refinishing SCCs are listed in table 3 below.

Table 3: 2023 NEI VOC emissions factors for Automotive Refinishing

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401005000	Auto Refinishing	VOC	30.32	lb/employee	[4], [5], [6]

E. Controls

VOC emissions from Automotive Refinishing are controlled through Code of Maryland Regulations (COMAR) 26.11.19.23: Control of VOC Emissions from Vehicle Refinishing. COMAR 26.11.19.23 establishes operating standards for vehicle refinishing facilities in Maryland through the implementation of VOC content limits for coatings and cleaning solvents used during the preparation, application, and drying phases of vehicle refinishing, coating application standards, work practices standards and monitoring and record keeping requirements. Note that the autobody refinishing category does not include new car coating. COMAR 26.11.19.23 allows MDE to take an 8% reduction in VOC emissions.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category, and then applying a control factor.

$$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Section C)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)
RE = Rule Effectiveness with source category *s*
RP = Rule Penetration with source category *s*
CE = Control Efficiency with source category *s*

HAP emissions are estimated using the VOC emissions and HAP speciation factors (See Table 1 in Appendix) It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s*

G. Point Source Subtraction

There are no point source-specific SCCs for Automotive Refinishing; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from automotive refinishing in Anne Arundel County, Maryland are included in the table below.

Table 4: Sample Calculations of VOC emissions for Automotive Refinishing (SCC 2401005000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$\left(3{,}747\ employees \times 30.32 \frac{lb/employee}{2000}\right) \times (1 - 0.08)$	52.26 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. County Business Patterns: 2021. U.S. Department of Commerce. Retrieved October 21, 2024 from https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy..

[5] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019

[6] U.S. Environmental Protection Agency: Emission Inventory Improvement Program, Auto Body Refinishing, Volume III: Chapter 13, January 2000.

APPENDIX

Table 1. HAP speciation factors for Automotive Refinishing. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401005000	Auto Refinishing	1330207	Xylenes	2.65E-01	2402
2401005000	Auto Refinishing	108883	Toluene	1.34E-01	2402
2401005000	Auto Refinishing	108101	Methyl isobutyl ketone	3.19E-02	2402
2401005000	Auto Refinishing	171	Glycol Ethers	9.61E-03	2402
2401005000	Auto Refinishing	107211	Ethylene glycol	1.65E-03	2402

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

AVIATION GASOLINE STAGE I

A. Source Category Description

Aviation gasoline is the only aviation fuel that contains lead as a knock-out component for small reciprocating piston-engine crafts in civil aviation. Commercial and military aviation rarely use this fuel. Stage I aviation gasoline is shipped to airports and is filled into bulk terminals, and then into tanker trucks; these processes fall under the definition of "stage 1". These filling processes cause the displacement of vapors into the atmosphere during the transfer of gasoline from tank trucks to storage tanks, and vice versa.

Table 1: 2023 NEI SCC Aviation Gasoline Stage I

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501080050	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 1: Total

B. Overview of Calculations

Aviation Gasoline Volatile Organic Compound (VOC) emissions are estimated using county-level aviation gasoline consumption, derived from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] aircraft landing and takeoff (LTO) counts from FAA OPSNET[2], and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on information from a variety of sources.[3, 4, 5]

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level aviation gasoline consumption and county-level landing LTO data. The calculations for estimating emissions from stage 1 aviation gasoline distribution involve first estimating the amount of aviation gasoline consumed in each county, based on state-level aviation gasoline consumption data from SEDS. State-level aviation gasoline consumption is then distributed to the counties based on the proportion of LTOs. The SEDS MSN Code AVTCP is used to identify the total consumption of aviation gasoline in units of thousand barrels. Data are then converted to gallons by multiplying the barrels consumption by a factor of 42 gallons per barrel. County LTO data for "general aviation" activity is used to apportion state aviation fuel to the county-level based on the proportion of LTOs in the county to total LTOs for the state. The 2023 NEI uses 2023 SEDS aviation gasoline fuel consumption and 2023 general aviation LTO counts to estimate county-level consumption of aviation gasoline, as show in in Table 2.

Table 2: 2023 County Level Aviation Gas Fuel Consumption

County Name	State County FIPs	General Aviation LTO	LTO Fraction	EIS SEDS Aviation Gasoline Consumption (mmBtu)	Aviation Gasoline Fuel Consumption (Gallons)
Allegany	24001	1,468	0.01026	44,000 barrels * 42 gallons/barrel = 1,848,000 gallons	18,952.59
Anne Arundel	24003	6,437	0.04497		83,098.32
Baltimore	24005	21,649	0.15124		279,499.03

Calvert	24009	12	0.00008		154.93
Caroline	24011	950	0.00664		12,264.96
Carroll	24013	10,002	0.06988		129,130.65
Cecil	24015	519	0.00363		6,700.54
Charles	24017	750	0.00524		9,682.86
Dorchester	24019	4,962	0.03467		64,061.81
Frederick	24021	18,126	0.12663		234,008.95
Garrett	24023	3,425	0.02393		44,218.40
Harford	24025	1,983	0.01385		25,595.03
Howard	24027	0	0.00000		0.00
Kent	24029	600	0.00419		7,746.29
Montgomery	24031	8,313	0.05808		107,324.84
Prince Georges	24033	3,483	0.02433		44,960.76
Queen Annes	24035	6,784	0.04739		87,584.71
Saint Mary's	24037	7,796	0.05446		100,650.12
Somerset	24039	579	0.00404		7,468.71
Talbot	24041	9,675	0.06759		124,902.46
Washington	24043	9,489	0.06629		122,507.57
Wicomico	24045	9,013	0.06296		116,355.72
Worcester	24047	15,128	0.10569		195,309.78
Baltimore City	24510	2,000	0.01397		25,820.96

D. Emissions Factors

VOC emission factors for stage 1 aviation gasoline distribution are taken from the TRC report *Estimation of Alkylated Lead Emissions*.[6] Emissions factors are separated by source-type and then summed to arrive at an overall VOC emission factor. Note that there are no tank farms, thus emissions from valves and pumps are not estimated.

VOC emission factors for stage I aviation gasoline are listed in table 3 below.

Table 3. VOC Emissions Factors for Aviation Gasoline Distribution-Stage 1 (2501080050)

Pollutant	Emission Source	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Factor Reference
VOC	Aviation Gas Unloading/ Tank Filling - tank fill	1,081	mg/l gasoline*	9.02E-3	LB/GAL AvGas	7
	Aviation Gas Unloading/ Tank Filling - Storage tank working	432		3.61E-3		
	Aviation Gas Tank Truck Filling - Composite	1,235		1.03E-2		
	Aviation Gas Storage Tank - Breathing losses	203		1.69E-3		
	~~Aviation Gas - Fugitive from valves~~	~~0.26~~	~~kg/valve/day~~	~~5.73E-1~~	~~LB/valve/day~~	
	~~Aviation Gas - Fugitive from pumps~~	~~2.7~~	~~kg/seal/day~~	~~5.95E0~~	~~LB/seal/day~~	
	Total VOC Emission Factor for Maryland			0.0246	lb/gal	

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$	=	Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$	=	Activity data for county *c* associated with source category *s* (Table 2)
$EF_{VOC,s}$	=	Calculated VOC emissions factor for source category *s* (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors (see Table 1 in Appendix).

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$	=	Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$	=	Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$	=	Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for Aviation Gasoline Stage I, therefore, point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from stage 1 aviation gasoline consumption in Anne Arundel County, Maryland are included in the table below.

Table 4: Sample calculation for tons of VOC emissions for Stage I Aviation Gasoline in Ann Arundel County

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$(83{,}098\ gallons \times 0.0246\ lb/gallon)/2000$	1.02 tons of VOC in 2023

I. References

[1] Energy Information Administration.. State Energy Data System (SEDS*) Table F1: Aviation gasoline consumption, price, and expenditure estimates, 2023*

[2] Federal Aviation Administration OPSNET Airport Operations & ADIP – search terms: Maryland, 2023 &

[3] U.S. Environmental Protection Agency. 1984. *Locating and Estimating Air Emissions from Sources of Ethylene Dichloride.* Table 16, EPA-450/4-84-007d. RTP, NC. https://www3.epa.gov/ttn/chief/le/ethyldi.pdf

[4] Memorandum from Greg LaFlam and Tracy Johnson (PES) to Stephen Shedd (EPA/OAQPS). *Speciated Hazardous Air Pollutants - Baseline Emissions and Emissions Reductions Under the Gasoline Distribution NESHAP.* August 9, 1996.

[5] Personal Communication via e-mail from Stephen Shedd (EPA/OAQPS) to Laurel Driver (EPA/OAQPS). E-mail dated May 29, 2002.

[6] TRC Environmental Corporation. 1993. *Estimation of Alkylated Lead Emissions, Final Report.* Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC.

[7] TRC Environmental Corporation. 1993. *Estimation of Alkylated Lead Emissions, Final Report.* Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC.

APPENDIX

Table 1. HAP Emissions Factors for Aviation Gasoline Distribution-Stage 1 (2501080050)

Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Factor Reference
Ethylene Dichloride	107062	0.26	mg/l gasoline*	2.17E-6	LB/GAL AvGas	3
Lead**	7439921			6.27E-6	LB/ LB VOC	6
2,2,4-Trimethylpentane	540841			8.00E-3		4
TBenzene	71432			9.00E-3		
Cumene	98828			1.00E-4		5
Ethylbenzene	100414			1.00E-3		4
Hexane	110543			1.60E-2		
Naphthalene	91203			5.00E-4		
Toluene	108883			1.30E-2		
Xylene	1330207			5.00E-3		

AVIATION GASOLINE STAGE 2

A. Source Category Description

Aviation gasoline (also called "AvGas") is the only aviation fuel that contains lead as a knock-out component for small reciprocating, piston-engine crafts in civil aviation.[1] Commercial and military aviation rarely use this fuel. Stage 2 involves the transfer of fuel from the tanker trucks into general aviation aircraft; during this process vapors are also displaced into the atmosphere.

Table 1: 2023 NEI Aviation Gasoline Stage 2

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501080100	Storage and Transport	Petroleum and Petroleum Product Storage	Airports: Aviation Gasoline	Stage 2: Total

B. Overview of Calculations

Aviation Gasoline Volatile Organic Compound (VOC) emissions are estimated using county-level aviation gasoline consumption, derived from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] aircraft landing and takeoff (LTO) counts from FAA OPSNET[2], and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on information from a variety of sources. [3, 4, 5]

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level aviation gasoline consumption and county-level landing LTO data. The calculations for estimating emissions from stage 2 aviation gasoline distribution involve first estimating the amount of aviation gasoline consumed in each county, based on state-level aviation gasoline consumption data from SEDS. State-level aviation gasoline consumption is then distributed to the counties based on the proportion of LTOs. The SEDS MSN Code AVTCP is used to identify the total consumption of aviation gasoline in units of thousand barrels. Data are then converted to gallons by multiplying the barrels consumption by a factor of 42 gallons per barrel. County LTO data for "general aviation" activity is used to apportion state aviation fuel to the county-level based on the proportion of LTOs in the county to total LTOs for the state. The 2023 NEI uses 2023 SEDS aviation gasoline fuel consumption and 2023 general aviation LTO counts to estimate county-level consumption of aviation gasoline, as show in in Table 2.

Table 2: 2023 County Level Aviation Gas Fuel Consumption

County Name	State County FIPs	General Aviation LTO	LTO Fraction	EIS SEDS Aviation Gasoline Consumption (mmBtu)	Aviation Gasoline Fuel Consumption (Gallons)
Allegany	24001	1,468	0.01026	44,000 barrels * 42 gallons/barrel = 1,848,000 gallons	18,952.59
Anne Arundel	24003	6,437	0.04497		83,098.32
Baltimore	24005	21,649	0.15124		279,499.03

Calvert	24009	12	0.00008		154.93
Caroline	24011	950	0.00664		12,264.96
Carroll	24013	10,002	0.06988		129,130.65
Cecil	24015	519	0.00363		6,700.54
Charles	24017	750	0.00524		9,682.86
Dorchester	24019	4,962	0.03467		64,061.81
Frederick	24021	18,126	0.12663		234,008.95
Garrett	24023	3,425	0.02393		44,218.40
Harford	24025	1,983	0.01385		25,595.03
Howard	24027	0	0.00000		0.00
Kent	24029	600	0.00419		7,746.29
Montgomery	24031	8,313	0.05808		107,324.84
Prince Georges	24033	3,483	0.02433		44,960.76
Queen Annes	24035	6,784	0.04739		87,584.71
Saint Mary's	24037	7,796	0.05446		100,650.12
Somerset	24039	579	0.00404		7,468.71
Talbot	24041	9,675	0.06759		124,902.46
Washington	24043	9,489	0.06629		122,507.57
Wicomico	24045	9,013	0.06296		116,355.72
Worcester	24047	15,128	0.10569		195,309.78
Baltimore City	24510	2,000	0.01397		25,820.96

D. Emissions Factors

VOC emission factors for stage 2 aviation gasoline distribution are taken from the TRC report *Estimation of Alkylated Lead Emissions*.[6]

VOC emission factors for stage 2 aviation gasoline are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Aviation Gasoline Stage 2

Pollutant	Emission Source	Emission Factor (original)	Emission Factor Units (original)	Emission Factor	Emission Factor Units
VOC	Fuel Transfer from Tanker Trucks to General Aviation Aircraft	1,420*	mg/l gasoline**	0.012	LB/GAL AvGas

* This emission factor represents the sum of the emission factor for uncontrolled displacement losses (1,340 mg/l) and spillage (80 mg/l).

** Converted from mg/l to LB/GAL using conversion factors of 3.785 liters per gallon and 453,592 mg per pound.

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC and HAP emissions from stage 2 aviation gasoline are calculated by multiplying the activity

data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = VOC emissions factor for source category s (Table 3 and Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for Aviation Gasoline Stage II, therefore, point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from stage II aviation gasoline consumption in Anne Arundel County, Maryland are included in the table below.

Table 4: Sample calculation for tons of VOC emissions for Stage II Aviation Gasoline in Ann Arundel County

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$(83{,}098\ gallons \times 0.012\ lb/gallon)/2000$	0.4985 tons of VOC in 2023

I. References

[1] Energy Information Administration.. State Energy Data System (SEDS*) Table F1: Aviation gasoline consumption, price, and expenditure estimates, 2023*

[2] Federal Aviation Administration OPSNET Airport Operations & ADIP – search terms: Maryland, 2023 &

[3] U.S. Environmental Protection Agency. 1984. *Locating and Estimating Air Emissions from Sources of Ethylene Dichloride.* Table 16, EPA-450/4-84-007d. RTP, NC. https://www3.epa.gov/ttn/chief/le/ethyldi.pdf

[4] Memorandum from Greg LaFlam and Tracy Johnson (PES) to Stephen Shedd (EPA/OAQPS). *Speciated Hazardous Air Pollutants - Baseline Emissions and Emissions Reductions Under the Gasoline Distribution NESHAP.* August 9, 1996.

[5] Personal Communication via e-mail from Stephen Shedd (EPA/OAQPS) to Laurel Driver (EPA/OAQPS). E-mail dated May 29, 2002.

[6] TRC Environmental Corporation. 1993. *Estimation of Alkylated Lead Emissions, Final Report.* Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC.

[7] TRC Environmental Corporation. 1993. *Estimation of Alkylated Lead Emissions, Final Report.* Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC.

[8] Memorandum from Greg LaFlam and Tracy Johnson (PES) to Stephen Shedd (EPA/OAQPS). *Speciated Hazardous Air Pollutants - Baseline Emissions and Emissions Reductions Under the Gasoline Distribution NESHAP.* August 9, 1996

[9] Personal Communication via e-mail from Stephen Shedd (EPA/OAQPS) to Laurel Driver (EPA/OAQPS). E-mail dated May 29, 2002.

[10] TRC Environmental Corporation. 1993. *Estimation of Alkylated Lead Emissions, Final Report.* Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC.

APPENDIX

Table 1. HAP emission factors for Aviation Gasoline Stage II.

Pollutant	Pollutant Code	Emission Source	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Factor Reference
Ethylene Dichloride	107062	All processes	0.226*	mg/l gasoline**	1.88 E-6	LB/GAL AvGas	7
Lead***	7439921	All processes			8.50 E-8		10
2,2,4-Trimethylpentane	540841	All processes			8.00E-3	LB/ LB VOC	8
Benzene	71432	All processes			9.00E-3		
Cumene	98828	All processes			1.00E-4		9
Ethylbenzene	100414	All processes			1.00E-3		8
Hexane	110543	All processes			1.60E-2		
Naphthalene	91203	All processes			5.00E-4		
Toluene	108883	All processes			1.30E-2		
Xylene	1330207	All processes			5.00E-3		

BAKERIES

A. Source Category Description

Bakeries emit Volatile Organic Compounds (VOC), primarily ethanol formed by yeast fermentation of bread or dough, during the baking process. Ethanol is emitted through a vent, along with combustion product gases. Large commercial bakeries are inventoried as point sources. In-store and neighborhood bakeries have lower emissions, and thus are considered area sources.

Table 1: 2023 Bakeries SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2302050000	Industrial Processes	Food and Kindred Products: SIC 20	Bakery Products	Total

B. Overview of Calculations

Bakery emissions in the 2023 NEI are estimated using employment and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level employment data from the U.S. Census Bureau.[1] County Business Pattern NAICS Codes utilized are 311811 and 311812. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany	24001	0	3,682 Employees from State Business Patterns.	0
Anne Arundel	24003	152		152
Baltimore	24005	557	Withheld Employment = State Employment – County Employment = 317.	557
Calvert	24009	0		0
Caroline	24011	0		0
Carroll	24013	0		0
Cecil	24015	10		10
Charles	24017	27	Midpoints = 0	27
Dorchester	24019	0		0
Frederick	24021	173	Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	173
Garrett	24023	0		0
Harford	24025	0		0

Howard	24027	71		71
Kent	24029	0		0
Montgomery	24031	510		510
Prince Georges	24033	708		708
Queen Annes	24035	15		15
Saint Mary's	24037	0		0
Somerset	24039	0		0
Talbot	24041	0		0
Washington	24043	48		48
Wicomico	24045	0		0
Worcester	24047	7		7
Baltimore City	24510	1,087		1,087
Total		3,365		3,365

D. Emissions Factors

The emission factor used to estimate bakery emissions are described in a Radian Corporation memo dated April 24, 1992, entitled, "VOC Emissions from Bakeries".[2]

VOC emission factors for Bakery SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Bakeries

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2302050000	Bakeries	VOC	200	lb/employee	[3]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from bakeries are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)

G. Point Source Subtraction

Since emissions from bakeries occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 1 of the

Appendix.

Point source subtraction for this sector is completed at the county level through adjusting employment. Facility level annual emissions from the mapped SCCs are divided by the *uncontrolled* emission factor, which yields the number of employees in the county associated with the source category. The county employment is then adjusted downward by the number of employees. Nonpoint emissions are then estimated using the point source adjusted employment. The resultant emissions represent emissions only associated with nonpoint activity.

The employment adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{e,c} = Ep_{VOCc,s} \times 2000 \,/\, EF_{VOC,s}}$$

Where:

$NP_{s,c}$ = Nonpoint source employment in county *c* for source category *s*, in tons per year
$Ep_{VOC,c,s}$ = Annual point VOC emissions for the mapped SCCs in county *c* for source category *s*, in tons per year
$EF_{VOC,s}$ = Uncontrolled VOC emissions factor for source category *s*

The point source employment estimates for bakeries is outlined in Table 4 below.

Table 4: Point Source Employment Adjustment for Bakeries (SCC 2302050000)

FIPS State and County Code	FIPS State Code	FIPS County Code	County Name	County Type	Postal State Code	Point Source Reduction VOC (tpy)	Total County Employment for Facilities
24001	24	001	Allegany	County	MD	0	0
24003	24	003	Anne Arundel	County	MD	0	0
24005	24	005	Baltimore	County	MD	28.17	256
24009	24	009	Calvert	County	MD	0	0
24011	24	011	Caroline	County	MD	0	0
24013	24	013	Carroll	County	MD	19.09	174
24015	24	015	Cecil	County	MD	0	0
24017	24	017	Charles	County	MD	0	0
24019	24	019	Dorchester	County	MD	48.53	441
24021	24	021	Frederick	County	MD	0	0
24023	24	023	Garrett	County	MD	0	0
24025	24	025	Harford	County	MD	0	0
24027	24	027	Howard	County	MD	0	0
24029	24	029	Kent	County	MD	0	0
24031	24	031	Montgomery	County	MD	0	0
24033	24	033	Prince George's	County	MD	0	0
24035	24	035	Queen Anne's	County	MD	0	0
24037	24	037	St. Mary's	County	MD	0	0
24039	24	039	Somerset	County	MD	0	0

24041	24	041	Talbot	County	MD	0	0
24043	24	043	Washington	County	MD	0	0
24045	24	045	Wicomico	County	MD	0	0
24047	24	047	Worcester	County	MD	0	0
24510	24	510	Baltimore	City	MD	93.34	849

H. Sample Calculations

Sample calculations for VOC emissions from bakeries in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Bakeries (SCC 2302050000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s}} = \boldsymbol{A_{c,s}} \times \boldsymbol{EF_{VOC,s}}$	$\left(152\ employees\ \times 220 \frac{lb/employee}{2000}\right)$	16.72 tons of VOC in 2023

I. References

[1] U.S. Census Bureau. County Business Patterns: 2021. U.S. Department of Commerce. Retrieved October 21, 2024 from https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html.

[2] VOC Emissions from Bakeries, memorandum from Lucy Adams to SIP Inventory Preparers and EPA Regions, April 24, 1992.

[3] VOC Emissions from Bakeries, memorandum from Lucy Adams to SIP Inventory Preparers and EPA Regions, April 24, 1992.

APPENDIX

Table 1. Point-Nonpoint Crosswalk for Bakeries (SCC 2302050000)

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
30203201	Industrial Processes	Food and Agriculture	Bakeries	Bread Baking: Sponge-Dough Process	2302050000	Bakery Products
30203202	Industrial Processes	Food and Agriculture	Bakeries	Bread Baking: Straight-Dough Process	2302050000	Bakery Products
30203203	Industrial Processes	Food and Agriculture	Bakeries	Material Handling and Transferring	2302050000	Bakery Products
30203204	Industrial Processes	Food and Agriculture	Bakeries	Flour Storage	2302050000	Bakery Products
30203205	Industrial Processes	Food and Agriculture	Bakeries	Cracker and Cookie Baking	2302050000	Bakery Products
30203299	Industrial Processes	Food and Agriculture	Bakeries	Other Not Classified	2302050000	Bakery Products
30203404	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Intermediate Fermentor (F4 Stage)	2302050000	Bakery Products
30203405	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Stock Fermentor (F5 Stage)	2302050000	Bakery Products
30203406	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Pitch Fermentor (F6 Stage)	2302050000	Bakery Products
30203407	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Trade Fermentor (F7 Stage)	2302050000	Bakery Products
30203410	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Wastewater Treatment	2302050000	Bakery Products
30203415	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Extrusion	2302050000	Bakery Products
30203420	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Dryer	2302050000	Bakery Products
30203421	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Drying Chamber	2302050000	Bakery Products
30203422	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Rotolouvre Dryer	2302050000	Bakery Products
30203423	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Airlift Dryer: Batch Process	2302050000	Bakery Products
30203424	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Dry Yeast	Airlift Dryer: Continuous Process	2302050000	Bakery Products
30203504	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Intermediate Fermentor (F4 Stage)	2302050000	Bakery Products
30203505	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Stock Fermentor (F5 Stage)	2302050000	Bakery Products
30203506	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Pitch Fermentor (F6 Stage)	2302050000	Bakery Products
30203507	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Trade Fermentor (F7 Stage)	2302050000	Bakery Products

30203510	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Wastewater Treatment	2302050000	Bakery Products
30203530	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Harvesting	2302050000	Bakery Products
30203531	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Harvesting: Centrifuge	2302050000	Bakery Products
30203532	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Harvesting: Plate and Frame Filter Press	2302050000	Bakery Products
30203533	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Harvesting: Rotary Vacuum Filter	2302050000	Bakery Products
30203534	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Harvesting: Mixers	2302050000	Bakery Products
30203535	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Harvesting: Extrusion	2302050000	Bakery Products
30203536	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Harvesting: Cutting	2302050000	Bakery Products
30203540	Industrial Processes	Food and Agriculture	Bakers Yeast Manufacturing - Compressed Yeast	Packaging	2302050000	Bakery Products

BREWERIES

A. Source Category Description

Breweries emit Volatile Organic Compounds (VOC), primarily ethanol, during the fermentation process. Although large-scale commercial breweries have been inventoried as point sources, there are microbreweries and brewpubs that emit lower levels of VOCs and therefore must be inventoried as area sources. These smaller breweries emit most of their VOCs from the fermentation room, not the brew kettle as is the case with the large breweries.

Table 1: 2023 Brewery SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2302070001	Industrial Processes	Food and Kindred Products: SIC 20	Fermentation/Beverages	Breweries

B. Overview of Calculations

Brewery VOC emissions in the 2023 NEI are estimated using brew production and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific and county-level beer production from the Maryland's Alcohol, Tobacco and Cannabis Commission's *2023 Alcohol & Tobacco Tax Annual Report.* [1] The 2023 NEI uses 2023 beer production estimates, as shown in Table 2.

Table 2: 2023 County Level Beer Production.

County Name	State County FIPs	Total Beer Production FY 2023 (Barrels)
Allegany	24001	417
Anne Arundel	24003	5,553
Baltimore	24005	95,108
Calvert	24009	1,243
Caroline	24011	2
Carroll	24013	4,259
Cecil	24015	143
Charles	24017	0
Dorchester	24019	9,295
Frederick	24021	70,708
Garrett	24023	0
Harford	24025	5,241
Howard	24027	8,148
Kent	24029	8
Montgomery	24031	17,714

Prince Georges	24033	5,572
Queen Annes	24035	4,781
Saint Mary's	24037	19
Somerset	24039	0
Talbot	24041	186
Washington	24043	3,941
Wicomico	24045	10,000
Worcester	24047	564
Baltimore City	24510	21,966
Total		264,845

D. Emissions Factors

Emissions from the small breweries were calculated using an emission factor cited in a February 5, 1992 Technical Memorandum prepared by Radian Corporation for EPA.[2] This emission factor is 56.743 lbs. VOC per 1000 barrels produced.

VOC emission factors for brewery SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Breweries

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2302070001	Breweries	VOC	0.05674	lb/barrel	[3]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from breweries are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)

G. Point Source Subtraction

There are no point source specific SCCs for breweries; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from breweries in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Breweries (SCC 2302070001) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s}} = \boldsymbol{A_{c,s}} \times \boldsymbol{EF_{VOC,s}}$	$\left(5{,}533\ barrels\ \times 0.05674 \frac{lb/barrel}{2000}\right)$	0.1570 tons of VOC in 2023

I. Reference

[1] Maryland Alcohol, Tobacco and Cannabis Commission: *2023 Alcohol & Tobacco Tax Annual Report*. Retrieved December 3, 2024 from https://atcc.maryland.gov/wp-content/uploads/sites/24/2024/08/Annual-Report-FY2023.pdf

[2] United States Environmental Protection Agency under Contract No. 68-D0-0125 to Radian Corporation. *VOC Emissions From Breweries*. February 5, 1992.

[3] United States Environmental Protection Agency under Contract No. 68-D0-0125 to Radian Corporation. *VOC Emissions From Breweries*. February 5, 1992.

CAMPFIRES

A. Source Category Description

Burning wood in campfires is often an outdoor recreational activity enjoyed by many outdoor enthusiasts. This activity is usually limited to publicly or privately owned camp sites, which can sometimes be located in local/state/national parks. Campfires are a source of air pollution since burning wood emits multiple air pollutants, both gaseous and particulate pollutants including criteria air pollutants and precursors, hazardous air pollutants and greenhouse gases.

Table 1: 2023 NEI Campfires SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2810090001	Miscellaneous Area Sources	Other Combustion	Open Fire	Campfires

B. Overview of Calculations

Campfire emissions in the 2023 NEI are estimated using the amount of firewood burned per campsite and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on the number of public and private campsites, surveyed cordwood sales data from Maryland Department of Natural Resources (DNR)[1], and assumptions about the tons of wood per cord. Firewood consumption is estimated using the following formula:

$$\boldsymbol{Consumption_{c,s} = Campsite_{c,s} \times CordCampsite_s \times Density_s}$$

Where:

$Consumption_{c,s}$ = Annual firewood consumption in county *c* for source category *s*, in tons per year
$Campsite_{c,s}$ = Public and private campsite count for county *c* associated with source category *s* (Appendix Table 1)
$CordCampsite_s$ = Calculated cords per campsite surveyed from for source category *s*
$Density_s$ = Density of tons of wood per cord for source category *s.* This is adopted from EPA's campfire methodology[2] and is 1.3062 tons of wood per cord.

MDE surveyed DNR for cordwood sales. 28 parks, covering 1,996 individual campsites, reported 483.52 cords sold in 2023. This yields a cords per campsite value of 0.24, which is then applied to all campsites in Maryland. The 2023 NEI uses 2023 firewood consumption estimates, as shown in Table 2

Table 2: 2021 County Level Firewood Consumption

County Name	State County FIPs	Public & Private Campsite Count	Firewood Consumption (Tons)

Allegany	24001	681	215.4809
Anne Arundel	24003	502	158.8420
Baltimore	24005	356	112.6449
Calvert	24009	489	154.7286
Caroline	24011	335	106.0001
Carroll	24013	202	63.9165
Cecil	24015	421	133.2121
Charles	24017	225	71.1941
Dorchester	24019	143	45.2478
Frederick	24021	573	181.3077
Garrett	24023	608	192.3823
Harford	24025	263	83.2180
Howard	24027	73	23.0985
Kent	24029	411	130.0479
Montgomery	24031	113	35.7553
Prince Georges	24033	697	220.5436
Queen Annes	24035	2	0.6328
Saint Mary's	24037	657	207.8868
Somerset	24039	135	42.7165
Talbot	24041	0	0.0000
Washington	24043	790	249.9705
Wicomico	24045	261	82.5852
Worcester	24047	1,954	618.2814
Baltimore City	24510	0	0.0000
Total		9,891	3,129.6937

D. Emissions Factors

For the 2023 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors for campfires with align with those used for residential wood combustion – outdoor burning (SCC 2104008100), which EPA assumes is similar for campfires.[3] MDE finds EPA's method to be reasonable when other data on campfire emission factors is not available, and has aligned most of its emission factors to match with EPAs.

MDE is aware of three studies conducted by the United States Department of Agriculture (USDA) Forest Service in collaboration with the Minnesota Pollution Control Agency (MPCA) between 2019 and 2021.[4],[5] These studies quantified fine particulate matter (PM2.5) emissions from two commercially available outdoor fire pits designed to burn wood logs with minimal smoke production (low smoke) and from a traditional outdoor fire pit. The studies demonstrated that the average steady-burn fine particulate emission factor for a traditional outdoor fire pit is 2.55 grams per kilogram of wood burned (g/kg), or 5.1 pounds per ton of wood burned (lbs/ton), which is 80% lower than the value assumed by EPA. The same studies showed that the average steady-burn carbon monoxide (CO) emission factor for a traditional outdoor fire pit is 42.475 g/kg or 84.95 lbs/ton, which is 43% lower than the value assumed by EPA. MDE revised and updated its PM and CO emission factors based on the USDA and MPCA studies.

MDE made one final modification to the PM emission factors. EPA assumes that the emission factor for PM10 and PM2.5 are identical. MDE adopted a similar approach for PM 10, making it identical to the updated PM2.5 emission factor. Also, EPA's documentation indicates that condensable PM (PM-CON) is

4.7% of total PM, and filterable PM (PM-FIL) is 95.3% of total PM. MDE adopted the same assumptions and broke the total 5.1 lbs/ton of PM into 0.23 lbs/ton for PM-CON and 4.86 lbs/ton for PM-FIL.

Emission factors for campfire SCCs are listed in table 3 below.

Table 3. 2023 NEI Emissions factors for Campfires

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2810090001	Campfires	VOC	18.9	lb/ton wood	5
		CO	84.95		6,7
		NOX	2.6		5
		PM-CON	0.2399		6,7
		PM10-FIL	4.8601		6,7
		PM10-PRI	5.1		6,7
		PM25-FIL	4.8601		6,7
		PM25-PRI	5.1		6,7
		SO2	0.4		5
		NH3	1.8		5
		Mercury	0.00004		5

E. Controls

As previously stated, The USDA and MPCA studies quantified PM2.5 emissions from two commercially available outdoor fire pits designed to burn wood logs with minimal smoke production (low smoke) and from a traditional outdoor fire pit. A comparison between low smoke and traditional fire pits reduced PM2.5 emissions by approximately 29%. However, the usage of low-smoke fire pits at campgrounds is unknown.

MDE will not estimate emissions reductions from increased low-smoke fire pit usage until data around their usage at campgrounds is made available.

F. Emissions

Total VOC emissions from campfires are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{c,s} = Consumption_{c,s} \times EF_s \times [1 - RE \times RP \times CE]}$$

Where:

$E_{,c,s}$ = Annual emissions in county c for source category s, in tons per year
$Consumption_{c,s}$ = Annual firewood consumption in county c for source category s, in tons per year (Table 2)
EF_s = Emissions factor for source category s (Table 3)

Where Controls are Reserved Pending Additional Data:

RE = Rule Effectiveness with source category s
RP = Rule Penetration with source category s
CE = Control Efficiency with source category s

G. Point Source Subtraction

There is no point source subtraction for this SCC.

H. Sample Calculations

Sample calculations for VOC emissions from campfires in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for campfires in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{c,s} = Consumption_{c,s} \times EF_s \times [1 - RE \times RP \times CE]}$	$\left(158.8\ tons\ firewood \times 18.9 \frac{lb/ton}{2000}\right)$ *controls are reserved pending additional data	1.5 tons of VOC in 2023

I. References

[1] Maryland Department of Natural Resources: Maryland Park Service. State Parks and Forests that Offer Camping. https://dnr.maryland.gov/publiclands/pages/campinginfo.aspx

[2] U.S. Environmental Protection Agency. Campfire Nonpoint Emissions Methodology and Operation Instructions. June 2025. 2023NEI_NEMO_Campfire NEMO 2023NEI_3jun2025.docx

[3] U.S. Environmental Protection Agency. Campfire Nonpoint Emissions Methodology and Operation Instructions. June 2025. 2023NEI_NEMO_Campfire NEMO 2023NEI_3jun2025.docx

[4] Shawn Urbanski, PhD, USDA Forest Service. *USDA FOREST SERVICE RECREATIONAL FIRE PIT EMISSIONS TESTING: Final Report to the Minnesota Pollution Control Agency*. March 25, 2020. https://www.leg.mn.gov/docs/2020/other/200710.pdf

[5] Megan Kuhl-Stennes, et al, USDA Forest Service. *Minnesota Residential Wood Combustion Survey Results Recreational Firepit Emissions Testing*. December 2022. https://www.pca.state.mn.us/sites/default/files/aq-ei4-48.pdf

APPENDIX

Table 1. Public and Private Campgrounds in Maryland

State	FIPS	Campground Name	Type	No. Campsites	Source
MD	24001	C and O Canal National Historical Park - Fifteen Mile Creek	NP	10	https://www.recreation.gov/camping/campgrounds/252968?tab=seasons
MD	24001	C and O Canal National Historical Park - Paw Paw Tunnel	NP	10	https://www.recreation.gov/camping/campgrounds/252971?tab=seasons
MD	24001	C and O Canal National Historical Park - Spring Gap	NP	14	https://www.recreation.gov/camping/campgrounds/252967?tab=seasons
MD	24001	Canal Tunnel River	PRI	40	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24001	Dans Mountain State park Hill Run Group Campsite	SP	1	https://dnr.maryland.gov/publiclands/Pages/western/DansMountain/Camping.aspx
MD	24001	Green Ridge State Forest	SF	100	https://dnr.maryland.gov/forests/Pages/publiclands/Greenridge/Recreation-Camping.aspx
MD	24001	Hillcrest River	PRI	60	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24001	Little Orleans	PRI	150	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24001	Rocky Gap State Park	SP	296	https://dnr.maryland.gov/publiclands/Pages/western/RockyGap/Overnight-Accommodations.aspx
MD	24003	Adventure Bound	PRI	270	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24003	Annapolis NS - Family Camping	MIL	14	https://www.armymwr.com/index.php/programs-and-services/outdoor-recreation/camping-rv-parks/maryland#Annapolis
MD	24003	Camp Meade - RV Park	MIL	54	https://www.armymwr.com/index.php/programs-and-services/outdoor-recreation/camping-rv-parks/maryland#Annapolis
MD	24003	Downs Park Youth Group Camping	CP	2	https://www.aacounty.org/recreation-parks/parks/downs-park/camping
MD	24003	Emory Waters Nature Preserve	CP	2	https://www.aacounty.org/recreation-parks/parks/popular-activities/paddle-camping
MD	24003	KOA Holiday Washington DCT	PRI	156	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24003	Sandy Point State Park Youth Group Cmaping	SP	2	https://dnr.maryland.gov/publiclands/pages/southern/sandypoint/camping.aspx
MD	24003	Stocketts Run	CP	2	https://www.aacounty.org/recreation-parks/parks/popular-activities/paddle-camping
MD	24005	Gunpowder Falls State Park - Camp Cone	SP	8	https://dnr.maryland.gov/publiclands/Pages/central/gunpowder.aspx

MD	24005	Gunpowder Falls State Park - Camp Wood	SP	4	https://dnr.maryland.gov/publiclands/Pages/central/gunpowder.aspx
MD	24005	Hart-Miller Island	SP	22	https://dnr.maryland.gov/publiclands/Pages/central/HartMiller/Camping.aspx
MD	24005	Merry Meadows	PRI	300	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24005	Patapsco Valley State Park - Hilton	SP	22	https://dnr.maryland.gov/publiclands/Pages/central/PatapscoValley/Hilton/Camping.aspx
MD	24009	Breezy Point Beach	CP	82	https://www.calvertcountymd.gov/breezypoint#:~:text=Seated%20at%20the%20heart%20of%20the%20Chesapeake,pristine%20beach%20soaking%20up%20the%20sun%2C%20while
MD	24009	Calvert Cliffs State Park Youth Group Camping	SP	5	https://dnr.maryland.gov/publiclands/Pages/southern/calvertcliffs.aspx
MD	24009	KINGS LANDING PARK	CP	7	https://www.calvertcountymd.gov/3744/Kings-Landing-Park#:~:text=Table_title:%20Youth%20Group%20Campground%20(Tents%20Only)%20Table_content:,GROUP%20SIZE:%20151%2D200%20%7C%20FEE:%20$150%20%7C
MD	24009	Patuxtent Camp Sites	PRI	0	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24009	Solomons Island Navy Recreation Center	MIL	395	https://www.armymwr.com/index.php/programs-and-services/outdoor-recreation/camping-rv-parks/maryland#Annapolis
MD	24011	Holiday Park	PRI	200	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24011	Martinak State Park	SP	70	https://dnr.maryland.gov/publiclands/Pages/eastern/Martinak/Camping.aspx
MD	24011	Tuckahoe State Park	SP	65	https://dnr.maryland.gov/publiclands/Pages/eastern/Tuckahoe/Camping-and-Cabins.aspx
MD	24013	Patapsco Valley State Park - McKeldin Youth Group Cmaping	SP	2	https://parkreservations.maryland.gov/create-booking/results?resourceLocationId=-2147483629&mapId=-2147483541&searchTabGroupId=0&bookingCategoryId=6&startDate=2025-10-28&endDate=2025-10-29&nights=1&isReserving=true&peopleCapacityCategoryCounts=%5B%5B-32768,null,1,null%5D%5D&searchTime=2025-10-28T14:09:52.773&flexibleSearch=%5Bfalse,false,null,1%5D&filterData=%7B%7D
MD	24013	Ramblin Pines	PRI	200	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24015	Elk Neck State Park	SP	265	https://dnr.maryland.gov/publiclands/Pages/central/ElkNeck/River-Camping-Area.aspx
MD	24015	Woodlands Camping Resort	PRI	156	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24017	Aqua Land	PRI	110	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24017	Goose Bay Marina	PRI	90	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm

MD	24017	Smallwood State Park	SP	25	https://dnr.maryland.gov/publiclands/Pages/southern/Smallwood/Camping.aspx
MD	24019	Taylor's Isaland Family Campgrounds	PRI	143	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24021	Brunswick Family	PRI	148	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24021	Catoctin Mountain Park - Adirondack Shelters	NP	2	https://www.recreation.gov/camping/campgrounds/233321?tab=info
MD	24021	Catoctin Mountain Park - Camp Misty Mount	NP	29	https://www.recreation.gov/camping/campgrounds/233241?tab=seasons
MD	24021	Catoctin Mountain Park - Camp Round Meadow	NP	1	https://www.recreation.gov/camping/campgrounds/251264?tab=info
MD	24021	Catoctin Mountain Park - Owens Creek	NP	50	https://www.recreation.gov/camping/campgrounds/247762
MD	24021	Catoctin Mountain Park - Poplar Grove	NP	3	https://www.recreation.gov/camping/campgrounds/232503?tab=info
MD	24021	Crows Nest	PRI	110	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24021	Cunningham Falls State Park - Houck Area	SP	146	https://dnr.maryland.gov/publiclands/Pages/western/cunningham.aspx
MD	24021	Cunningham Falls State Park - Manor Area	SP	27	https://dnr.maryland.gov/publiclands/Pages/western/cunningham.aspx
MD	24021	Evergreen Point Village	PRI	25	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24021	Gambrill State Park	SP	32	https://dnr.maryland.gov/publiclands/Pages/western/gambrill.aspx
MD	24023	Big Run State Park	SP	29	https://dnr.maryland.gov/publiclands/Pages/western/BigRun/Camping.aspx
MD	24023	Bumble Bee Rv Park	PRI	35	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24023	Deep Creek Lake State Park	SP	109	https://dnr.maryland.gov/publiclands/Pages/western/deepcreek.aspx
MD	24023	Double G	PRI	130	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24023	New Germany State Park	SP	61	https://dnr.maryland.gov/publiclands/Pages/western/NewGermany/Cabins-and-Campsites.aspx
MD	24023	Potomac-Garrett State Forest - Lost Land Run	SF	5	https://dnr.maryland.gov/forests/Pages/publiclands/PotomacGarrett/Camping.aspx
MD	24023	Potomac-Garrett State Forest - Piney Mountain	SF	7	https://dnr.maryland.gov/forests/Pages/publiclands/PotomacGarrett/Camping.aspx
MD	24023	Potomac-Garrett State Forest - Snaggy Mountain	SF	10	https://dnr.maryland.gov/forests/Pages/publiclands/PotomacGarrett/Camping.aspx

MD	24023	Potomac-Garrett State Forest - Wallman/Laurel Run	SF	14	https://dnr.maryland.gov/forests/Pages/publiclands/PotomacGarrett/Camping.aspx
MD	24023	Savage River State Forest	SF	81	https://dnr.maryland.gov/forests/Pages/publiclands/SavageRiver/Camping.aspx
MD	24023	Sleepy Hollow Campground	PRI	32	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24023	Swallow Falls State Park	SP	65	https://dnr.maryland.gov/publiclands/Pages/western/SwallowFalls/Camping.aspx
MD	24023	Youghiogheny River Lake - Mill Run	NP	30	https://www.recreation.gov/camping/campgrounds/159090?tab=info
MD	24025	Aberdeen Proving Ground - RV Park	MIL	35	https://www.armymwr.com/index.php/programs-and-services/outdoor-recreation/camping-rv-parks/maryland#Annapolis
MD	24025	Aberdeen Proving Ground - Skippers Point	MIL	20	https://www.armymwr.com/index.php/programs-and-services/outdoor-recreation/camping-rv-parks/maryland#Annapolis
MD	24025	Bar Harbor	PRI	93	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24025	Camp Ramblewood	PRI	40	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24025	Susquehanna State Park	SP	75	https://dnr.maryland.gov/publiclands/Pages/central/Susquehanna/Camping.aspx
MD	24027	Patapsco Valley State Park - Hollofield	SP	73	https://dnr.maryland.gov/publiclands/Pages/central/PatapscoValley/Hollofield/Camping.aspx
MD	24029	Bay Shore	PRI	140	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24029	Duck Neck	PRI	271	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24031	C and O Canal National Historical Park - Marsden Tract	NP	6	https://www.recreation.gov/camping/campgrounds/251544?tab=info
MD	24031	Little Bennett Regional Park	CP	100	https://montgomeryparks.org/parks-and-trails/little-bennett-regional-park/little-bennett-campground/
MD	24031	Robert C. McDonell County Park - Cabin John Campsites	CP	7	https://montgomeryparks.org/services/permits-rentals/campsites/
MD	24033	Andrews AFB - FAM Camp	MIL	58	https://www.armymwr.com/index.php/programs-and-services/outdoor-recreation/camping-rv-parks/maryland#Annapolis
MD	24033	Cedarville State Forest	SF	48	https://dnr.maryland.gov/publiclands/Pages/southern/Cedarville/Camping.aspx
MD	24033	Cherry Hill	PRI	400	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm

MD	24033	Greenbelt Campground	NP	157	https://www.recreation.gov/camping/campgrounds/232474?tab=info
MD	24033	Louise F. Cosca Regional Park	CP	25	https://mdpgparksweb.myvscloud.com/webtrac/web/search.html?category=CRPCAMP&display=graphical&module=RN&_csrf_token=cd6C156B1T633I2W3D4S2I4C644Q525B035H5S4W560D5I4F6M5B015M5257671S5N4C6F4K024I5R6G5B0C6W5X5H4Z01614Q6B4V6U5P3G554X0A5V5U5A6R1H5L4X59
MD	24033	Patuxtent River Park - Iron Pot Landing	CP	1	https://www.pgparks.com/parks_trails/patuxent-river-park
MD	24033	Patuxtent River Park - Jug Bay Natural Area	CP	5	https://www.pgparks.com/parks_trails/patuxent-river-park
MD	24033	Patuxtent River Park - Milltown Landing	CP	1	https://www.pgparks.com/parks_trails/patuxent-river-park
MD	24033	Patuxtent River Park - Spice Creek	CP	1	https://www.pgparks.com/parks_trails/patuxent-river-park
MD	24033	Patuxtent River Park - White Oak Landing	CP	1	https://www.pgparks.com/parks_trails/patuxent-river-park
MD	24035	Wye Island Natural Resources Management Area	SP	2	https://dnr.maryland.gov/publiclands/Pages/eastern/WyeIsland/Camping.aspx
MD	24037	Camp Merryelande	PRI	30	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24037	Dennis Point Marina	PRI	100	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24037	La Grande	PRI	70	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24037	Patuxent River NAS - Goose Creek/Hog Point/ Paradise/West Basin Recreation Area	MIL	50	https://www.navymwrpaxriver.com/programs/6c5ed81d-dfa5-4c4d-b150-ca718c4534be
MD	24037	Point Lookout State Park	SP	90	https://dnr.maryland.gov/publiclands/Pages/southern/pointlookout.aspx
MD	24037	Seaside View Recreation Park	PRI	75	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24037	Take It Easy	PRI	242	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24039	Janes Island State Park	SP	105	https://dnr.maryland.gov/publiclands/Pages/eastern/janesisland.aspx
MD	24039	Lake Somerset	PRI	30	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24043	Antietem National Battlefield - Rohrbach Group Campground	NP	10	https://www.recreation.gov/camping/campgrounds/251263?tab=seasons
MD	24043	C and O Canal National Historical Park - Antietam Creek	NP	20	https://www.recreation.gov/camping/campgrounds/252970

MD	24043	C and O Canal National Historical Park - McCoys Ferry	NP	13	https://www.recreation.gov/camping/campgrounds/252969
MD	24043	Fort Frederick State Park	SP	29	https://dnr.maryland.gov/publiclands/Pages/western/FortFrederick/Camping.aspx
MD	24043	Greenbrier State Park	SP	165	https://dnr.maryland.gov/publiclands/Pages/western/greenbrier.aspx
MD	24043	Happy Hills	PRI	205	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24043	KOA Holiday Hagerstown Antietam	PRI	96	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24043	The Treehouse Camp	PRI	33	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24043	Washington Monument State Park Youth Group Camping	SP	4	https://dnr.maryland.gov/publiclands/Pages/western/Washington/Camping.aspx
MD	24043	Yogi Bears Jellystone	PRI	215	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24045	Roaring Point Waterfront	PRI	130	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24045	Sandy Hill	PRI	99	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24045	Woodlawn	PRI	32	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24047	Assateague National Seashore	NP	242	https://www.recreation.gov/camping/campgrounds/232507?tab=campsites
MD	24047	Assateague State Park	SP	345	https://dnr.maryland.gov/publiclands/Pages/eastern/assateague.aspx
MD	24047	Island Resort	PRI	93	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24047	Pocomoke State Forest - Mataponi Ponds	SF	4	https://dnr.maryland.gov/publiclands/Pages/eastern/pocomokeriver.aspx
MD	24047	Pocomoke State Park - Milburn Landing	SP	36	https://dnr.maryland.gov/publiclands/Pages/eastern/pocomokeriver.aspx
MD	24047	Pocomoke State Park - Shad Landing	SP	180	https://dnr.maryland.gov/publiclands/Pages/eastern/pocomokeriver.aspx
MD	24047	Sun Outdoors Frontier Town	PRI	542	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24047	Sun Outdoors Ocean City Getaway	PRI	169	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm
MD	24047	Sun Outtdoors Ocean City	PRI	343	https://www.allstays.com/Campgrounds/Maryland-private-campgrounds-map.htm

COLD CLEANING DEGREASING

A. Source Category Description

Industrial and institutional cleaning (cold clean degreasing) is seen primarily at auto repair stations or manufacturing facilities, where solvents at room temperature (or slightly warmed) are used to clean parts via immersion or rinsing.

Cold clean degreasing are usually small emissions sources and because they are widely scattered and frequently used, they are most easily treated as area sources. If they are co-located at a major source, they may be included in the point source inventory, and those emissions will need to be subtracted from the area source estimate.

There are two basic types of cleaning machines: batch and in-line cleaning machines (also called continuous cleaning machines). Both of these equipment types are designed to use solvent to clean parts. The solvent is either used to clean in its non-vapor liquid form (at a temperature below the boiling point, referred to as cold cleaning), or heated to a temperature above its boiling point (referred to as vapor cleaning). Other solvent cleaning operations involve the use of solvent in wipe-cleaning and equipment cleanup. Emissions from solvent cleaning machines can also be considered to be point sources; therefore, the estimation process for the source category must take this into account to prevent double counting of emissions. Additionally, emissions from solvent cleanup may be included as part of an industry – or process-specific emission estimate.

Table 1: 2023 NEI Cold Clean Degreasing SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2415000000	Solvent Utilization	Degreasing	All process/all industries	Total: All Solvent Types

B. Overview of Calculations

Cold Cleaning Degreasing Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and controlled emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized are 331///, 332///, 333///, 334///, 335///, 336///, 337///, 339///, 441///, 483///, 484///, 485///, 488///, 8111//, and 8112//. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. Finally, emissions from stationary sources are subtracted off of estimated nonpoint emissions to prevent double counting. This is accomplished by adjusting county employment. Additional details on point source subtraction is provided in Section G. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, = County Employment, otherwise = Midpoint X Adjustment Factor	Point Source Employee Subtraction	Point Source Adjusted Employment (If Adjusted Employment – Point Source Employee is <0, = 0, otherwise = Adjusted Employment – Point Source Employee)
Allegany	24001	2,639	183,660 Employees from State Business Patterns Withheld Employment = State Employment – County Employment = 44,068 Midpoints = 0 Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	2,639	0	2,639
Anne Arundel	24003	24,219		24,219	0	24,219
Baltimore	24005	19,327		19,327	158	19,169
Calvert	24009	1,033		1,033	0	1,033
Caroline	24011	1,047		1,047	0	1,047
Carroll	24013	5,325		5,325	0	5,325
Cecil	24015	3,128		3,128	136	2,992
Charles	24017	2,681		2,681	0	2,681
Dorchester	24019	1,020		1,020	0	1,020
Frederick	24021	6,369		6,369	12	6,357
Garrett	24023	990		990	0	990
Harford	24025	6,622		6,622	0	6,622
Howard	24027	7,608		7,608	0	7,608
Kent	24029	347		347	0	347
Montgomery	24031	14,910		14,910	0	14,910
Prince Georges	24033	15,627		15,627	29	15,598
Queen Annes	24035	1,333		1,333	0	1,333
Saint Mary's	24037	1,605		1,605	10	1,595
Somerset	24039	119		119	0	119
Talbot	24041	745		745	0	745
Washington	24043	7,161		7,161	0	7,161
Wicomico	24045	2,843		2,843	1,676	1,167
Worcester	24047	565		565	0	565
Baltimore City	24510	12,329		12,329	0	12,329
Total		139,592		139,592	2,021	137,571

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

To align MDE's emission factor with EPA's values, MDE adjusted its uncontrolled emission factor, such that, when the state's credit for emissions control programs are applied, the final emission factor used to estimate emissions is equal to EPA's emission factor (which assumes controls within the factor). MDE's

adjusted uncontrolled emission factor is 17.737 lbs/employee, as is demonstrated in table 3 below. When controls are applied (as discussed in Section E), MDE's final emission factor will be 8.23 lbs/employee, which is consistent with EPA's emission factor.

VOC emission factors for cold cleaning degreasing are listed in table 3 below.

Table 3: 2023 NEI VOC emissions factors

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
241500000	Degreasing	VOC	87	lb/employee	[4]
Adjustment to Align with EPA Emission Factor					
MDE Controlled Emission Factor: 87*[1-67 control efficiency * 0.8 rule effectiveness * 1 rule effectiveness]		VOC	40.368	lb/employee	
EPA Emission Factor		VOC	8.23	lb/employee	[5], [6], [7]
Difference in Emission Factor: -79.61%					
MDE Adjusted Uncontrolled Emission Factor: 87*-79.61%+87		VOC	17.737	lb/employee	

E. Controls

VOC emissions from cold clean degreasing are controlled through Code of Maryland Regulations (COMAR) 26.11.19.09: Control of VOC Emissions from Cold and Vapor Degreasing. The regulation mandates that all cold degreasing material must have a vapor pressure less than or equal to 1 mm Hg at 20 degrees centigrade after May 15, 1996. The regulation also requires that good operating practices be implemented to minimize VOC losses. MDE estimates a 67% control efficiency, with a rule effectiveness of 80% and a rule penetration of 100%

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)
RE = Rule Effectiveness with source category *s*
RP = Rule Penetration with source category *s*
CE = Control Efficiency with source category *s*

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

Since emissions from cold clean degreasing occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Point source subtraction for this sector is completed at the county level through adjusting employment. Facility level annual emissions from the mapped SCCs are divided by the *uncontrolled* emission factor, which yields the number of employees in the county associated with the source category. The county employment is then adjusted downward by the number of employees. Nonpoint emissions are then estimated using the point source adjusted employment. The resultant emissions represent emissions only associated with nonpoint activity.

The employment adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{e,c} = Ep_{VOCc,s} \times 2000 \,/\, EF_{VOC,s}}$$

Where:

$NP_{s,c}$ = Nonpoint source employment in county *c* for source category *s*, in tons per year
$Ep_{VOC,c,s}$= Annual point VOC emissions for the mapped SCCs in county *c* for source category *s*, in tons per year
$EF_{VOC,s}$ = Uncontrolled VOC emissions factor for source category *s*

The point source employment estimates for cold clean degreasing is outlined in Table 4 below.

Table 4: Point Source Employment Adjustment for Cold Clean Degreasing (SCC 241500000)

FIPS State and County Code	FIPS State Code	FIPS County Code	County Name	County Type	Postal State Code	Point Source Reduction VOC (tpy)	Total County Employment for Facilities
24001	24	001	Allegany	County	MD		0
24003	24	003	Anne Arundel	County	MD		0
24005	24	005	Baltimore	County	MD	1.40	158
24009	24	009	Calvert	County	MD		0
24011	24	011	Caroline	County	MD		0
24013	24	013	Carroll	County	MD		0
24015	24	015	Cecil	County	MD	1.20	136
24017	24	017	Charles	County	MD		0
24019	24	019	Dorchester	County	MD		0

24021	24	021	Frederick	County	MD	0.11	12
24023	24	023	Garrett	County	MD		0
24025	24	025	Harford	County	MD		0
24027	24	027	Howard	County	MD		0
24029	24	029	Kent	County	MD		0
24031	24	031	Montgomery	County	MD		0
24033	24	033	Prince George's	County	MD	0.26	29
24035	24	035	Queen Anne's	County	MD		0
24037	24	037	St. Mary's	County	MD	0.09	10
24039	24	039	Somerset	County	MD		0
24041	24	041	Talbot	County	MD		0
24043	24	043	Washington	County	MD		0
24045	24	045	Wicomico	County	MD	14.86	1,676
24047	24	047	Worcester	County	MD		0
24510	24	510	Baltimore	City	MD		0

H. Sample Calculations

Sample calculations for VOC emissions from Degreasing in Anne Arundel County, Maryland are included in the table below.

Table 5: Sample Calculations of VOC emissions for Cold Clean Degreasing (SCC 241500000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$\left((17.74\ {}^{lb}/_{employee} \times 24{,}291\ employees) /2000) \times [1 - 0.67 \times 0.8 \times 1]\right)$	99.66 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. County Business Patterns: 2021. U.S. Department of Commerce. Retrieved October 21, 2024 from https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Eastern Research Group. Emissions Inventory Improvement Project: Volume 3, Chapter 6. September 1997.

[5] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy

[6] California Air Resources Board (CARB): Final 2015 Consumer & Commercial Product Survey Data Summaries, 2019.

[7] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019.

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APPENDIX

Table 1. HAP speciation factors for Cold Clean Degreasing. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2415000000	Degreasing	108883	Toluene	0.02350000	95817
2415000000	Degreasing	67561	Methanol	0.02330000	95817
2415000000	Degreasing	110543	N-hexane	0.00717000	95817
2415000000	Degreasing	100425	Styrene	0.00646000	95817
2415000000	Degreasing	1330207	Xylenes	0.00603000	95817
2415000000	Degreasing	171	Glycol Ethers	0.00490000	95817
2415000000	Degreasing	127184	Perchloroethylene	0.00213000	95817
2415000000	Degreasing	95476	O-xylene	0.00117000	95817
2415000000	Degreasing	107211	Ethylene glycol	0.00108000	95817
2415000000	Degreasing	108383	M-xylene	0.00108000	95817
2415000000	Degreasing	79016	Trichloroethylene	0.00097900	95817
2415000000	Degreasing	111422	Diethanolamine	0.00078200	95817
2415000000	Degreasing	122996	Phenoxyethanol	0.00074900	95817
2415000000	Degreasing	75092	Dichloromethane	0.00055800	95817
2415000000	Degreasing	100414	Ethylbenzene	0.00043300	95817
2415000000	Degreasing	106423	P-xylene	0.00036500	95817
2415000000	Degreasing	N590	Polycyclic Organic Matter	0.00016800	95817
2415000000	Degreasing	108101	Methyl isobutyl ketone	0.00012600	95817
2415000000	Degreasing	80626	Methyl methacrylate	0.00012300	95817

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table2. Point-Nonpoint Crosswalk for Cold Clean Degeasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
30101470	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning	2415000000	Degreasing
30101471	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning: Hand Wipe	2415000000	Degreasing
30101472	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning: Tanks, Vessels, etc.	2415000000	Degreasing
30102070	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning	2415000000	Degreasing
30102071	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning: Hand Wipe	2415000000	Degreasing
30102072	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning: Tanks, Vessels, etc.	2415000000	Degreasing
30102426	Industrial Processes	Chemical Manufacturing	Synthetic Organic Fiber	Equipment Cleanup	2415000000	Degreasing
30400340	Industrial Processes	Secondary Metal Production	Grey Iron Foundries	Grinding/Cleaning	2415000000	Degreasing
30400342	Industrial Processes	Secondary Metal Production	Grey Iron Foundries	Casting Cleaning/Chippers	2415000000	Degreasing
30400711	Industrial Processes	Secondary Metal Production	Steel Foundries	Cleaning	2415000000	Degreasing
30400725	Industrial Processes	Secondary Metal Production	Steel Foundries	Casting Cleaning/Tumblers	2415000000	Degreasing
30510005	Industrial Processes	Mineral Products	Bulk Materials Elevators	Cleaning	2415000000	Degreasing
30900301	Industrial Processes	Fabricated Metal Products	Abrasive Cleaning of Metal Parts	Brush Cleaning	2415000000	Degreasing
30900302	Industrial Processes	Fabricated Metal Products	Abrasive Cleaning of Metal Parts	Tumble Cleaning	2415000000	Degreasing
30901101	Industrial Processes	Fabricated Metal Products	Conversion Coating of Metal Products	Alkaline Cleaning Bath	2415000000	Degreasing
30901102	Industrial Processes	Fabricated Metal Products	Conversion Coating of Metal Products	Acid Cleaning Bath (Pickling)	2415000000	Degreasing
31303502	Industrial Processes	Electrical Equipment	Manufacturing - General Processes	Cleaning	2415000000	Degreasing
31306501	Industrial Processes	Electrical Equipment	Semiconductor Manufacturing	Cleaning Processes: Wet Chemical: Specify Aqueous Solution	2415000000	Degreasing
31306502	Industrial Processes	Electrical Equipment	Semiconductor Manufacturing	Cleaning Process: Plasma Process: Specify Gas Used	2415000000	Degreasing
31401560	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup	2415000000	Degreasing
31401561	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Tools (Other than Spray Guns)	2415000000	Degreasing
31401562	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Spray Guns	2415000000	Degreasing
31401563	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Molds	2415000000	Degreasing
31401570	Industrial Processes	Transportation Equipment	Boat Manufacturing	Waste Disposal: Used Cleanup Solvents	2415000000	Degreasing
31612001	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	Tank Cleaning Operations	2415000000	Degreasing
31612002	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	General Cleaning Operations	2415000000	Degreasing
31612003	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	Parts Cleaning Operations	2415000000	Degreasing
40100201	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): Open-top Vapor Degreasing	2415000000	Degreasing
40100202	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): Open-top Vapor Degreasing	2415000000	Degreasing
40100203	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: Open-top Vapor Degreasing	2415000000	Degreasing

40100204	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: Open-top Vapor Degreasing	2415000000	Degreasing
40100205	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: Open-top Vapor Degreasing	2415000000	Degreasing
40100206	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Toluene: Open-top Vapor Degreasing	2415000000	Degreasing
40100207	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorotrifluoroethane (Freon): Open-top Vapor Degreasing	2415000000	Degreasing
40100208	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Chlorosolve: Open-top Vapor Degreasing	2415000000	Degreasing
40100209	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Butyl Acetate: Open-top Vapor Degreasing	2415000000	Degreasing
40100215	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: Open-top Vapor Degreasing	2415000000	Degreasing
40100216	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	Degreaser: Entire Unit	2415000000	Degreasing
40100217	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit	2415000000	Degreasing
40100221	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): Conveyorized Vapor Degreasing	2415000000	Degreasing
40100222	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform):Conveyorized Vapor Degreaser	2415000000	Degreasing
40100223	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100224	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100225	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100235	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: with Vaporized Solvent: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100236	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: with Non-boiling Solvent: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100251	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): General Degreasing Units	2415000000	Degreasing
40100252	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): General Degreasing Units	2415000000	Degreasing
40100253	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: General Degreasing Units	2415000000	Degreasing
40100254	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: General Degreasing Units	2415000000	Degreasing
40100255	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: General Degreasing Units	2415000000	Degreasing
40100256	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Toluene: General Degreasing Units	2415000000	Degreasing
40100257	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorotrifluoroethane (Freon): General Degreasing Units	2415000000	Degreasing
40100258	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorofluoromethane: General Degreasing Units	2415000000	Degreasing
40100259	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): General Degreasing Units	2415000000	Degreasing
40100295	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: General Degreasing Units	2415000000	Degreasing
40100296	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: General Degreasing Units	2415000000	Degreasing

40100297	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: Open-top Vapor Degreasing	2415000000	Degreasing
40100298	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100299	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: Open-top Vapor Degreasing	2415000000	Degreasing
40100301	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methanol	2415000000	Degreasing
40100302	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methylene Chloride	2415000000	Degreasing
40100303	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Stoddard (Petroleum Solvent)	2415000000	Degreasing
40100304	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Perchloroethylene	2415000000	Degreasing
40100305	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	1,1,1-Trichloroethane (Methyl Chloroform)	2415000000	Degreasing
40100306	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Trichloroethylene	2415000000	Degreasing
40100307	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Isopropyl Alcohol	2415000000	Degreasing
40100308	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methyl Ethyl Ketone	2415000000	Degreasing
40100309	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Freon	2415000000	Degreasing
40100310	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Acetone	2415000000	Degreasing
40100311	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Glycol Ethers	2415000000	Degreasing
40100335	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Entire Unit	2415000000	Degreasing
40100336	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Degreaser: Entire Unit	2415000000	Degreasing
40100399	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Other Not Classified	2415000000	Degreasing
40201105	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Equipment Cleanup:Fabric Coating(Also Spec Coat Method Codes 4-02-04X)	2415000000	Degreasing
40201305	Chemical Evaporation	Surface Coating Operations	Paper Coating	Equipment Cleanup	2415000000	Degreasing
40201402	Chemical Evaporation	Surface Coating Operations	Large Appliances	Cleaning/Pretreatment	2415000000	Degreasing
40201405	Chemical Evaporation	Surface Coating Operations	Large Appliances	Equipment Cleanup	2415000000	Degreasing
40201502	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Cleaning/Pretreatment	2415000000	Degreasing
40201505	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Equipment Cleanup	2415000000	Degreasing
40201602	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Cleaning/Pretreatment	2415000000	Degreasing

40201605	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Equipment Cleanup	2415000000	Degreasing
40201702	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Cleaning/Pretreatment	2415000000	Degreasing
40201705	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Equipment Cleanup	2415000000	Degreasing
40201802	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Cleaning/Pretreatment	2415000000	Degreasing
40201805	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Equipment Cleanup	2415000000	Degreasing
40202002	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Cleaning/Pretreatment	2415000000	Degreasing
40202005	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Equipment Cleanup	2415000000	Degreasing
40202105	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Equipment Cleanup	2415000000	Degreasing
40202202	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Cleaning/Pretreatment	2415000000	Degreasing
40202205	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Equipment Cleanup	2415000000	Degreasing
40202302	Chemical Evaporation	Surface Coating Operations	Large Ships	Cleaning/Pretreatment	2415000000	Degreasing
40202305	Chemical Evaporation	Surface Coating Operations	Large Ships	Equipment Cleanup	2415000000	Degreasing
40202402	Chemical Evaporation	Surface Coating Operations	Aerospace	Cleaning/Pretreatment	2415000000	Degreasing
40202405	Chemical Evaporation	Surface Coating Operations	Aerospace	Equipment Cleanup	2415000000	Degreasing
40202502	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Cleaning/Pretreatment	2415000000	Degreasing
40202505	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Equipment Cleanup	2415000000	Degreasing
40202602	Chemical Evaporation	Surface Coating Operations	Steel Drums	Cleaning/Pretreatment	2415000000	Degreasing
40202605	Chemical Evaporation	Surface Coating Operations	Steel Drums	Equipment Cleanup	2415000000	Degreasing
40204150	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup	2415000000	Degreasing
40204151	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204152	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204161	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204250	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup	2415000000	Degreasing
40204251	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204252	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204261	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204350	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup	2415000000	Degreasing
40204351	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204352	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204361	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204460	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup	2415000000	Degreasing
40204461	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing

40204462	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204471	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204560	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup	2415000000	Degreasing
40204561	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204562	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204571	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204660	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup	2415000000	Degreasing
40204661	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204662	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204671	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204760	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup	2415000000	Degreasing
40204761	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204762	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204771	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste: Cleaning Rags	2415000000	Degreasing
40288824	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Clean-up	2415000000	Degreasing
40500215	Chemical Evaporation	Printing/Publishing	Letterpress	Cleaning Solution	2415000000	Degreasing
40500314	Chemical Evaporation	Printing/Publishing	Flexographic	Propyl Alcohol Cleanup	2415000000	Degreasing
40500413	Chemical Evaporation	Printing/Publishing	Lithographic	Isopropyl Alcohol Cleanup	2415000000	Degreasing
40500414	Petroleum and Solvent Evaporation	Printing/Publishing	General	Flexographic: Propyl Alcohol Cleanup	2415000000	Degreasing
40500417	Chemical Evaporation	Printing/Publishing	Offset Lithography	Cleaning Solution: Water-based	2415000000	Degreasing
40500514	Chemical Evaporation	Printing/Publishing	Gravure	Cleanup Solvent	2415000000	Degreasing
40500802	Chemical Evaporation	Printing/Publishing	Screen Printing	Fugitive Emissions: Cleaning Rags	2415000000	Degreasing
40600259	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels	Tanker/Barge Cleaning	2415000000	Degreasing
49000301	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Ethylene Glycol	2415000000	Degreasing
49000302	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Chlorobenzene	2415000000	Degreasing
49000303	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	o-Dichlorobenzene	2415000000	Degreasing
49000304	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Creosote	2415000000	Degreasing
49000399	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Other Not Classified	2415000000	Degreasing

49000401	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Acetone	2415000000	Degreasing
49000402	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Perchloroethylene	2415000000	Degreasing
49000403	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Methyl Methacrylate	2415000000	Degreasing
49000404	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Phenol	2415000000	Degreasing
49000405	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Propylene Glycol	2415000000	Degreasing
49000499	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Other Not Classified	2415000000	Degreasing

COMMERCIAL AND CONSUMER SOLVENTS

A. Source Category Description

The solvent sector is a diverse collection of consumer and commercial product related gas-phase organic emissions. Included in this sector are everyday items, such as household products, toiletries, aerosol products, rubbing compounds, windshield washing fluid, polishes, waxes, non-industrial adhesives, space deodorants, moth control agents and laundry detergents. These sources generate emissions through evaporative processes and include organics that fulfill product functions beyond acting as a traditional solvent (e.g., propellants, fragrances).

The 2023 National Emissions Inventory (NEI) will add one Source Classification Code (SCC) to this sector (2461900000; see Table 1) to preserve Maryland's historical emissions estimation methodologies (allowing for an assessment of emissions changes over time) while accounting for updates from the Environmental Protection Agency's (EPA) new framework[1] which includes emissions from previously unaccounted sources such as fragrances and propellants. The remaining SCCs were included in previous NEI's.

Table 1: 2023 NEI Commercial and Consumer Solvent SCCs.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2460100000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Personal Care Products	Total: All Solvent Types
2460200000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Household Products	Total: All Solvent Types
2460400000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Total: All Solvent Types
2460500000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Coatings and Related Products	Total: All Solvent Types
2460600000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Total: All Solvent Types
2460800000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All FIFRA Related Products	Total: All Solvent Types
2460900000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	Misc. Products	Total: All Solvent Types
2461900000	Solvent Utilization	Misc. Non-industrial: Commercial	Miscellaneous Products: NEC	Total: All Solvent Types

B. Overview of Calculations

Commercial and Consumer Solvent Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using population and controlled emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[2].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), emissions

(Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific county-level population data from the U.S. Census Bureau.[3] The 2023 NEI uses 2023 population estimates, as shown in Table 2.

Table 2: 2023 County Level Population.

County Name	State County FIPs	Population for Inventory Year
Allegany	24001	67,273
Anne Arundel	24003	594,582
Baltimore	24005	844,703
Calvert	24009	94,728
Caroline	24011	33,593
Carroll	24013	176,639
Cecil	24015	105,672
Charles	24017	171,973
Dorchester	24019	32,879
Frederick	24021	293,391
Garrett	24023	28,423
Harford	24025	264,644
Howard	24027	336,001
Kent	24029	19,303
Montgomery	24031	1,058,474
Prince Georges	24033	947,430
Queen Annes	24035	52,508
Saint Mary's	24037	115,281
Somerset	24039	24,910
Talbot	24041	37,823
Washington	24043	155,813
Wicomico	24045	104,800
Worcester	24047	54,171
Baltimore City	24510	565,239
Total		6,180,253

D. Emissions Factors

The recommended emission factor that combines emissions from all SCC's is 7.84 pounds of VOC per person per year, from *Air Emissions Inventory Improvement Program Volume III; Area Sources; Preferred and Alternative Methods.*[4] This represents the "uncontrolled" emission factor. MDE adjusts the uncontrolled emission factor through the implementation of five distinct rules aimed at reducing VOC emissions through product reformulation. Control programs are further discussed in Section E.

To account for additional emissions associated with fragrances and propellants, while preserving MDE's long-standing use of the emission factors outlined below, MDE took the difference between (1) its total

emission factor for Commercial and Consumer Solvents, and (2) EPA's total emission factor for commercial and consumer solvents.

VOC emission factors for all commercial and consumer solvent SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Commercial and Consumer Products.

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2460100000	All Personal Care Products	VOC	1.5236689	lb/capita	OTC V
2460200000	All Household Products	VOC	0.4578964	lb/capita	OTC V
2460400000	All Automotive Aftermarket Products	VOC	0.8319050	lb/capita	OTC V
2460500000	All Coatings and Related Products	VOC	0.6994453	lb/capita	OTC V
2460600000	All Adhesives and Sealants	VOC	0.3711182	lb/capita	OTC V
2460800000	All FIFRA Related Products	VOC	1.2242533	lb/capita	OTC V
2460900000	Misc. Products	VOC	0.0505128	lb/capita	OTC V
2461900000	Miscellaneous Non-industrial: Commercial	VOC	2.6012002	lb/capita	Diff
2461900000 Calculations					
SCC	**Description**	**Pollutant Code**	**EPA Controlled Emission Factor**	**MDE Controlled Emission Factor**	**Total Diff**
2460100000	All Personal Care Products	VOC	2.84	1.5236689	
2460200000	All Household Products	VOC	1.99	0.4578964	
2460400000	All Automotive Aftermarket Products	VOC	0.08	0.8319050	
2460500000	All Coatings and Related Products	VOC	1.4	0.6994453	
2460600000	All Adhesives and Sealants	VOC	1.33	0.3711182	
2460800000	All FIFRA Related Products	VOC	0.08	1.2242533	
2460900000	Misc. Products	VOC	0.04	0.0505128	
2461900000	Miscellaneous Non-industrial: Commercial	VOC	7.76	5.1587998	2.6012

E. Controls

Controlling organic emissions from the commercial and consumer products is largely achieved through product reformulation, where existing VOC ingredients are substituted with exempt organic compounds (e.g., acetone) or the VOC mass content of products is lowered.[*] Regulations are often set to limit the VOC content of chemical products, with California typically setting the most stringent limits in the country[5]. Maryland is an Ozone Transport Commission (OTC) state and has adopted four phases of commercial and consumer product rules.

Commercial and consumer products are regulated by five separate category measures. They are: Federal Regulations, OTC Phase I controls, OTC Phase II controls, OTC Phase III Controls and OTC Phase IV controls. Each of the control measures are discussed briefly below and are estimated in Table 4:

- Control Set 1: Federal regulations provide a 20% in emissions from 3.9 lbs VOC/person subset of the total commercial and consumer products category.
- Control Set 2: OTC Phase I rule was based on the five CARB consumer products rules and further emissions reductions of 14.2% beyond the federal regulation.

[*] A second pathway for controlling organic emissions from the solvent utilization sector involves post-use controls. These methods include add-on controls, manufacturing process modifications, and disposal techniques. This would generally only be applicable to SCC 2460500000, and adoption varies widely.

- Control Set 3: OTC Phase II rule was based on the five CARB consumer products rules and further emission reductions of 2% beyond the federal regulation.
- Control Set 4: OTC Phase III rule was based on the five CARB consumer products rules and further emissions reductions of 3.1% beyond the federal regulation.
- Control Set 5: OTC Phase IV rule was based on the five CARB consumer products rules and further emissions reductions of 10.3% beyond the federal regulation.

Table 4. 2023 Control Programs for Commercial and Consumer Products.

	Original (1996) EPA Per Capita VOC Emission Factor (lb VOC / person / year)	Federal Rule VOC Emission Factor (lb VOC / person / year)	OTC Phase I VOC Emission Factor (lb VOC / person / year)	OTC Phase II VOC Emission Factor (lb VOC / person / year)	OTC Phase III VOC Emission Factor (lb VOC / person / year)	OTC Phase IV VOC Emission Factor (lb VOC / person / year)
2460100000	2.32	2.08	1.79	1.7529695	1.6986275	1.5236689
2460200000	0.79	0.63	0.54	0.5268063	0.5104753	0.4578964
2460400000	1.36	1.13	0.98	0.9571004	0.9274303	0.8319050
2460500000	0.95	0.95	0.82	0.8047066	0.7797607	0.3994453
2460600000	0.57	0.51	0.43	0.4269687	0.4137326	0.3711182
2460800000	1.78	1.68	1.44	1.4084942	1.3648309	1.2242533
2460900000	0.07	0.07	0.07	0.0581146	0.0563131	0.6994453
Total	7.84	7.06	6.06	5.9351604	5.7511704	5.1587998

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Section C)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year (Eqn. 1)
$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for Commercial and Consumer Solvents; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from personal care product solvent utilization in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Personal Care Products (SCC 2460100000) in Anne Arundel County

Eq. #	Equation	Values for Anne Arundel County	Result
1	$E_C = EF_{SCC} \times P_C$	$(1.5236689\ {}^{lb}/_{capita} \times 594{,}582\ people)/2000$	452.97 tons of VOC in 2023

I. References

[1] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[2] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[3] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[4] Eastern Research Group, Inc. Volume III: Chapter 5: Consumer and Commercial Solvent Use Final Report, August 1996. Retrieved April 8, 2024 from https://www.epa.gov/sites/default/files/2015-08/documents/iii05.pdf.

APPENDIX

Table 1. HAP speciation factors for Commercial and Consumer Products. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2460100000	All Personal Care Products	108883	Toluene	1.57E-03	95823
2460100000	All Personal Care Products	111422	Diethanolamine	1.13E-03	95823
2460100000	All Personal Care Products	122996	Phenoxyethanol	1.03E-03	95823
2460100000	All Personal Care Products	171	Glycol Ethers	6.59E-04	95823
2460100000	All Personal Care Products	110543	N-hexane	5.40E-04	95823
2460100000	All Personal Care Products	85449	Phthalic anhydride	2.70E-04	95823
2460200000	All Household Products	108883	Toluene	2.35E-02	95817
2460200000	All Household Products	67561	Methanol	2.33E-02	95817
2460200000	All Household Products	110543	N-hexane	7.17E-03	95817
2460200000	All Household Products	100425	Styrene	6.46E-03	95817
2460200000	All Household Products	1330207	Xylenes	6.03E-03	95817
2460200000	All Household Products	171	Glycol Ethers	4.90E-03	95817
2460200000	All Household Products	127184	Perchloroethylene	2.13E-03	95817
2460200000	All Household Products	95476	O-xylene	1.17E-03	95817
2460200000	All Household Products	107211	Ethylene glycol	1.08E-03	95817
2460200000	All Household Products	108383	M-xylene	1.08E-03	95817
2460200000	All Household Products	79016	Trichloroethylene	9.79E-04	95817
2460200000	All Household Products	111422	Diethanolamine	7.82E-04	95817
2460200000	All Household Products	122996	Phenoxyethanol	7.49E-04	95817
2460200000	All Household Products	75092	Dichloromethane	5.58E-04	95817
2460200000	All Household Products	100414	Ethylbenzene	4.33E-04	95817
2460200000	All Household Products	106423	P-xylene	3.65E-04	95817
2460200000	All Household Products	N590	Polycyclic Organic Matter	1.68E-04	95817
2460200000	All Household Products	108101	Methyl isobutyl ketone	1.26E-04	95817
2460200000	All Household Products	80626	Methyl methacrylate	1.23E-04	95817
2460400000	All Automotive Aftermarket Products	108883	Toluene	2.35E-02	95817
2460400000	All Automotive Aftermarket Products	67561	Methanol	2.33E-02	95817
2460400000	All Automotive Aftermarket Products	110543	N-hexane	7.17E-03	95817
2460400000	All Automotive Aftermarket Products	100425	Styrene	6.46E-03	95817
2460400000	All Automotive Aftermarket Products	1330207	Xylenes	6.03E-03	95817
2460400000	All Automotive Aftermarket Products	171	Glycol Ethers	4.90E-03	95817
2460400000	All Automotive Aftermarket Products	127184	Perchloroethylene	2.13E-03	95817
2460400000	All Automotive Aftermarket Products	95476	O-xylene	1.17E-03	95817
2460400000	All Automotive Aftermarket Products	107211	Ethylene glycol	1.08E-03	95817
2460400000	All Automotive Aftermarket Products	108383	M-xylene	1.08E-03	95817
2460400000	All Automotive Aftermarket Products	79016	Trichloroethylene	9.79E-04	95817

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2460400000	All Automotive Aftermarket Products	111422	Diethanolamine	7.82E-04	95817
2460400000	All Automotive Aftermarket Products	122996	Phenoxyethanol	7.49E-04	95817
2460400000	All Automotive Aftermarket Products	75092	Dichloromethane	5.58E-04	95817
2460400000	All Automotive Aftermarket Products	100414	Ethylbenzene	4.33E-04	95817
2460400000	All Automotive Aftermarket Products	106423	P-xylene	3.65E-04	95817
2460400000	All Automotive Aftermarket Products	N590	Polycyclic Organic Matter	1.68E-04	95817
2460400000	All Automotive Aftermarket Products	108101	Methyl isobutyl ketone	1.26E-04	95817
2460400000	All Automotive Aftermarket Products	80626	Methyl methacrylate	1.23E-04	95817
2460600000	All Adhesives and Sealants	107211	Ethylene glycol	1.25E-01	95811
2460600000	All Adhesives and Sealants	1330207	Xylenes	4.45E-02	95811
2460600000	All Adhesives and Sealants	108883	Toluene	3.57E-02	95811
2460600000	All Adhesives and Sealants	100425	Styrene	3.21E-02	95811
2460600000	All Adhesives and Sealants	100414	Ethylbenzene	1.62E-02	95811
2460600000	All Adhesives and Sealants	171	Glycol Ethers	1.22E-02	95811
2460600000	All Adhesives and Sealants	110543	N-hexane	1.09E-02	95811
2460600000	All Adhesives and Sealants	80626	Methyl methacrylate	1.01E-03	95811
2460600000	All Adhesives and Sealants	67561	Methanol	9.48E-04	95811
2460600000	All Adhesives and Sealants	108054	Vinyl acetate	7.39E-04	95811
2460600000	All Adhesives and Sealants	79107	Acrylic acid	4.96E-04	95811
2460600000	All Adhesives and Sealants	84742	Dibutyl phthalate	3.68E-04	95811
2460600000	All Adhesives and Sealants	75092	Dichloromethane	3.44E-04	95811
2460600000	All Adhesives and Sealants	111422	Diethanolamine	2.85E-04	95811
2460600000	All Adhesives and Sealants	108952	Phenol	2.06E-04	95811
2460600000	All Adhesives and Sealants	108101	Methyl isobutyl ketone	1.25E-04	95811
2460600000	All Adhesives and Sealants	108383	M-xylene	1.22E-04	95811
2460600000	All Adhesives and Sealants	98828	Cumene	1.14E-04	95811
2460600000	All Adhesives and Sealants	91203	Naphthalene	6.77E-05	95811
2460600000	All Adhesives and Sealants	131113	Dimethyl phthalate	6.21E-05	95811
2460600000	All Adhesives and Sealants	N590	Polycyclic Organic Matter	3.43E-05	95811
2460600000	All Adhesives and Sealants	50000	Formaldehyde	1.32E-05	95811
2460600000	All Adhesives and Sealants	79016	Trichloroethylene	5.29E-06	95811
2460600000	All Adhesives and Sealants	95476	O-xylene	4.68E-06	95811
2460600000	All Adhesives and Sealants	75070	Acetaldehyde	1.71E-06	95811
2460600000	All Adhesives and Sealants	106423	P-xylene	1.46E-06	95811
2460600000	All Adhesives and Sealants	71432	Benzene	1.21E-06	95811
2460800000	All FIFRA Related Products	171	Glycol Ethers	9.52E-03	95826
2460800000	All FIFRA Related Products	107211	Ethylene glycol	1.56E-03	95826
2460800000	All FIFRA Related Products	N590	Polycyclic Organic Matter	5.66E-04	95826
2460800000	All FIFRA Related Products	98828	Cumene	5.24E-04	95826
2460800000	All FIFRA Related Products	91203	Naphthalene	2.80E-04	95826

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2460800000	All FIFRA Related Products	111422	Diethanolamine	2.07E-04	95826
2460800000	All FIFRA Related Products	108883	Toluene	1.21E-04	95826
2460800000	All FIFRA Related Products	1330207	Xylenes	1.12E-04	95826
2460800000	All FIFRA Related Products	121448	Triethylamine	3.60E-05	95826
2460800000	All FIFRA Related Products	108383	M-xylene	3.22E-05	95826
2460800000	All FIFRA Related Products	110543	N-hexane	1.52E-05	95826
2460800000	All FIFRA Related Products	67561	Methanol	1.53E-06	95826
2460900000	Misc. Products	107211	Ethylene glycol	1.69E-02	95822
2460900000	Misc. Products	110543	N-hexane	6.88E-03	95822
2460900000	Misc. Products	122996	Phenoxyethanol	4.68E-04	95822
2460900000	Misc. Products	111422	Diethanolamine	3.84E-04	95822
2460900000	Misc. Products	79016	Trichloroethylene	1.93E-04	95822
2460900000	Misc. Products	1330207	Xylenes	9.71E-05	95822
2460900000	Misc. Products	98828	Cumene	8.59E-05	95822
2460900000	Misc. Products	100414	Ethylbenzene	6.87E-05	95822
2460900000	Misc. Products	108101	Methyl isobutyl ketone	3.81E-05	95822
2460900000	Misc. Products	171	Glycol Ethers	3.81E-05	95822
2460900000	Misc. Products	79107	Acrylic acid	3.40E-05	95822
2460900000	Misc. Products	108883	Toluene	2.72E-05	95822
2460900000	Misc. Products	91203	Naphthalene	7.48E-06	95822
2460900000	Misc. Products	108383	M-xylene	5.77E-06	95822
2460500000	All Coatings and Related Products	108883	Toluene	1.28E-01	95812
2460500000	All Coatings and Related Products	95476	O-xylene	3.29E-02	95812
2460500000	All Coatings and Related Products	108383	M-xylene	2.70E-02	95812
2460500000	All Coatings and Related Products	100414	Ethylbenzene	1.20E-02	95812
2460500000	All Coatings and Related Products	106423	P-xylene	1.02E-02	95812
2460500000	All Coatings and Related Products	110543	N-hexane	6.11E-03	95812
2460500000	All Coatings and Related Products	108101	Methyl isobutyl ketone	5.01E-03	95812
2460500000	All Coatings and Related Products	171	Glycol Ethers	1.72E-03	95812
2460500000	All Coatings and Related Products	98828	Cumene	4.61E-04	95812
2460500000	All Coatings and Related Products	N590	Polycyclic Organic Matter	4.44E-04	95812
2460500000	All Coatings and Related Products	67561	Methanol	4.01E-04	95812
2460500000	All Coatings and Related Products	107211	Ethylene glycol	3.94E-04	95812
2460500000	All Coatings and Related Products	91203	Naphthalene	2.16E-04	95812
2460500000	All Coatings and Related Products	84742	Dibutyl phthalate	1.27E-04	95812
2460500000	All Coatings and Related Products	121448	Triethylamine	3.42E-06	95812

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Cooking

1. Sector Descriptions and Overview

Cooking is a source of both gaseous and particulate pollutants.[1,2,3,4,5,6,7] Primary particulate emissions from cooking is predominantly organic carbon[2,5] and positive matrix factorization analysis of Aerosol Mass Spectrometry data from multiple cities in the United States suggest cooking contributes ~16% of observed organic aerosol and ~8% of observed $PM_{2.5}$ in urban areas.[8,9] In total, emissions from cooking are estimated for commercial and residential cooking (Table 1).

Table 1: Cooking Source Classification Codes

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2302002100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Charbroiling	Conveyorized Charbroiling
2302002200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Charbroiling	Under-fired Charbroiling
2302003000	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Deep Fat Frying
2302003100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Frying	Flat Griddle Frying
2302003200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Frying	Clamshell Griddle Frying
2812001000	Miscellaneous Area Sources	Food and Kindred Products: SIC 20	Residential Cooking - Total	Total

Note: EPA will no longer generate default emissions estimates for 2810025000 ("Residential Grilling").

2. EPA-Developed Estimates

To estimate emissions from commercial establishments, the amount of meat cooked on various cooking devices in each county is estimated. These estimates are year-specific and based on activity statistics from a 2001 telephone survey in southern California[10] and annually varying restaurant count statistics. These meat consumption estimates are then scaled to match estimates of commercially consumed meat consumption statistics from the U.S. Department of Agriculture's Food Availability Data System.[11] For residential cooking sources, the mass of residentially consumed meat consumption statistics from the U.S. Department of Agriculture's Food Availability Data System are also used. Commercial meat consumption is estimated at the county-level, but residential meat consumption is downscaled from national USDA consumption statistics to the county-level using population.

Emission factors

Emissions factors from 5 studies are utilized to estimate emissions from commercial and residential cooking. For commercial cooking, McDonald et al. 2003[5] and Norbeck 1997[12]. For residential cooking, emissions factors span several orders-of-magnitude.[1,3,13] Given the uncertainty in the emissions factors and range of the studies included here, the 90th percentile emissions factors for each pollutant for residential cooking were adopted and applied. These emissions factors should be updated as newer

results become available.

Cooking Device	Meat	Pollutant	Emissions Factor (lb/ton meat consumption)	Reference	Notes
Conveyorized Char-broilers (2302002100)	Steak	CO	16.58	Ref. 5; Table 2	Hamburger Auto-Char
		VOC	4.55	Ref. 12; Table XIII	Hamburger Auto-Char
		PM25-PRI	14.80	Ref. 12; Table XIII	Hamburger Auto-Char
	Hamburger	CO	16.58	Ref. 5; Table 2	Hamburger Auto-Char
		VOC	4.55	Ref. 12; Table XIII	Hamburger Auto-Char
		PM25-PRI	14.80	Ref. 12; Table XIII	Hamburger Auto-Char
	Poultry	CO	9.68	Ref. 5; Table 2	Chicken Under-Char
		VOC	3.65	Ref. 12; Table V	Chicken Under-Char
		PM25-PRI	20.93	Ref. 12; Table V	Chicken Under-Char
	Pork	CO	9.68	Ref. 5; Table 2	Chicken Under-Char
		VOC	3.65	Ref. 12; Table V	Chicken Under-Char
		PM25-PRI	20.93	Ref. 12; Table V	Chicken Under-Char
	Seafood	CO	9.68	Ref. 5; Table 2	Chicken Under-Char
		VOC	0.76	Ref. 12; Table VI	Seafood Under-Char
		PM25-PRI	6.53	Ref. 12; Table VI	Seafood Under-Char
	Other	CO	9.68	Ref. 5; Table 2	Chicken Under-Char
		VOC	3.65	Ref. 12; Table V	Chicken Under-Char
		PM25-PRI	20.93	Ref. 12; Table V	Chicken Under-Char
Underfired Char-broilers (2302002200)	Steak	CO	9.94	Ref. 5; Table 2	Steak Under-Char
		VOC	1.71	Ref. 12; Table XVII	Steak Under-Char
		PM25-PRI	34.40	Ref. 12; Table XVII	Steak Under-Char
	Hamburger	CO	27.44	Ref. 5; Table 2	Hamburger Under-Char
		VOC	7.89	Ref. 12; Table IV	Hamburger Under-Char
		PM25-PRI	65.33	Ref. 12; Table IV	Hamburger Under-Char
	Poultry	CO	9.68	Ref. 5; Table 2	Chicken Under-Char
		VOC	3.65	Ref. 12; Table V	Chicken Under-Char
		PM25-PRI	20.93	Ref. 12; Table V	Chicken Under-Char
	Pork	CO	9.68	Ref. 5; Table 2	Chicken Under-Char
		VOC	3.65	Ref. 12; Table V	Chicken Under-Char
		PM25-PRI	20.93	Ref. 12; Table V	Chicken Under-Char
	Seafood	CO	9.68	Ref. 5; Table 2	Chicken Under-Char
		VOC	0.76	Ref. 12; Table VI	Seafood Under-Char
		PM25-PRI	6.53	Ref. 12; Table VI	Seafood Under-Char
	Other	CO	9.68	Ref. 5; Table 2	Chicken Under-Char
		VOC	3.65	Ref. 12; Table V	Chicken Under-Char
		PM25-PRI	20.93	Ref. 12; Table V	Chicken Under-Char
Deep-Fat Fryers (2302003000)	Steak	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.25	Ref. 12; Table VIII	Chicken Deep Fryer
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Hamburger	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.25	Ref. 12; Table VIII	Chicken Deep Fryer
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Poultry	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.25	Ref. 12; Table VIII	Chicken Deep Fryer
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Pork	CO	0.90	Ref. 5; Table 2	Chicken Griddle

Cooking Device	Meat	Pollutant	Emissions Factor (lb/ton meat consumption)	Reference	Notes
		VOC	0.25	Ref. 12; Table VIII	Chicken Deep Fryer
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Seafood	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.28	Ref. 12; Table IX	Seafood Deep Fryer
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Other	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.25	Ref. 12; Table VIII	Chicken Deep Fryer
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
Flat Griddles (2302003100)	Steak	CO	0.76	Ref. 5; Table 2	Hamburger Griddle
		VOC	0.14	Ref. 12; Table X	Hamburger Flat Griddle
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Hamburger	CO	0.76	Ref. 5; Table 2	Hamburger Griddle
		VOC	0.14	Ref. 12; Table X	Hamburger Flat Griddle
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Poultry	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.79	Ref. 12; Table XI	Chicken Flat Griddle
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Pork	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.79	Ref. 12; Table XI	Chicken Flat Griddle
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Seafood	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.21	Ref. 12; Table XII	Seafood Griddle
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
	Other	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.79	Ref. 12; Table XI	Chicken Flat Griddle
		PM25-PRI	10.00	Ref. 12; Table X	Hamburger Flat Griddle
Clamshell Griddles (2302003200)	Steak	CO	0.76	Ref. 5; Table 2	Hamburger Griddle
		VOC	0.03	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
		PM25-PRI	1.70	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
	Hamburger	CO	0.76	Ref. 5; Table 2	Hamburger Griddle
		VOC	0.03	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
		PM25-PRI	1.70	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
	Poultry	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.03	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
		PM25-PRI	1.70	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
	Pork	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.03	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
		PM25-PRI	1.70	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
	Seafood	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.03	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
		PM25-PRI	1.70	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
	Other	CO	0.90	Ref. 5; Table 2	Chicken Griddle
		VOC	0.03	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
		PM25-PRI	1.70	Ref. 12; Table XVI	Hamburger Clam Shell Griddle
Residential (2812001000)	Total	CO	13.52	Ref. 13; Ref. 1	See Below
		VOC	0.11	Ref. 13; Ref. 3	See Below
		PM25-PRI	1.05	Ref. 13; Ref. 1	See Below

Cooking Device	Meat	Pollutant	Emission Factor (g/kg)	Emission Factor (lb/ton)	Reference
Charcoal Grill	Seafood	VOC	0.0826	0.1652	Ref. 13
Charbroiling	Hamburger	VOC	0.058	0.116	Ref. 3
Shallow Frying	Beef	VOC	0.042	0.084	Ref. 3
Charcoal Grill	Seafood	VOC	0.0412	0.0824	Ref. 13
Deep Frying	Seafood	VOC	0.039	0.078	Ref. 3
Charcoal Grill	Beef	VOC	0.035	0.07	Ref. 13
Charcoal Grill	Pork	VOC	0.0239	0.0478	Ref. 13
Shallow Frying	Beef	VOC	0.015	0.03	Ref. 3
Shallow Frying	Pork	VOC	0.013	0.026	Ref. 3
Charbroiling	Beef	VOC	0.011	0.022	Ref. 3
Shallow Frying	Pork	VOC	0.007	0.014	Ref. 3
Charbroiling	Poultry	VOC	0.004	0.008	Ref. 3
Shallow Frying	Poultry	VOC	0.0033	0.0066	Ref. 3
Shallow Frying	Hamburger	VOC	0.003	0.006	Ref. 3
90th Percentile	--	VOC	0.05	0.11	--
Charcoal Grill	Seafood	PM25-PRI	1.104	2.208	Ref. 13
Charcoal Grill	Seafood	PM25-PRI	0.918	1.836	Ref. 13
Charcoal Grill	Beef	PM25-PRI	0.531	1.062	Ref. 13
Stovetop Gas	Lasagna	PM25-PRI	0.4528	0.9056	Ref. 1
Charcoal Grill	Pork	PM25-PRI	0.472	0.944	Ref. 14
Stovetop Gas	Seafood	PM25-PRI	0.2243	0.4486	Ref. 1
Stovetop Gas	Pork	PM25-PRI	0.1922	0.3844	Ref. 1
Stovetop Gas	Pork	PM25-PRI	0.1673	0.3346	Ref. 1
Stovetop Electric	Seafood	PM25-PRI	0.1642	0.3284	Ref. 1
Stovetop Gas	Lasagna	PM25-PRI	0.1535	0.307	Ref. 1
Stovetop Gas	Seafood	PM25-PRI	0.1409	0.2818	Ref. 1
Stovetop Gas	Beef	PM25-PRI	0.0994	0.1988	Ref. 1
Stovetop Gas	Pork	PM25-PRI	0.0829	0.1658	Ref. 1
Stovetop Electric	Pork	PM25-PRI	0.0828	0.1656	Ref. 1
Stovetop Gas	Beef	PM25-PRI	0.0721	0.1442	Ref. 1
Stovetop Electric	Lasagna	PM25-PRI	0.044	0.088	Ref. 1
Stovetop Gas	Beef	PM25-PRI	0.0288	0.0576	Ref. 1
Stovetop Gas	Full Meal	PM25-PRI	0.0261	0.0522	Ref. 1
Stovetop Gas	Beef	PM25-PRI	0.0166	0.0332	Ref. 1
Stovetop Gas	Pork	PM25-PRI	0.0139	0.0278	Ref. 1
Stovetop Gas	Beef	PM25-PRI	0.0103	0.0206	Ref. 1
Stovetop Gas	Pork	PM25-PRI	0.0023	0.0046	Ref. 1
90th Percentile	--	PM25-PRI	0.53	1.05	--
Charcoal Grill	Beef	CO	9.13	18.26	Ref. 13
Charcoal Grill	Seafood	CO	7.07	14.14	Ref. 13
Charcoal Grill	Pork	CO	7.01	14.02	Ref. 13
Stovetop Gas	Seafood	CO	6.7349	13.4698	Ref. 1
Charcoal Grill	Seafood	CO	5.59	11.18	Ref. 13
Stovetop Gas	Seafood	CO	5.428	10.856	Ref. 1
Stovetop Gas	Seafood	CO	4.0998	8.1996	Ref. 1
Stovetop Gas	Seafood	CO	3.8806	7.7612	Ref. 1
Stovetop Electric	Seafood	CO	2.1551	4.3102	Ref. 1

Stovetop Electric	Seafood	CO	1.2163	2.4326	Ref. 1
Stovetop Gas	Pork	CO	1.0343	2.0686	Ref. 1
Stovetop Gas	Lasagna	CO	0.9655	1.931	Ref. 1
Stovetop Gas	Pork	CO	0.7233	1.4466	Ref. 1
Stovetop Gas	Lasagna	CO	0.7142	1.4284	Ref. 1
Stovetop Gas	Pork	CO	0.3775	0.755	Ref. 1
Stovetop Gas	Pork	CO	0.333	0.666	Ref. 1
Microwave	Pork	CO	0.2213	0.4426	Ref. 1
Stovetop Gas	Pork	CO	0.201	0.402	Ref. 1
Stovetop Gas	Beef	CO	0.1636	0.3272	Ref. 1
Stovetop Gas	Full Meal	CO	0.1609	0.3218	Ref. 1
Stovetop Gas	Beef	CO	0.1563	0.3126	Ref. 1
Stovetop Gas	Beef	CO	0.1376	0.2752	Ref. 1
Stovetop Gas	Pork	CO	0.1186	0.2372	Ref. 1
Stovetop Gas	Beef	CO	0.0927	0.1854	Ref. 1
Microwave	Lasagna	CO	0.0874	0.1748	Ref. 1
Stovetop Electric	Lasagna	CO	0.0753	0.1506	Ref. 1
Stovetop Gas	Beef	CO	0.0701	0.1402	Ref. 1
Stovetop Electric	Pork	CO	0.061	0.122	Ref. 1
Stovetop Gas	Beef	CO	0.0532	0.1064	Ref. 1
Stovetop Electric	Pork	CO	0.0264	0.0528	Ref. 1
90th Percentile	--	CO	6.76	13.52	--

Activity data

Activity data is the amount of meat consumed away from home and at home. For commercial cooking, these estimates are based on a 2001 telephone survey in southern California[11] that reports the fraction of restaurants in a county that use different pieces of commercial cooking equipment by restaurant-type, the average number of cooking devices per restaurant, and the average mass of meat cooked on each device. The county-level number of various restaurant-types are retrieved from Open Street Map. Restaurant count statistics are pulled from this database using the SIC codes listed below.

Hoovers Restaurant Type	SIC Code
Ethnic Food	5812-01
Fast Food	5812-03
Family	5812-05
Steak & BBQ	5812-08

County-level restaurant count statistics are then multiplied by the fraction of restaurants in a county that use different pieces of commercial cooking equipment by restaurant-type, the average number of cooking devices per restaurant, and the average mass of meat cooked on each device. These values are summarized below.

Restaurant Type	Conveyorized Charbroilers	Underfired Charbroilers	Deep-Fat Fryers	Flat Griddles	Clamshell Griddles
Ethnic Food	3.5%	47.5%	81.9%	62.7%	4.0%
Fast Food	18.6%	30.8%	96.8%	51.9%	14.7%
Family	10.1%	60.9%	91.4%	82.9%	1.4%

Seafood	0.0%	52.6%	100.0%	36.8%	10.5%
Steak & BBQ	6.9%	55.2%	82.8%	89.7%	0.0%

Fraction of restaurants in a county that use different pieces of commercial cooking equipment by restaurant-type; Reference 11, Table 4.

Restaurant Type	Conveyorized Charbroilers	Underfired Charbroilers	Deep-Fat Fryers	Flat Griddles	Clamshell Griddles
Ethnic Food	1.62	1.54	1.63	1.88	1.80
Fast Food	1.07	1.58	3.10	1.43	2.09
Family	1.71	1.29	2.34	2.03	2.03
Seafood	1.10	1.10	2.47	1.11	1.50
Steak & BBQ	1.56	1.63	2.42	1.35	1.35

Average number of cooking devices per restaurant. Average of non-specific charbroiler and griddle used, where necessary; Reference 11, Table 5.

Restaurant Type	Conveyorized Charbroilers	Underfired Charbroilers	Deep-Fat Fryers	Flat Griddles	Clamshell Griddles
Steak	6.14	4.68	4.72	4.32	2.43
Hamburger	20.74	7.02	7.14	9.42	34.17
Poultry	10.75	8.40	14.88	5.17	5.74
Pork	1.50	3.85	1.52	2.90	3.06
Seafood	3.09	3.71	4.13	2.40	16.44
Other	--	1.08	7.12	1.50	--

Average mass of meat cooked per year on each cooking device (tons); Reference 11, Table 13.

The total mass of each type of meat commercially cooked on each appliance-type in a county is then estimated using the following equation:

$$M_{c,t,a} = \sum_{r} \left(R_{c,r} \times A_{r,a} \times N_{r,a}\right) \times T_{t,a} \times SF \quad (1)$$

Where:

$M_{c,t,a}$ = Estimated mass of commercially cooked meat in county (*c*) for each meat-type (*t*) on each appliance (*a*), in tons
$R_{c,r}$ = Number of restaurants in county (*c*) for each restaurant-type (*r*), in #
$A_{r,a}$ = Estimated percent of restaurants for each restaurant-type (*r*) containing > 1 appliance (*a*), in %
$N_{r,a}$ = Estimated number of appliances (*a*) for each restaurant-type (*r*), when appliance (*a*) is present, in #
$T_{t,a}$ = Average mass of meat cooked for each meat-type (*t*) on each appliance (*a*), in tons/appliance
SF = Scale factor applied to ensure national-level meat consumption matches USDA statistics, in %
c = County
t = Meat-Type (e.g., Steak, Hamburger, etc.)
r = Restaurant-Type (e.g., Fast Food, Family, Seafood, etc.)
a = Appliance (e.g., Conveyorized Charbroiler, Underfired Charbroiler, etc.)

The Scale Factor in Equation 1 is year-specific and derived using meat consumption statistics from the U.S.

Department of Agriculture's Food Availability Data System.[11] Data on the total retail consumption (disappearance) of beef, pork, veal, and lamb, chicken and turkey, and seafood are retrieved, and using data from the USDA's Food Consumption and Nutrition Intakes, it is assumed that ~65% of meat is consumed at home and ~35% is consumed away from home (restaurants, fast food, school, etc.). These percentages are subsequently used to estimate consumption at home and scale commercial cooking meat consumption. Below, total residential and commercial meat consumption from the USDA's Food Availability Data System by meat-type estimates are provided for recent years followed by a table illustrating the derivation of the Scale Factor used in Equation 1 for 2020.

Year	U.S. Population [millions]	Total Retail Consumption [short tons]							
		Beef	Veal	Pork	Lamb	Broilers	Other Chicken	Turkey	Fresh and Frozen Fish and Shellfish
2017	325.206	9241066	32433	8084865	175957	14702927	190839	2670584	1957000
2018	326.924	9334729	36908	8254606	184520	15023743	210624	2639784	2006500
2019	328.476	9513368	33726	8531797	187058	15529076	206207	2624113	--
2020	330.114	9620124	27430	8498334	200439	15794921	220422	2593854	--
2021	332.141	9761741	26559	8396295	224643	15940560	228949	2536547	--

***Consumption statistics for fresh and frozen fish and shellfish is not available after 2018.**

Quantity	Steak	Hamburger	Poultry	Pork	Seafood	Other
USDA Consumption at Home*	3,129,835**	3,129,835**	12,108,724	5,529,738	1,305,599	148,271
USDA Commercial Consumption*	1,680,227**	1,680,227**	6,500,473	2,968,596	700,901	79,598
Base Methods Commercial Consumption	10,659,881	21,403,948	25,760,847	5,297,171	9,525,427	10,037,655
Scale Factor	15.76%	7.85%	25.23%	56.04%	7.36%	0.79%

Mass of meat consumed at home and commercially, as reported by the USDA's Food Availability Data System, mass of meat consumption estimated using base methods (Equation 1), and scale factor (SF in Equation 1) applied to ensure total meat consumption is consistent with USDA statistics.

* = Using data from the USDA's Food Consumption and Nutrition Intakes, it is assumed that ~65% of meat is consumed at home and ~35% is consumed away from home (restaurants, fast food, school, etc.).

** = It is assumed that half of all beef consumption reported in the USDA's Food Availability Data System is steak and half is hamburger.

Allocation

Commercial meat consumption is estimated at the county-level. For residential consumption, population is used to disaggregate national-level estimates of "at home" meat consumption to the county-level.

Controls

Based on data from one study,[2] an estimated control efficiency for $PM_{2.5}$ and VOC emissions is 25.0% and 27.4%, respectively, when using a fabric filter and 85.7% and 77.7%, respectively, when using an electrostatic precipitator. No controls are assumed when estimating emissions from this category, but

these values are provided in the event an inventory developer might need control efficiency values for their calculations.

Emissions

Emissions are quantified using county-level consumption estimates and the emissions factors provided above as follows:

$$E_{c,a} = \sum_{t} \left(M_{c,t,a} \times EF_{t,a} \right) \quad (2)$$

Where:

$E_{c,a}$	= Estimated annual emissions in county (*c*) on each appliance (*a*), in tons
$M_{c,t,a}$	= Estimated mass of commercially cooked meat in county (*c*) for each meat-type (*t*) on each appliance (*a*), in tons
$EF_{t,a}$	= Emissions factor for meat-type (*t*) on appliance (*a*), in lbs/ton
c	= County
t	= Meat-Type (e.g., Steak, Hamburger, etc.)
a	= Appliance (e.g., Conveyorized Charbroiler, Underfired Charbroiler, etc.)

Point Source Subtraction

There are no point source SCCs that overlap with the processes described here. Therefore, point source subtraction is not performed.

Improvements/Changes in the 2023 NEI

Significant changes were made when estimating cooking emissions for the 2023 NEI. For commercial cooking, similar methods were employed to estimate county-level meat consumption by appliance-type, but those numbers are now scaled to match estimates of commercially consumed meat consumption statistics from the U.S. Department of Agriculture's Food Availability Data System.[11] For residential cooking emissions, prior methods attempted to estimate emissions from residential backyard grilling. For the 2023 NEI, a more complete estimate of cooking emissions in residential settings was estimated. Since the new methods are meant to capture all residential cooking sources, including backyard grilling, the prior SCC for which the EPA estimated emissions has been replaced with a new, broader SCC. Like commercial cooking, meat consumption in residential settings is estimated nationally using data from the U.S. Department of Agriculture and scaled to the county-level using population.

Puerto Rico and Virgin Islands

Emissions from Puerto Rico and the Virgin Islands are calculated using the same methodology described above.

Input Template Format for EIS

Two EIS Input Templates are created to allow S/L data submitters to provide more local information on cooking. If the S/L have data on any of these parameters, they can provide values that, once passing quality assurance checks, will replace EPA default data. The relevant variable (Agency Value) for each of the input templates is provided here. Refer to the EIS Input Template Instructions and Glossary for more information on relevant template names, template value codes, descriptions and sources of default data

for each parameter.

- Control Factor (scalar 0 to 1 with 0 being no control, and 1 being 100% controlled); in the tool, the county-level emissions will be multiplied by (1-control factor): applicable to each of the five commercial cooking processes only.
- County-level Restaurants (Number of Restaurants by type)

Agencies are strongly encouraged to populate source (Agency Source Description), source year (Agency Source Year), notes (Agency Source Note) for any activity data they provide. EPA's DEFAULT_VALUE (and associated DEFAULT_SOURCE, DEFAULT_SOURCE_YEAR and DEFAULT_NOTE) will be used in the wagon wheel where S/L input data are not provided.

3. References

[1] R. Fortmann, P. Kariher and R. Clayton, Indoor Air Quality: Residential Cooking Exposures, ARCADIS Geraghty & Miller, Inc., Prepared for the State of California Air Resources Board; Contract Num: 97-330, 2001.

[2] N. Gysel, W. A. Welch, C. L. Chen, P. Dixit, D. R. Cocker, 3rd and G. Karavalakis, Particulate matter emissions and gaseous air toxic pollutants from commercial meat cooking operations, *Journal of Environmental Science*, 2018, **65**, 162-170.

[3] F. Klein, S. M. Platt, N. J. Farren, A. Detournay, E. A. Bruns, C. Bozzetti, K. R. Daellenbach, D. Kilic, N. K. Kumar, S. M. Pieber, J. G. Slowik, B. Temime-Roussel, N. Marchand, J. F. Hamilton, U. Baltensperger, A. S. Prevot and I. El Haddad, Characterization of Gas-Phase Organics Using Proton Transfer Reaction Time-of-Flight Mass Spectrometry: Cooking Emissions, *Environ Sci Technol*, 2016, **50**, 1243-1250.

[4] T. Liu, Z. Wang, D. D. Huang, X. Wang and C. K. Chan, Significant Production of Secondary Organic Aerosol from Emissions of Heated Cooking Oils, *Environ Sci Tech Let*, 2018, **5**, 32-37.

[5] J. D. McDonald, B. Zielinska, E. M. Fujita, J. C. Sagebiel, J. C. Chow and J. G. Watson, Emissions from charbroiling and grilling of chicken and beef, *J Air Waste Manag Assoc*, 2003, **53**, 185-194.

[6] J. J. Schauer, M. J. Kleeman, G. R. Cass and B. R. T. Simoneit, Measurement of Emissions from Air Pollution Sources. 1. C1 through C29 Organic Compounds from Meat Charbroiling, *Environ Sci Technol*, 1999, **33**, 1566-1577.

[7] J. J. Schauer, M. J. Kleeman, G. R. Cass and B. R. T. Simoneit, Measurement of Emissions from Air Pollution Sources. 4. C1-C27 Organic Compounds from Cooking with Seed Oils, *Environ Sci Technol*, 2002, **36**, 567-575.

[8] P. L. Hayes, A. M. Ortega, M. J. Cubison, K. D. Froyd, Y. Zhao, S. S. Cliff, W. W. Hu, D. W. Toohey, J. H. Flynn, B. L. Lefer, N. Grossberg, S. Alvarez, B. Rappenglueck, J. W. Taylor, J. D. Allan, J. S. Holloway, J. B. Gilman, W. C. Kuster, J. A. De Gouw, P. Massoli, X. Zhang, J. Liu, R. J. Weber, A. L. Corrigan, L. M. Russell, G. Isaacman, D. R. Worton, N. M. Kreisberg, A. H. Goldstein, R. Thalman, E. M. Waxman, R. Volkamer, Y. H. Lin, J. D. Surratt, T. E. Kleindienst, J. H. Offenberg, S. Dusanter, S. Griffith, P. S. Stevens, J. Brioude, W.

M. Angevine and J. L. Jimenez, Organic aerosol composition and sources in Pasadena, California, during the 2010 CalNex campaign, *J Geophys Res-Atmos*, 2013, **118**, 9233-9257.

[9] Y. L. Sun, Q. Zhang, J. J. Schwab, K. L. Demerjian, W. N. Chen, M. S. Bae, H. M. Hung, O. Hogrefe, B. Frank, O. V. Rattigan and Y. C. Lin, Characterization of the sources and processes of organic and inorganic aerosols in New York city with a high-resolution time-of-flight aerosol mass apectrometer, *Atmos Chem Phys*, 2011, **11**, 1581-1602.

[10] M. Potepan, *Charbroiling Activity Estimation*, Public Research Institute, Prepared for the California Air Resources Board and the California Environmental Protection Agency; Contract Num: 98-721, 2001.

[11] https://www.ers.usda.gov/data-products/food-availability-per-capita-data-system/

[12] J. M. Norbeck, *Further Development of Emission Test Methods and Development of Emission Factors for Various Commercial Cooking Operations*, Prepared for the South Coast Air Quality Management District; Contract Num: 96027, 1997.

[13] C. A. Alves, M. Evtyugina, E. Vicente, A. Vicente, C. Goncalves, A. I. Neto, T. Nunes and N. Kovats, Outdoor charcoal grilling: Particulate and gas-phase emissions, organic speciation and ecotoxicological assessment, *Atmos Environ*, 2022, **285**.

GREENWASTE COMPOSTING

A. Source Category Description

Greenwaste composting includes the diversion of yard waste, food waste, and other biogenic waste from landfills to composting facilities. Estimates of emissions of volatile organic compounds (VOC), ammonia (NH3), and three hazardous air pollutants (HAPs), acetaldehyde; methanol; and naphthalene, from greenwaste composting are based on the amount of food and yard waste composted. Composting of biogenic waste is currently not included in emissions estimates for this category as activity data on this waste type is not available. In 2014, greenwaste composting in the US, Puerto Rico, and US Virgin Islands resulted in approximately 6,948 tons of NH3 and 49,162 tons of VOC emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2680003000	Waste Disposal, Treatment, and Recovery	Composting	Greenwaste	All Processes

Note that this source category does not include the composting of biosolids from wastewater treatment plants or manure management facilities. There are separate SCCs for biosolids (2680001000) and for a mixture of greenwaste and biosolids (2680002000). EPA is not currently estimating emissions for these SCCs. If S/L/Ts report any emissions for the mixture SCC, emissions from the greenwaste portion of that mixture may be duplicative of some or all of the EPA emissions estimates described here. Note also that this source category estimates emissions from composting facilities but does not estimate emissions from backyard composting.

B. Overview of Calculations

The calculations for estimating the emissions from greenwaste composting involve first estimating the amount of food and yard waste composted in each county. The amount of state-level food waste composted is available from the EPA report *Food Waste Management in the United States, 2015*. The amount of state-level yard waste composted is estimated by calculating the per-capita amount of yard waste composted using national data from the EPA report *Advancing Sustainable Materials Management: 2015 Fact Sheet*, and multiplying that by the state population. The state-level yard and food waste are summed together and distributed to the counties based on the proportion of employment at solid waste landfills. The total amount of greenwaste composted is multiplied by emissions factors for VOC and NH3 to estimate emissions of these pollutants from greenwaste composting. Sources of data and calculations for the amount of food and yard waste composted are discussed in section C. The process of allocating food and yard waste activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from greenwaste composting is discussed in section G.

C. Activity Data

The activity data for this source category is the amount of food and yard waste composted, which is estimated using data from two EPA reports: the national-level amount of yard waste composted comes from *Advancing Sustainable Materials Management: 2015 Fact Sheet* and the state-level amount of food waste composted comes from *Food Waste Management in the United States, 2014*.[1,2]

Table 1 shows the total national-level amount of yard waste generated and recovered for composting.

Table 1. Annual Waste Generated and Recovered in the US in 2015

Material	Waste Generated (million tons)	Waste Recovered (million tons)
Yard trimmings	34.72	21.29

Source: Reference 1, Table 1

The values from Table 1 are used with the U.S. population in 2017 of 329 million people[3] to determine per-capita values of food and yard waste recovered for composting.

$$PC_{yard,US} = \frac{W_{yard,US}}{P_{US}} \quad (1)$$

Where:

$PC_{yard,US}$ = Per-capita yard waste recovered for composting in the US, in tons per person per year
$W_{yard,US}$ = Total annual yard waste recovered in the US, in tons/year
P_{US} = US population

This calculation results in per-capita values of approximately 0.066 tons per person per year of yard waste recovered for composting. Please note that EPA data on composting does not include backyard composting.

The per-capita yard waste values from equation 1 are multiplied by the population of each state to estimate the state-level amount of yard waste recovered for composting.

$$W_{yard,s} = PC_{yard,US} \times P_s \quad (2)$$

Where:

$W_{yard,s}$ = Annual yard waste recovered for composting in state *s*, in tons
$PC_{yard,US}$ = Per-capita yard waste recovered for composting in the US, in tons per person per year
P_s = Population of state *s*

EPA reports the amount of food waste composted at the state level in the report *Food Waste Management in the United States, 2015*.[2] These values are shown in Table 2. EPA collected these data from state environmental websites and contacts with state agencies. The data year for each state is listed, and represents the latest data available. The data were not altered from the original reference for use in this methodology.

Table 2. State-level food waste composting.

State	Food Composted (tons)	Data Year	State	Food Composted (tons)	Data Year
California	715,119	2012	Nevada	35,869	2014
Colorado	29,130	2013	New Hampshire	110	2012
Connecticut	4,644	2013	New Jersey	28,634	2012
Delaware	17,626	2013	New York	44,405	2013
Florida	158,711	2014	North Carolina	38,014	2014
Georgia	8,021	2014	Ohio	81,450	2014
Hawaii	39,287	2014	Oregon	50,143	2013
Indiana	13,525	2013	Pennsylvania	56,851	2013
Iowa	4,334	2010	Rhode Island	150	2014
Kansas	1,127	2010	South Carolina	4,277	2014
Maine	1,658	2010	Tennessee	1,500	2013
Maryland	69,643	2014	Texas	188	2012
Massachusetts	2,753	2014	Vermont	14,738	2013
Michigan	8,700	2013	Virginia	2,454	2014
Minnesota	46,751	2013	Washington	65,221	2013

State	Food Composted (tons)	Data Year
Mississippi	242	2013
Missouri	16,000	2014
Wisconsin	8,677	2013
Total	**1,569,952**	

Source: Reference 2, Table 3.

The state-level amount of total greenwaste composted is the sum of the state-level food and yard waste composted.

$$W_{GW,s} = W_{yard,s} + W_{food,s} \quad (3)$$

Where:

$W_{GW,s}$ = Annual total greenwaste recovered for composting in state *s*, in tons
$W_{yard,s}$ = Annual yard waste recovered for composting in state *s*, in tons
$W_{food,s}$ = Annual food waste recovered for composting in state *s*, in tons, from Table 2

The process used to distribute the state-level amount of greenwaste composted to the counties is discussed in section D.

D. Allocation Procedure

Comprehensive data on the county locations of composting facilities is not available. As a result, the analysis assumes that greenwaste composting facilities are co-located with solid waste landfills.

State-level food greenwaste composting activity (from equation 3) is allocated to the county-level using employment at solid waste landfills (NAICS code 562212). Specifically, state-level estimates of greenwaste collected for composting are multiplied by the ratio of county- to state- level number of employees at landfills.

$$EmpFrac_c = \frac{Emp_c}{Emp_s} \quad (4)$$

Where:

$EmpFrac_c$ = The fraction of landfill employees in county *c*
Emp_c = The number of landfill employees in county *c*
Emp_s = The number of landfill employees in state *s*

Employment data are from the U.S. Census Bureau's 2016 County Business Patterns (CBP).[4] Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of range codes is used. Many counties and some smaller states have only one solid waste landfill, leading to withheld data in the county and/or state business pattern data. To estimate employment in counties and states with withheld data, the following procedure is used for NAICS code 562212.

To gap-fill withheld state-level employment data:

a. State-level data for states with known employment in NAICS 562212 are summed to the national level.
b. The total sum of state-level known employment from step a is subtracted from the national total reported employment for NAICS 562212 in the national-level CBP to determine the employment total for the withheld states.
c. Each of the withheld states is assigned the midpoint of the range code reported for that state. Table 3 lists the range codes and midpoints.
d. The midpoints for the states with withheld data are summed to the national-level.

e. An adjustment factor is created by dividing the number of withheld employees (calculated in step b of this section) by the sum of the midpoints (step d).
f. For the states with withheld employment data, the midpoint of the range for that state (step c) is multiplied by the adjustment factor (step e) to calculate the adjusted state-level employment for landfills.

These same steps are then followed to fill in withheld data in the county-level business patterns.

g. County-level data for counties with known employment are summed by state.
h. County-level known employment is subtracted from the state total reported in state-level CBP (or, if the state-level data are withheld, from the state total estimated using the procedure discussed above).
i. Each of the withheld counties is assigned the midpoint of the range code (Table 3).
j. The midpoints for the counties with withheld data are summed to the state level.
k. An adjustment factor is created by dividing the number of withheld employees (step h) by the sum of the midpoints (step j).
l. For counties with withheld employment data, the midpoints (step i) are multiplied by the adjustment factor (step k) to calculate the adjusted county-level employment for landfills.

Table 3. Ranges and midpoints for data withheld from state and county business patterns

Employment Code	Ranges	Midpoint
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000
M	100,000+	

For example, take the 2016 CBP data for NAICS 562212 (Landfills) in Arizona provided in Table 4.

Table 4. 2016 County Business Pattern for NAICS 562212 in Arizona

State FIPS	County FIPS	County Name	NAICS	Employment Code	Employment
04	001	Apache	562212	B	withheld
04	007	Gila	562212	A	withheld
04	012	La Paz	562212	A	withheld
04	013	Maricopa	562212		296
04	015	Mohave	562212	B	withheld
04	017	Navajo	562212	B	withheld
04	021	Pinal	562212		40
04	023	Santa Cruz	562212		withheld
04	025	Yavapai	562212	A	withheld
04	027	Yuma	562212	B	withheld

Note: Counties in Arizona that do not have employment in solid waste landfills are excluded from this table.

1. The total number of known county-level employees in Arizona is 336.

2. The state-level CBP reports 522 employees for NAICS 562212 in Arizona. This means there are 186 employees total for the 8 counties for which data are withheld.

3. The counties with withheld data are assigned midpoints according to their employment code in Table 3. For example, Apache County is given a midpoint of 60 employees (since range code B is 20-99) and Gila County is given a midpoint of 10 employees.

4. The state total of the midpoints for all withheld counties is 270 employees.

5. The adjustment factor is 186/272 = 0.6889.

6. The adjusted employment for Apache County is 60 × 0.6889 = 41. Gila County has an adjusted employment of 10 × 0.6889 = 7 employees.

Once county- and state-level employment have been estimated, the ratio of county to state employees (from equation 4) is calculated and multiplied by the state-level greenwaste recovered for composting (from equation 3) to calculate the amount of waste composted in each county.

$$W_{GW,c} = EmpFrac_c \times W_{GW,s} \quad (5)$$

Where:

$W_{GW,c}$ = Annual total greenwaste composted in county c, in tons
$W_{GW,s}$ = Annual total greenwaste recovered for composting in state s, in tons
$EmpFrac_c$ = The fraction of landfill employees in county c

E. Emissions Factors

Emissions factors for greenwaste composting are reported in Table 5. The emissions factors for VOC and ammonia (NH3) are taken from the California Air Resources Board Emissions Inventory Methodology for Composting Facilities,[5] and are unaltered from the original reference. The emissions factors for the HAPs (acetaldehyde, methanol, and naphthalene) are taken from Kumar et al.[6]

Table 5. Emissions Factors for Composting of Greenwaste (2680003000)

Pollutant	Pollutant Code	Emissions Factor	Emissions Factor Units	Emissions Factor Reference
VOC	VOC	4.67	lbs./ton compost	5
Ammonia	NH3	0.66		
Acetaldehyde	75070	0.0014	lbs./lbs. VOC	6
Methanol	67561	0.1279		
Naphthalene	91203	0.005		

F. Controls

There are no controls assumed for this category.

G. Emissions

The total annual greenwaste composted in each county is multiplied by the emissions factors in Table 5 to estimate emissions. For VOC and NH3, the emissions are multiplied by a conversion factor to convert from pounds to tons.

$$E_{p,c} = W_{GW,c} \times EF_p \times \frac{1\ ton}{2000\ lbs.} \quad (6)$$

Where:

$E_{p,c}$ = Annual emissions of pollutant p in county c, in tons for VOC and NH3 and lbs. for HAPs
$W_{GW,c}$ = Annual total greenwaste recovered for composting in state s, in tons
EF_p = Emissions factor for pollutant p, in tons of pollutant per ton of greenwaste composted

Emissions of HAPs are estimated by applying speciation factors found in Table 5 to annual VOC emissions. For HAPS, no conversion factor is needed and the emissions are reported in tons.

$$E_{h,c} = E_{VOC,c} \times SF_h \quad (7)$$

Where:

$E_{h,c}$ = Annual emissions of HAP h in county c, in tons per year
$E_{VOC,c}$ = Annual VOC emissions in county c, in tons
SF_h = Speciation factor for HAP h, in tons of HAP emissions per ton of VOC emissions

H. Point Source Subtraction

There are no point source-specific SCCs for composting; therefore point source subtraction is not performed for this category.

I. Sample Calculations

Table 6 lists sample calculations to determine the VOC emissions from composting of greenwaste in Apache County, Arizona.

Table 6. Sample calculations for VOC emissions from greenwaste composting in Apache County, AZ.

Eq. #	Equation	Values for Apache County, AZ	Result
1	$PC_{yard,US} = \frac{W_{yard,US}}{P_{US}}$	$\frac{21.08\ million\ tons\ yard\ waste}{329\ million\ people}$	0.064 tons yard waste per person per year
2	$W_{yard,s} = PC_{yard,US} \times P_s$	$0.064\ tons\ yard\ waste\ per\ person \times 7{,}016{,}270\ people\ in\ AZ$	449,041 tons yard waste composted in AZ
3	$W_{GW,s} = W_{yard,s} + W_{food,s}$	449,041 tons yard waste + 0 tons food waste	443,520 tons green-waste composted in AZ
4	$EmpFrac_c = \frac{Emp_c}{Emp_s}$	$\frac{41\ employees\ in\ Apache\ County}{522\ employees\ in\ AZ}$	0.079 fraction of solid waste employees in Apache County, AZ
5	$W_{GW,c} = EmpFrac_c \times W_{GW,s}$	$0.079\ fraction \times 443{,}520\ tons\ greenwaste\ composted$	35,038 tons greenwaste composted in Apache County, AZ
6	$E_{p,c} = W_{GW,c} \times EF_p \times \frac{1\ ton}{2000\ lbs.}$	35,038tons greenwaste × 4.67 lbs. VOC per ton greenwaste × $\frac{1\ ton}{2000\ lbs.}$	82 tons VOC emissions from greenwaste composting in Apache County, AZ

J. Changes from 2014 Methodology

There are no significant changes from the methodology used to calculate the 2014 v2 NEI emissions.

K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are calculated using 2010 population data,[7] since 2014 Census Data does not exist for the U.S. Virgin Islands.

L. References

[1] U.S. EPA. 2018. *Advancing Sustainable Materials Management: 2015 Fact Sheet,* Table1. Generation, Recovery, and Discards of Products in MSW, 2015. http://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures-report

[2] U.S. EPA. 2016. *Food Waste Management in the United States, 2014.* Office of Resource Conservation and Recovery. https://www.epa.gov/sites/production/files/2016-12/documents/food_waste_management_2014_12082016_508.pdf

[3] U.S. Census Bureau. *2017 Total Population, American Community Survey,* https://data.census.gov/cedsci/table?hidePreview=false&tid=ACSDT1Y2017.B01003&vintage=2018

[4] U.S. Census Bureau. *2016 County Business Patterns*, https://www.census.gov/content/census/en/data/datasets/2016/econ/cbp/2016-cbp.html

[5] California Air Resources Board. 2015. ARB Emissions Inventory Methodology for Composting Facilities. Table A-4. https://www.arb.ca.gov/ei/areasrc/Composting%20Emissions%20Inventory%20Methodology%20Final%20Combined.pdf. Emission factor data taken from Draft Staff Report on Proposed Amended Rule 1133.1 (chipping and grinding activities) and Proposed Rule 1133.3 (emissions reductions from greenwaste composting operations),Table III-3, http://www.healthysoil.org/images/4-PAR1133.1_PR1133.3_FullDraftSR.pdf

[6] Kumar, A., C.P. Alaimo, R. Horowitz, F.M. Mitloehner, M.J. Kleeman, and P.G. Green. 2011. Volatile organic compound emissions from green waste composting: Characterization and ozone formation. Atmospheric Environment, 45:1841-1848.

[7] U.S. Census Bureau, Decennial Censuses, 2010 Census: Summary File 1, http://www2.census.gov/census_2010/04-Summary_File_1/.

CREMATION – HUMAN AND ANIMAL

A. Source Category Description

The cremation of human remains results in emissions of particulate matter, SO_2, NOx, VOC, CO, and HAPs. In particular, it is a significant source of mercury emissions, due to mercury in dental fillings, as well as mercury in blood and tissues. In 2014, human cremation resulted in the emissions of nearly two tons of mercury.

The cremation of animals also results in emissions of CAPs and HAPs, though it emits less mercury than human cremation. In 2014, animal cremation resulted in the emissions of 81 lbs. of mercury.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals

B. Overview of Calculations

The calculations for estimating emissions from human cremation involve estimating the number of deaths in each age group in each county, using data from the Centers for Disease Control and Prevention. The number of deaths is multiplied by the average weight by age group and the state-level cremation rate from the National Funeral Directors Association to estimate the total amount of cremations in each county in terms of mass. This number is multiplied by an emissions factor to estimate the emissions of CAPs and HAPs. Emissions of mercury include emissions from mercury in fillings in teeth and in blood and tissues. The emissions from mercury in fillings are estimated based on data on the number of filled teeth per person in each age group and assumptions about the proportion of fillings that contain mercury and the amount of mercury in each filling.

The calculations for estimating emissions from animal cremation involve determining the number of cremated animals nationally, and distributing this number to each county based on population. The number of cremated animals is multiplied by average weights for cats and dogs to determine the amount of cremations in each county in terms of mass. This number is multiplied by an emissions factor to estimate the emissions of CAPs and HAPS.

Sources of data and calculations for the number of human and animal cremations are discussed in section C. The process of allocating the number of animal cremations to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from human and animal cremation is discussed in section G.

C. Activity Data

Human Cremation

The activity data for human cremation is based on the number of deaths in each county in 13 age groups, from the Centers for Disease Control and Prevention WONDER database.[1] Data for some counties are withheld in the WONDER database. These gaps are filled using the data on the total number of deaths by age group in each state (which includes the number of deaths that are withheld at the county level). First, the sum of the reported county-level number of deaths in each age group and state is subtracted from the reported state-level number of deaths in each age group to determine the total number of deaths withheld at the county level in each state and age group.

$$Deaths_withheld_{s,a} = Deaths_state_{s,a} - \sum Deaths_county_{s,a} \quad \text{(H1)}$$

Where:

$Deaths_withheld_{s,a}$ = Total number of withheld deaths in state s in age group a
$Deaths_state_{s,a}$ = Total number of deaths reported at the state level in state s in age group a
$Deaths_county_{s,a}$ = Total number of deaths reported at the county level in state s in age group a

The total number of withheld deaths are distributed to the counties based on the proportion of population in those counties to the total state population.

$$Pop_ratio_c = \frac{Pop_c}{Pop_s} \quad \text{(H2)}$$

Where:

Pop_ratio_c = The population ratio used to distribute withheld deaths in state s to county c
Pop_c = The total population of county c
Pop_s = The total population of state s

The number of withheld deaths in each state is multiplied by the county population ratio to distribute the withheld deaths to the counties. Note that this step is only performed for counties where county-level data on number of deaths is withheld; this step is not performed where county-level data on deaths is reported.

$$Deaths_{c,a} = Deaths_withheld_{s,a} \times Pop_ratio_c \quad \text{(H3)}$$

Where:

$Deaths_{c,a}$ = The number of deaths in county c in age group a
$Deaths_withheld_{s,a}$ = Total number of withheld deaths in state s in age group a, from equation H1
Pop_ratio_c = The population ratio used to distribute withheld deaths in state s to county c, from equation H2

The total number of deaths in each county (either reported directly in the CDC WONDER database or estimated using equation H3) is multiplied by a state-level cremation rate, reported by the National Funeral Directors Association (NFDA), [2] shown in Table 1. It is assumed that the state-level cremation rate applies to all counties within the state.

$$Cremations_{c,a} = Deaths_{c,a} \times Cremation_rate_s \quad \text{(H4)}$$

Where:

$Cremations_{c,a}$ = The number of human cremations in county c in age group a
$Deaths_{c,a}$ = The number of deaths in county c in age group a
$Cremation_rate_s$ = The rate of human cremations in state s, from Table 1

Table 1. Human cremation rate by state. Error! Bookmark not defined.

State	Cremation Rate	State	Cremation Rate
Alabama	23.1%	District of Columbia	40.0%
Alaska	66.3%	Florida	62.4%
Arizona	66.1%	Georgia	37.1%
Arkansas	32.7%	Hawaii	72.7%
California	63.4%	Idaho	56.8%
Colorado	68.6%	Illinois	42.8%
Connecticut	50.3%	Indiana	36.6%
Delaware	46.2%	Iowa	42.2%

State	Cremation Rate
Kansas	29.00%
Kentucky	68.30%
Louisiana	69.70%
Maine	39.30%
Maryland	66.40%
Massachusetts	72.10%
Michigan	56.30%
Minnesota	51.40%
Mississippi	47.00%
Missouri	67.00%
Montana	42.30%
Nebraska	75.10%
Nevada	63.60%
New Hampshire	48.90%
New Jersey	42.70%
New Mexico	48.70%
New York	28.60%
North Carolina	29.60%
North Dakota	47.70%
Ohio	46.50%
Oklahoma	76.40%
Oregon	48.10%
Pennsylvania	46.00%
Rhode Island	41.40%
South Carolina	33.40%
South Dakota	44.90%
Tennessee	34.50%
Texas	39.00%
Utah	78.00%
Vermont	34.70%
Virginia	59.50%
Washington	71.90%
West Virginia	50.70%
Wisconsin	43.60%
Wyoming	71.90%

The CDC provides estimates of the average weight of individuals in each age group.[3] This number is multiplied by the number of cremations in each county in each age group and then summed across all age groups to estimate the total amount of cremations in tons in each county.

$$Cremations_tons_c = \sum_{a=1}^{A} Cremations_{c,a} \times W_a \times \frac{1\ ton}{2{,}000\ lbs} \quad \text{(H5)}$$

Where:

$Cremations_tons_c$ = The weight of humans cremated in county c, in tons
$Cremations_c$ = The number of human cremations in county c, from equation H4
W_a = The average weight of individuals from age group a

Animal Cremation

The Pet Loss Professionals Alliance (PLPA) conducted a survey that estimated that there were 1,840,965 pet cremations in 2012, and that 99 percent of deceased pets are cremated.[4] In addition, the Humane Society of the United States estimates that there are 2,700,000 adoptable dogs and cats euthanized in animal shelters each year.[5] It is assumed that all of these shelter animals are cremated. Therefore, there are a total of approximately 4,540,965 animal creations each year. Note that this estimate does not double count the number of animal cremations, because the PLPA study counts the number of cremations of pets—i.e. animals that are owned by people—whereas the Humane Society estimates are for animals in shelters that were not adopted.

The population of cats and dogs is approximately 52.5 percent cats and 48.5 percent dogs.[5] Using this percentage and the total number of pets and shelter animals cremated annually, a total number of cats and a total number of dogs cremated annually can be calculated.

$$Cremations_{c/d,US} = Ratio_{c/d} \times (Cremations_pets_{US} + Cremations_shelter_{US}) \quad \text{(A1)}$$

Where:

$Cremations_{c/d}$ = Total cats, *c*, or dogs, *d*, cremated annually in the United States
$Ratio_{c/d}$ = Ratio of cats, *c*, or dogs, *d*, in the pet population
$Cremations_pets_{,US}$ = Total number of pets cremated annually in the United States
$Cremations_shelter_{,US}$ = Total number of shelter animals cremated annually in the United States

The average weight of a domestic cat is approximately 4.5 kg (9.9 pounds).[6] The average weight of a dog is difficult to determine due to large differences in breeds, but an average across breeds is 48.5 pounds.[7,*] To calculate the weight, in tons, of both cats and dogs cremated annually, the average weight values are multiplied by the total number of cats and total number of dogs cremated annually.

$$Cremations_tons_{c/d} = Cremations_{c/d} \times Weight_{c/d} \times \frac{1\ ton}{2{,}000\ pounds} \quad \text{(A2)}$$

Where:

$Cremations_tons_{c/d,US}$ = Total weight, in tons, of cats, *c*, or dogs, *d*, cremated annually in the United States
$Cremations_{c/d\ ,US}$ = Total cats, *c*, or dogs, *d*, cremated annually in the United States
$Weight_{c/d}$ = Average weight per animal, in pounds, of cats, *c*, or dogs, *d*

Once the weight of cats and weight of dogs cremated annually has been calculated, these values can be summed to derive a total weight of animals cremated annually. The total weight of cremated animals in 2017 was approximately 65,871 tons.

$$Cremations_tons_{animal} = Cremations_tons_{c} + Cremations_tons_{d} \quad \text{(A3)}$$

Where:

$Cremations_tons_{animal,US}$ = Total weight of animals cremated annually in the United States, in tons
$Cremations_tons_{c,US}$ = Total weight of cats, *c*, cremated annually in the United States, in tons
$Cremations_tons_{d,US}$ = Total weight of dogs, *d*, cremated annually in the United States, in tons

D. Allocation Procedure

Human Cremation

The number of deaths is reported by the CDC at the county level. Therefore, these data do not need to be allocated. For counties with withheld data on the number of deaths, the total number of withheld deaths is distributed to counties based on the proportion of population in those counties, as described in equations H1-H3.

Animal Cremation

The estimated national-level total weight of animals cremated are allocated to the county level based on the ratio of population in each county to the total national population.

$$Cremations_tons_{animal,c} = Cremations_tons_{animal,US} \times \frac{Pop_c}{Pop_{US}} \quad \text{(A4)}$$

Where:

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[*] Note that this is a straight average of the average adult weight for male and female dogs across breeds. It is not a weighted average that takes into account the popularity of different breeds in the United States.

$Cremations_tons_{animal,c}$ = Total weight of animals cremated in county *c*, in tons
$Cremations_tons_{animal,US}$ = Total weight of animals cremated annually in the United States, in tons, from equation A3
Pop_c = The total population of county *c*
Pop_{US} = The total population of the United States

E. Emissions Factors

Human and Animal Cremation – Blood and Tissues

The emissions factors for human and animal cremation for CAPs are from AP-42,[8] and a report by EPA on emissions tests of a crematory,[9] and are in units of pounds of emissions per ton cremated (Table 2). The emissions factors for most HAPs are a report from the California Air Resources Board,[10] as well as from the EPA emissions test of a crematory. The mercury emissions factor is from a review of multiple studies.[11] EPA uses the same emissions factors for emissions from cremation of blood and tissues for both humans and animals.

Table 2. Emissions factors for emissions from the cremation of human and animal blood and tissues. Emissions factors in this table do not account for emissions of mercury from dental fillings.

Pollutant	Pollutant Code	Emission Factor (lbs/ton)	Source
Carbon Monoxide	CO	2.947	8
Lead	7439921	0.009	9
Nitrogen Oxides	NOX	3.560	8
PM10 Primary	PM10-PRI	3.036	8 (65% of total PM)
PM2.5 Primary	PM25-PRI	2.022	8 (43.3% of total PM)
Sulfur Dioxide	SO2	2.173	8
Volatile Organic Compounds	VOC	0.299	8
Acenaphthene	83329	1.303E-06	10
Acenaphthylene	208968	8.971E-07	10
Acetaldehyde	75070	9.269E-04	10
Anthracene	120127	2.389E-06	10
Arsenic	7440382	5.097E-04	10
Benzo(a)anthracene	56553	1.166E-07	10
Benzo(a)pyrene	192972	4.720E-07	10
Benzo(b)fluoranthene	205992	1.737E-07	10
Benzo(g,h,i)perylene	191242	5.874E-07	10
Benzo(k)fluoranthene	207089	1.486E-07	10
Beryllium	7440417	1.760E-05	10
Cadmium	7440439	2.940E-03	9
Chromium (VI)	18540299	1.829E-04	10
Chrysene	218019	2.880E-07	10
Cobalt	7440484	8.869E-05	10
Dibenz(a,h)anthracene	53703	1.349E-07	10
Fluoranthene	206440	1.337E-06	10
Fluorene	86737	3.760E-06	10

Pollutant	Pollutant Code	Emission Factor (lbs/ton)	Source
Formaldehyde	50000	2.469E-04	10
Hydrogen Chloride	7647010	3.595E+00	9
Hydrogen Fluoride	7664393	8.651E-03	10
Indeno(1,2,3-cd)pyrene	193395	1.440E-07	10
Mercury	7439976	1.324E-04	11
Naphthalene	91203	7.520E-04	10
Nickel	7440020	4.149E-04	10
Phenanthrene	85018	1.531E-05	10
Pyrene	129000	1.474E-06	10
Selenium	7782492	4.971E-04	10

Human Cremation – Dental Mercury

In addition to mercury emitted from the cremation of blood and tissues, mercury is also emitted due to the cremation of dental fillings. The Bay Area Air Quality Management District (BAAQMD) issued a report in 2012 estimating the average amount of mercury in teeth per person for ten age groups, based on data from CDC's National Health and Nutrition Examination Survey.[12] Table 3 shows the estimated amount of material in restored teeth by age group from the BAAQMD study, which is matched to the age groups used by the CDC Wonder database, which is the source of data on deaths by age group.

The BAAQMD memorandum is used to estimate that 31.6 percent of filled teeth in the 5-24 age groups contain amalgam. According to the American Dental Association (ADA 1998) more than 75 percent of restorations before the 1970s used dental amalgam, which declined to 50 percent by 1991. Using these numbers, it is assumed that 50 percent of the filled teeth for 25-44 age groups contain amalgam, 62.5 percent of filled teeth in the 45-64 age group, and 75 percent of filled teeth for people over 65. The Food and Drug Administration has discouraged the use of dental amalgam in children under 6.[13] While EPA does not have data on the percent of fillings containing dental amalgam for the 1-4 age group, it is assumed that this age group has approximately half the dental amalgam of the other age groups under 20 years old. The analysis also assumes that 45 percent of all amalgam-containing fillings are mercury, based on information from the Food and Drug Administration.[13]

Table 3. Estimated amount of material in restored teeth.[12]

Age Groups in CDC WONDER Database	Age Groups in BAAQMD Memorandum	Avg. Material in Restored Teeth (g)	% of Fillings Containing Mercury
< 1 year	0-4 years+	0.000	0.0%
1-4 years		0.160	15.8%
5-9 years	5-14 years	0.720	31.6%
10-14 years			
15-19 years	15-24 years	1.070	31.6%
20-24 years			
25-34 years	25-34 years	2.230	50.0%
35-44 years	35-44 years	3.290	50.0%
45-54 years	45-54 years	4.310	62.5%
55-64 years	55-64 years	4.320	62.5%
65-74 years	65-74 years	3.780	75.0%
75-84 years	75-84 years	3.650	75.0%
85+ years	85+ years	2.960	75.0%

[+] It is assumed that children under the age of 1 have no dental mercury.

The emissions factor for mercury in teeth is calculated by multiplying the average amount of material in restored teeth per person by the percentage of fillings containing mercury in each age group and the proportion of mercury in dental amalgam (approximately 45 percent).

$$EF_teeth_{Hg,a} = Material_a \times ContainHg_a \times HgProportion \times 0.0022 \frac{lb}{g} \quad \text{(H6)}$$

Where:

$EF_teeth_{Hg,a}$ = Emission factor for mercury emissions from teeth due to cremation for age group *a*, in lbs. per cremation
$Material_a$ = The average amount of material in restored teeth for age group *a*, in grams, from Table 2
$ContainHg_a$ = The proportion of people in age group *a* with fillings that contain mercury, from Table 2
HgProportion = The proportion of dental amalgam that is mercury (approximately 45 percent)

F. Controls

There are no controls assumed for this source category.

G. Emissions

Human Cremation

To estimate the emissions of CAPs from human cremation, the total number of human cremations in each county, in tons, is multiplied by the emissions factor for each pollutant, from Table 2.

$$Emissions_{p,c} = Cremation_tons_c \times EF_p \quad \text{(H7)}$$

Where:

$Emissions_{p,c}$ = Emissions of pollutant *p* from human cremation in county *c*, in pounds
$Cremations_tons_c$ = The number of human cremations in county *c*, in tons
EF_p = Emissions factor for pollutant *p* from human cremation, in lbs. per ton

The emissions from mercury in teeth are estimated based on the number of cremations rather than the weight. To estimate the emissions of mercury from teeth during human cremation, the number of cremations in each age group is multiplied by the emissions factor for each age group and then summed across age groups.

$$Emissions_teeth_{Hg,c} = \sum_{a=1}^{A} Cremations_{c,a} \times EF_teeth_{Hg,a} \quad \text{(H8)}$$

Where:

$Emissions_teeth_{Hg,c}$ = Emissions of mercury in teeth from human cremation in county *c*, in pounds
$Cremations_{c,a}$ = The number of human cremations in county *c* in age group *a*
$EF_teeth_{Hg,a}$ = Emissions factor for mercury emissions from teeth due to cremation for age group *a*, in lbs. per cremation

The emissions from mercury from blood and tissues are estimated by multiplying the total number of cremations in each county, in tons, by the emissions factor for mercury from blood and tissues.

$$Emissions_tissue_{Hg,c} = Cremations_tons_c \times EF_tissue_{Hg} \quad \text{(H9)}$$

Where:

$Emissions_tissue_{Hg,c}$ = Emissions of mercury in tissues from human cremation in county *c*, in pounds
$Cremations_tons_c$ = The number of human cremations in county *c*, in tons
$EF_tissue_{Hg,a}$ = Emissions factor for mercury emissions from blood and tissues due to cremation for in lbs. per ton

The total emissions of mercury from cremation in each county is calculated by adding the emissions of mercury from teeth and the emissions of mercury from tissues.

$$Emissions_{Hg,c} = Emissions_teeth_{Hg,c} + Emissions_tissue_{Hg,c} \quad \text{(H10)}$$

Where:

$Emissions_{Hg,c}$ = Emissions of mercury from human cremation in county *c*, in pounds
$Emissions_teeth_{Hg,c}$ = Emissions of mercury in teeth from human cremation in county *c*, in pounds
$Emissions_tissue_{Hg,c}$ = Emissions of mercury in tissues from human cremation in county *c*, in pounds

Animal Cremation

$$Emissions_{p,c} = Cremation_tons_c \times EF_p \quad \text{(A5)}$$

Where:

$Emissions_{p,c}$ = Emissions of pollutant *p* from animal cremation in county *c*, in pounds
$Cremations_tons_c$ = The number of animal cremations in county *c*, in tons
EF_p = Emissions factor for pollutant *p* from animal cremation, in lbs. per ton

H. Point Source Subtraction

There are no point source-specific SCCs for crematoria; therefore point source subtraction is not performed for this category.

I. Sample Calculations

The following table lists the sample calculations for estimating mercury emissions from human cremation in the 85+ age group and animal cremation of cats in Clark County, ID. To estimate the total emissions in Clark County, these steps would be repeated to estimate emissions from all age groups and from cremation of dogs.

Table 4. Sample calculations for mercury emissions from human cremation for the 85+ age group and

cremation of cats in Clark County, ID.

Eq. #	Equation	Values for Clark County, ID	Result
H1	$Deaths_withheld_{s,a} = Deaths_state_{s,a} - \sum Deaths_county_{s,a}$	$4{,}013\ state\ level\ deaths - 3{,}997\ total\ county\ level\ deaths$	16 withheld deaths in Idaho
H2	$Pop_{ratio_c} = \frac{Pop_c}{Pop_s}$	$\frac{873\ people\ in\ Clark\ County}{1{,}975\ total\ population\ of\ counties\ with\ withheld\ deaths}$	0.442 population ratio
H3	$Deaths_{c,a} = Deaths_{withheld_{s,a}} \times Pop_{ratio_c}$	$16\ withheld\ deaths \times 0.442\ population\ ratio$	7 deaths in Clark County, ID
H4	$Cremations_{c,a} = Deaths_{c,a} \times Cremation_{rate_s}$	$7\ deaths \times 56.8\%\ cremation\ rate$	4 cremations in Clark County, ID
H5	$Cremations_tons_c = \sum_{a=1}^{A} Cremations_{c,a} \times W_a \times \frac{1\ ton}{2{,}000\ lbs}$	$4\ cremations \times 158.25\ lbs\ per\ person\ in\ 85 + age\ group \div 2000\ lbs\ per\ ton$	0.3165 tons cremations in Clark County, ID
H6	$EF_teeth_{Hg,a} = Material_a \times ContainHg_a \times HgProportion \times 0.0022 \frac{lb}{g}$	$2.96\ g\ mercury \times 75\ \%\ with\ mercury \times 45\%\ of\ fillings\ are\ mercury \times 0.0022$	0.0022 lbs. mercury per cremation
H7	$Emissions_{p,c} = Cremation_{tons_c} \times EF_p$	N/A	Completed in equation H9 for mercury
H8	$Emissions_{teeth_{Hg,c}} = \sum_{a=1}^{A} Cremations_{c,a} \times EF_{teeth_{Hg,a}}$	$4\ cremations \times 0.0022\ lbs\ per\ cremation$	0.0088 lbs. mercury from teeth in 85+ age group in Clark County, ID
H9	$Emissions_{tissue_{Hg,c}} = Cremations_{tons_c} \times EF_{tissue_{Hg}}$	$0.3165\ tons\ cremations \times 0.0015\ lbs\ per\ ton$	0.00047 lbs. mercury from tissues in 85+ age group in Clark County, ID

Eq. #	Equation	Values for Clark County, ID	Result
H10	$Emissions_{Hg,c} = Emissions_{teeth_{Hg,c}} + Emissions_{tissue_{Hg,c}}$	$0.0088\ lbs\ from\ teeth + 0{,}00047\ lbs.\ from\ tissues$	0.0093 lbs. mercury from cremation of 85+ age group in Clark County ID
A1	$Cremations_{c/d,US} = Ratio_{c/d} \times (Cremations_pets_{US} + Cremations_shelter_{US})$	$52.5\%\ of\ cats\ in\ pet\ population \times (1{,}840{,}965\ pet\ cremations + 2{,}700{,}000\ shelter\ animal\ cremations)$	2,384,006 cremated cats in the U.S.
A2	$Cremations_{tons\frac{c}{d}} = Cremations_{\frac{c}{d}} \times Weight_{\frac{c}{d}} \times \frac{1\ ton}{2{,}000\ pounds}$	$2{,}384{,}006\ cremated\ cats \times 9.9\ lbs\ per\ cat \div 2000\ lbs\ per\ ton$	11,800 tons of cremated cats in the U.S.
A3	$Cremations_{tons_{animal}} = Cremations_{tons_c} + Cremations_{tons_d}$	N/A	Cremations of dogs are not estimated in this sample calculation
A4	$Cremations_tons_{animal,c} = Cremations_tons_{animal,US} \times \frac{Pop_c}{Pop_{US}}$	$11{,}800\ cremated\ cats \times \frac{873\ people\ in\ Clark}{329{,}164{,}967\ people\ in\ US}$	0.03 tons cats cremated in Clark County, ID
A5	$Emissions_{p,c} = Cremation_{tons_c} \times EF_p$	$0.03 \times 0.0015\ lbs\ per\ ton$	0.000045 lbs. mercury emissions from cremation of cats in Clark County, ID

J. Changes from 2014 Methodology

There is one slight change from the 2014 methodology for the estimation of emissions from human cremation. In the 2014 methodology, the emissions factor for mercury emissions from cremation of blood and tissues was in units of per cremation. In the 2017 methodology, EPA uses the same emissions factor, but converted it to a per-ton emissions factor. The per-ton emissions factor is multiplied by the number of tons cremated in each county.

The most significant difference from the 2014 methodology for the estimation of emissions from animal cremation is that EPA now estimates emissions of pollutants other than mercury. In the 2017 methodology, EPA uses the emissions factors for cremation of human blood and tissues to estimate emissions from animals.

K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exists to calculate emissions from human cremation for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

Emissions from animal cremation are based on county population; therefore the emissions from animal cremation in Puerto Rico and the Virgin Islands are calculated using the method described for the rest of the counties.

L. References

[1] CDC. 2020. WONDER Database. Table 2. Available at: http://wonder.cdc.gov/, last accessed August 2018.

[2] National Funeral Directors Association (NFDA). 2018. The NFDA Cremation and Burial Report: Research, Statistics and Projections. Available at: https://www.nfda.org/resources/business-technical/cremation/cremation-exclusive-member-resources, last accessed August 2018.

[3] CDC. 2016. Anthropometric Reference Data for Children and Adults: United States, 2011-2014. Vital Health Statistics, Series 3, Number 29. Available at: https://www.cdc.gov/nchs/data/series/sr_03/sr03_039.pdf, last accessed August 2018.

[4] Pet Loss Professionals Alliance (PLPA). 2013. Pet Loss Professionals Alliance Releases Finding of Inaugural Professional Survey. Available at: http://connectingdirectors.com/articles/40088-pet-loss-professionals-alliance-releases-findings-of-inaugural-professional-survey, last accessed August 2018.

[5] Humane Society of the United States. 2014. Pets by the Numbers. Available at: http://www.humanesociety.org/issues/pet_overpopulation/facts/pet_ownership_statistics.html, last accessed August 2018.

[6] Mattern, M.Y. and D.A. McLennan. 2000. Phylogeny and Speciation of Felids. Cladistics, 16: 232-253.

[7] Modern Puppies. Breed Weight Chart. Available at: http://modernpuppies.com/breedweightchart.aspx, last accessed August 2018.

[8] U.S. Environmental Protection Agency. 1993. AP-42: Compilation of Air Emissions Factors, Fifth Edition, Volume I, Chapter 2.3 - Medical Waste Incineration, Tables 2.3-2 and 2.3-15.

[9] U.S. Environmental Protection Agency. 1999. Emission Test Evaluation of a Crematory at Woodlawn Cemetery in the Bronx, NY, Vol. I-III, EPA-454/R-99-049.

[10] California Air Resources Board. 1999. Development of Toxic Emissions Factors from Source Test Data Collected Under the Air Toxics Hot Spots Program, Part II, Volume I. Prepared by GE Energy and Environmental Research Corporation.

[11] Reindl, J. 2012. Summary of References on Mercury Emissions from Crematoria. Available at: http://www.ejnet.org/crematoria/reindl.pdf, last accessed August 2018.

[12] Lundquist, J.H. 2012. Mercury Emissions from the Cremation of Human Remains. Bay Area Air Quality Management District.

[13] Food and Drug Administration. 2017. About Dental Amalgam Fillings. Available at: https://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/DentalProducts/DentalAmalgam/ucm171094.htm, last accessed August 2018.

DRY CLEANING

A. Source Category Description

The dry cleaning industry is a service industry for the cleaning of garments, draperies, leather goods, and other fabric items. Dry cleaning operations do not use water that can swell textile fibers but typically use either synthetic halogenated or petroleum distillate organic solvents for cleaning purposes. Use of solvents rather than water prevents wrinkles and shrinkage of fabrics. The dry cleaning industry is the most significant emission source of perchloroethylene (PERC) in the United States.

The two major types of dry cleaning operations are coin-operated and commercial. Industrial launderers are usually associated with soap and detergent cleaning, but also use large capacity dry cleaning units. Coin-operated dry cleaning units are self-service machines that are usually found in laundromats. Commercial dry cleaners are independent small businesses that offer dry cleaning services to the public. Some commercial dry cleaning businesses provide numerous drop-off/pick-up outlet stores that are serviced by a single dry cleaning plant, and thus some sites identified as dry cleaners may not be emissions sources. Industrial launderers who use dry cleaning solvents are usually part of a business operation that generates soiled fabrics, where it is convenient or cost-effective to perform dry cleaning on site. Industrial launderers can also be large businesses that provide uniform and other rental services to business, industrial, and institutional customers.

Table 1: 2023 NEI Dry Cleaning

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2420000000	Solvent Utilization	Dry Cleaning	All Processes	Total: All Solvent Types

B. Overview of Calculations

Dry Cleaning Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized are 812320, 81231/, and 81233/. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor

Allegany	24001	0		0
Anne Arundel	24003	234		234
Baltimore	24005	460		460
Calvert	24009	8		8
Caroline	24011	0		0
Carroll	24013	38		38
Cecil	24015	0		0
Charles	24017	41		41
Dorchester	24019	0		0
Frederick	24021	47		47
Garrett	24023	0		0
Harford	24025	87		87
Howard	24027	197		197
Kent	24029	0	4,473 Employees from State Business Patterns.	0
Montgomery	24031	553		553
Prince Georges	24033	1,309	Withheld Employment = State Employment – County Employment = 404.	1,309
Queen Annes	24035	10		10
Saint Mary's	24037	10		10
Somerset	24039	0		0
Talbot	24041	16		16
Washington	24043	30	Midpoints = 0	30
Wicomico	24045	15		15
Worcester	24047	0	Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	0
Baltimore City	24510	1,014		1,014
Total		4,069		4,069

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

VOC emission factors for dry cleaning SCCs are listed in table 3 below.

Table 3: 2023 NEI VOC emissions factors for Dry Cleaning

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2420000000	Dry Cleaning	VOC	18.64	lb/employee	[4], [5], [6]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Section C)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year (Eqn. 1)
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

Since emissions from dry cleaning occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Maryland has no facilities that report dry cleaning emissions as part of its point-source emissions. Point-source subtraction is unnecessary.

H. Sample Calculations

Sample calculations for VOC emissions from dry cleaning in Anne Arundel County, Maryland are included in the table below.

Table 4: Sample Calculations of VOC emissions for Dry Cleaning (SCC 2420000000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}$	$\left(234\ employees \times 18.64 \frac{lb/employee}{2000}\right)$	2.18 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. County Business Patterns: 2021. U.S. Department of Commerce. Retrieved October 21, 2024 from https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] The Freedonia Group: Solvents, Industry Study #3429, The Freedonia Group, Cleveland, OH, 2016.

[5] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

APPENDIX

Table 1. HAP speciation factors for Solvent Utilization for Dry Cleaning (SCC 2420000000). For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2420000000	Dry Cleaning	127184	Perchloroethylene	4.63E-01	2422
2420000000	Dry Cleaning	71556	1,1,1-trichloroethane	4.40E-02	2422

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Dry Cleaning (SCC 2420000000)

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
41000230	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer	2420000000	Dry Cleaning
41000233	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Cool Down Cycle	2420000000	Dry Cleaning
41000232	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Drying Cycle	2420000000	Dry Cleaning
41000231	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Loading/Unloading	2420000000	Dry Cleaning
41000240	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration	2420000000	Dry Cleaning
41000245	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, All Carbon, Batch Operation	2420000000	Dry Cleaning
41000247	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, All Carbon, Continuous Operation	2420000000	Dry Cleaning
41000244	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, Carbon Core, Batch Operation	2420000000	Dry Cleaning
41000246	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, Carbon Core, Continuous Operation	2420000000	Dry Cleaning
41000242	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Multiple Charge	2420000000	Dry Cleaning
41000243	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Regenerative	2420000000	Dry Cleaning
41000241	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Single Charge	2420000000	Dry Cleaning
41000225	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Solvent Settling Tank: Batch Flow	2420000000	Dry Cleaning
41000226	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Solvent Settling Tank: Continuous Flow	2420000000	Dry Cleaning
41000202	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Stoddard	2420000000	Dry Cleaning
41000215	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Washer/Extractor	2420000000	Dry Cleaning
41000260	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal	2420000000	Dry Cleaning
41000265	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Cartridge, All Carbon	2420000000	Dry Cleaning
41000266	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Cartridge, Carbon Core Only	2420000000	Dry Cleaning
41000262	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Filter Waste, Centrifuged	2420000000	Dry Cleaning
41000261	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Filter Waste, Drained	2420000000	Dry Cleaning
41000263	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Settling Tank Sludge	2420000000	Dry Cleaning
41000264	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Still Waste	2420000000	Dry Cleaning
41080001	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Equipment Leaks	Equipment Leaks	2420000000	Dry Cleaning

41000130	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer	2420000000	Dry Cleaning
41000133	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Cool Down Cycle	2420000000	Dry Cleaning
41000132	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Drying Cycle	2420000000	Dry Cleaning
41000131	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Loading/Unloading	2420000000	Dry Cleaning
41000140	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration	2420000000	Dry Cleaning
41000145	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, All Carbon, Batch Operation	2420000000	Dry Cleaning
41000147	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, All Carbon, Continuous Operation	2420000000	Dry Cleaning
41000144	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, Carbon Core, Batch Operation	2420000000	Dry Cleaning
41000146	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, Carbon Core, Continuous Operation	2420000000	Dry Cleaning
41000142	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Multiple Charge	2420000000	Dry Cleaning
41000143	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Regenerative	2420000000	Dry Cleaning
41000141	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Single Charge	2420000000	Dry Cleaning
41000125	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Solvent Settling Tank: Batch Flow	2420000000	Dry Cleaning
41000126	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Solvent Settling Tank: Continuous Flow	2420000000	Dry Cleaning
41000101	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Stoddard	2420000000	Dry Cleaning
41000115	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Washer/Extractor	2420000000	Dry Cleaning
41000160	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal	2420000000	Dry Cleaning
41000165	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Cartridge, All Carbon	2420000000	Dry Cleaning
41000166	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Cartridge, Carbon Core Only	2420000000	Dry Cleaning
41000162	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Filter Waste, Centrifuged	2420000000	Dry Cleaning
41000161	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Filter Waste, Drained	2420000000	Dry Cleaning
41000163	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Settling Tank Sludge	2420000000	Dry Cleaning
41000164	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Still Waste	2420000000	Dry Cleaning
41082001	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Aggregate	Process Area Drains	2420000000	Dry Cleaning
41082002	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Aggregate	Process Equipment Drains	2420000000	Dry Cleaning
41082599	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Points of Generation	Other Not Classified	2420000000	Dry Cleaning
40100107	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Ethylene Oxide: General	2420000000	Dry Cleaning
40100198	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Other Not Classified	2420000000	Dry Cleaning
40100101	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Perchloroethylene	2420000000	Dry Cleaning
40100102	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard (Petroleum Solvent) (Use 4-10-001-01 or 4-10-002-01)	2420000000	Dry Cleaning
40100104	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard (Petroleum Solvent) (Use 4-10-001-02 or 4-10-002-02)	2420000000	Dry Cleaning
40100147	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard:Filtr Disp/Cooked Muck (Centrif) (Use 4-10-001-62 or 002-62)	2420000000	Dry Cleaning
40100146	Chemical Evaporation	Organic Solvent	Dry Cleaning	Stoddard:Filtr Disp/Cooked Muck(Drained) (Use 4-	2420000000	Dry Cleaning

		Evaporation		10-001-61 or 002-61)		
40100161	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Cartrige Filter Disposal	2420000000	Dry Cleaning
40100163	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Miscellaneous Fugitive	2420000000	Dry Cleaning
40100162	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Still Residue Disposal	2420000000	Dry Cleaning
40100160	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Washer/Dryer/Still	2420000000	Dry Cleaning
40100105	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorotrifluoroethane (Freon)	2420000000	Dry Cleaning
41000201	Petroleum and Solvent Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Stoddard	2420000000	Dry Cleaning
41000102	Petroleum and Solvent Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Stoddard	2420000000	Dry Cleaning
40100103	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Dry Cleaning	Perchloroethylene	2420000000	Dry Cleaning
40100113	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Dry Cleaning	Perchloroethylene	2420000000	Dry Cleaning
40100199	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Dry Cleaning	See Comment	2420000000	Dry Cleaning
40100106	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorotrifluoroethane (Freon)	2420000000	Dry Cleaning

COMMERCIAL/INSTITUTIONAL BIOMASS COMBUSTION

A. Source Category Description

Commercial and institutional fuel consumption includes emissions from boilers, engines, and other combustion sources from the commercial, and institutional sectors that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Biomass Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2103008000	Stationary Source Fuel Combustion	Commercial/ Institutional	Wood	Total: All Boiler Types

B. Overview of Calculations

Commercial/institutional biomass combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 2212//, 2213//, 42--, 44--, 51--, 52--, 53--,54--, 55--, 56--, 61--, 62--, 71--, 72--, and 81-- are used to apportion state-fuel to the county level based on the proportion of employment in the commercial sector to the total commercial sector state employment.

$$\boldsymbol{F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x}}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x

The 2023 NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for biomass commercial/institutional fuel combustion, as shown in Table 2.

Table 2: 2023 NEI County Level Fuel Consumption for Commercial/Institutional Biomass Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (mmBtu)	Fuel Consumption (mmBtu)
Allegany	24001	17,202	0.009345	1,313,000	12,270.11
Anne Arundel	24003	184,662	0.100319		131,718.63
Baltimore	24005	268,865	0.146063		191,780.28

Calvert	24009	14,130	0.007676		10,078.87
Caroline	24011	4,452	0.002419		3,175.59
Carroll	24013	38,796	0.021076		27,673.02
Cecil	24015	18,302	0.009943		13,054.74
Charles	24017	26,723	0.014517		19,061.40
Dorchester	24019	5,476	0.002975		3,906.01
Frederick	24021	69,590	0.037805		49,638.26
Garrett	24023	7,909	0.004297		5,641.46
Harford	24025	57,571	0.031276		41,065.15
Howard	24027	153,119	0.083183		109,219.14
Kent	24029	4,715	0.002561		3,363.19
Montgomery	24031	376,651	0.204618		268,663.59
Prince Georges	24033	200,372	0.108853		142,924.51
Queen Annes	24035	8,945	0.004859		6,380.43
Saint Mary's	24037	29,658	0.016112		21,154.93
Somerset	24039	2,944	0.001599		2,099.94
Talbot	24041	14,621	0.007943		10,429.10
Washington	24043	42,376	0.023021		30,226.62
Wicomico	24045	28,706	0.015595		20,475.87
Worcester	24047	17,370	0.009436		12,389.95
Baltimore City	24510	247,596	0.134508		176,609.19

D. Emission Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) biomass fuel consumption sectors are from AP-42.[3] The emissions factors for ammonia are taken from a Pechan report on ammonia emissions in the ICI sectors.[4] The emissions factors for hazardous air pollutants (HAP) are taken from EPA's SPECIATE database.[5]

Criteria air pollutant emission factors for commercial/institutional biomass combustion are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI emissions factors for Commercial/Institutional Biomass Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2103008000	Commercial/Institutional Wood	CO	0.6	lb/mmBtu	[3]
2103008000	Commercial/Institutional Wood	NOX	0.22	lb/mmBtu	
2103008000	Commercial/Institutional Wood	PM10-PRI	0.517	lb/mmBtu	
2103008000	Commercial/Institutional Wood	PM25-PRI	0.447	lb/mmBtu	
2103008000	Commercial/Institutional Wood	SO2	0.025	lb/mmBtu	
2103008000	Commercial/Institutional Wood	VOC	0.017	lb/mmBtu	

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from commercial/intuitional biomass combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate commercial/institutional biomass combustion point sources to estimate the amount of fuel consumption to subtract from the SEDS total. Facility level annual CO_2 emissions are divided by an emission factor[6], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$NP_{f,c} = Ep_{CO2c,s} \times 2000 \; / \; EF_{CO2,s}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county c for source category s, in mmBtu per year
$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county c for source category s, in tons per year
$EF_{CO2,s}$ = CO_2 emissions factor for source category s

The point source consumption estimates for commercial/institutional biomass combustion are outlined in Table 4 below.

Table 4: Point Source Employment Adjustment for Commercial/Institutional Biomass Combustion

County Name	FIPS State and County Code	Fuel Consumption (mmBtu)	Point Source Fuel Consumption Reduction (mmBtu)	Point Source Adjusted Fuel Consumption (mmBtu)
Allegany	24001	12,270.11	0.00	12,270.11
Anne Arundel	24003	131,718.63	0.00	131,718.63
Baltimore	24005	191,780.28	0.00	191,780.28
Calvert	24009	10,078.87	0.00	10,078.87

Caroline	24011	3,175.59	0.00	3,175.59
Carroll	24013	27,673.02	0.00	27,673.02
Cecil	24015	13,054.74	0.00	13,054.74
Charles	24017	19,061.40	0.00	19,061.40
Dorchester	24019	3,906.01	0.00	3,906.01
Frederick	24021	49,638.26	0.00	49,638.26
Garrett	24023	5,641.46	0.00	5,641.46
Harford	24025	41,065.15	0.00	41,065.15
Howard	24027	109,219.14	0.00	109,219.14
Kent	24029	3,363.19	0.00	3,363.19
Montgomery	24031	268,663.59	0.00	268,663.59
Prince George's	24033	142,924.51	0.00	142,924.51
Queen Anne's	24035	6,380.43	0.00	6,380.43
St. Mary's	24037	21,154.93	0.00	21,154.93
Somerset	24039	2,099.94	1,497,586.99	0.00
Talbot	24041	10,429.10	0.00	10,429.10
Washington	24043	30,226.62	0.00	30,226.62
Wicomico	24045	20,475.87	0.00	20,475.87
Worcester	24047	12,389.95	0.00	12,389.95
Baltimore City	24510	176,609.19	0.00	176,609.19

H. Sample Calculations

Sample calculations for VOC emissions from commercial/institutional biomass combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Commercial/Institutional Biomass Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(131{,}718.63\ mmBtu \times 0.017\ lb/mmBtu)/2000$	1.12 tons of VOC in 2023

I. References

1 Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

2 U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[4] E.H. Pechan and Associates, Inc. 2003. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Report. Durham, NC. Prepared for USEPA Emission Factor and Inventory Group.

[5] EPA. 2016. SPECIATE v4.5. Fireplace wood combustion – pine wood. https://www.epa.gov/air-emissions-modeling/speciate

[6] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1 Emissions factors for fuel consumption in the Commercial and Institutional Biomass Sector

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2.103E+09	50000	Formaldehyde	0.0014405	LB	E6BTU	5
2.103E+09	71432	Benzene	0.0004736	LB	E6BTU	5
2.103E+09	75070	Acetaldehyde	0.002107	LB	E6BTU	5
2.103E+09	83329	Acenaphthene	2.50E-06	LB	E6BTU	5
2.103E+09	85018	Phenanthrene	1.94E-05	LB	E6BTU	5
2.103E+09	86737	Fluorene	5.49E-06	LB	E6BTU	5
2.103E+09	90120	1-Methylnaphthalene	1.31E-05	LB	E6BTU	5
2.103E+09	91203	Naphthalene	0.0002807	LB	E6BTU	5
2.103E+09	91576	2-Methylnaphthalene	1.85E-05	LB	E6BTU	5
2.103E+09	98862	Acetophenone	4.82E-06	LB	E6BTU	5
2.103E+09	100414	Ethyl Benzene	2.83E-05	LB	E6BTU	5
2.103E+09	106990	1,3-Butadiene	0.0001447	LB	E6BTU	5
2.103E+09	107028	Acrolein	7.79E-05	LB	E6BTU	5
2.103E+09	108883	Toluene	0.0001954	LB	E6BTU	5
2.103E+09	108952	Phenol	0.0006492	LB	E6BTU	5
2.103E+09	120127	Anthracene	4.25E-06	LB	E6BTU	5
2.103E+09	120809	Catechol	0.0003858	LB	E6BTU	5
2.103E+09	123319	Hydroquinone	2.13E-05	LB	E6BTU	5
2.103E+09	123386	Propionaldehyde	0.0003153	LB	E6BTU	5
2.103E+09	129000	Pyrene	2.31E-06	LB	E6BTU	5
2.103E+09	203123	Benzo(g,h,i)Fluoranthene	1.01E-07	LB	E6BTU	5
2.103E+09	206440	Fluoranthene	3.77E-06	LB	E6BTU	5
2.103E+09	208968	Acenaphthylene	2.30E-05	LB	E6BTU	5
2.103E+09	832699	1-Methylphenanthrene	2.75E-06	LB	E6BTU	5
2.103E+09	1319773	Cresol/Cresylic Acid (Mixed Isomers)	0.0005807	LB	E6BTU	5
2.103E+09	1330207	Xylenes (Mixed Isomers)	9.66E-05	LB	E6BTU	5
2.103E+09	CO	Carbon Monoxide	0.6	LB	E6BTU	3; Section 1.6
2.103E+09	NH3	Ammonia	0.005	LB	E6BTU	4
2.103E+09	NOX	Nitrogen Oxides	0.22	LB	E6BTU	3; Section 1.6
2.103E+09	PM10-FIL	PM10 Filterable	0.5	LB	E6BTU	3; Section 1.6

2.103E+09	PM10-PRI	PM10 Primary (Filt + Cond)	0.517	LB	E6BTU	3; Section 1.6
2.103E+09	PM25-FIL	PM2.5 Filterable	0.43	LB	E6BTU	3; Section 1.6
2.103E+09	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.447	LB	E6BTU	3; Section 1.6
2.103E+09	PM-CON	PM Condensible	0.017	LB	E6BTU	3; Section 1.6
2.103E+09	SO2	Sulfur Dioxide	0.025	LB	E6BTU	3; Section 1.6
2.103E+09	VOC	Volatile Organic Compounds	0.017	LB	E6BTU	3; Section 1.6

INDUSTRIAL BIOMASS FUEL COMBUSTION

A. Source Category Description

Industrial fuel consumption includes emissions from boilers, engines, and other combustion sources from the Industrial sectors that are not reported as point sources.

Table 1. 2023 NEI Industrial Biomass Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types

B. Overview of Calculations

Industrial Biomass Combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] industrial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS 11--, 21--, 23--, 31--, 32-- and 33--, are used to apportion state-fuel to the county level based on the proportion of employment in the industrial sector to the total industrial sector state employment.

The total fuel consumption is adjusted to account for fuel used as an input to industrial processes where it is not combusted. Maryland assumes that 0% of industrial biomass throughput is not combusted. This assumption is based on the EIA Manufacturing Energy Consumption Survey (MECS)[3], which reports both total fuel consumption and non-combustion use of fuel by Census region.

$$\boldsymbol{F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x} \times (1 - nc_{f,industrial})}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x
$nc_{f,x}$ = Fraction of fuel f used as an industrial input and is not combusted in the industrial sector

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for biomass Industrial fuel combustion, as shown in Table 2.

Table 2: 2023 NEI County Level Fuel Consumption for Industrial Biomass Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (mmBtu)	Non-Fuel Combustion	Fuel Consumption (mmBtu)
Allegany	24001	2,886	0.011073	303,000	0.0%	3,355.12
Anne Arundel	24003	33,165	0.127247			38,555.96
Baltimore	24005	38,098	0.146174			44,290.82
Calvert	24009	2,579	0.009895			2,998.22
Caroline	24011	1,819	0.006979			2,114.68
Carroll	24013	9,303	0.035694			10,815.20
Cecil	24015	5,909	0.022672			6,869.51
Charles	24017	3,827	0.014683			4,449.08
Dorchester	24019	3,532	0.013552			4,106.13
Frederick	24021	16,507	0.063334			19,190.21
Garrett	24023	1,812	0.006952			2,106.54
Harford	24025	10,313	0.039569			11,989.38
Howard	24027	17,254	0.0662			20,058.63
Kent	24029	1,161	0.004455			1,349.72
Montgomery	24031	32,072	0.123054			37,285.30
Prince Georges	24033	39,127	0.150122			45,487.09
Queen Annes	24035	2,788	0.010697			3,241.19
Saint Mary's	24037	2,271	0.008713			2,640.15
Somerset	24039	688	0.00264			799.83
Talbot	24041	1,673	0.006419			1,944.95
Washington	24043	9,108	0.034946			10,588.50
Wicomico	24045	3,923	0.015052			4,560.68
Worcester	24047	1,642	0.0063			1,908.91
Baltimore City	24510	19,177	0.073578			22,294.22

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42[4] and EPA's SPECIATEv4.5 tool[5]. The emissions factor for ammonia is from E.H. Pechan and Associates, Inc (2003).[6]

Criteria air pollutant emissions factors for Industrial biomass combustion are listed in table 3 below.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Industrial Biomass Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2102008000	Industrial Biomass	CO	0.6	lb/mmBtu	[4]
		NOX	0.22		
		PM10-PRI	0.517		
		PM25-PRI	0.447		
		SO2	0.025		
		VOC	0.017		

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from industrial biomass combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, MDE utilizes the point source registry to locate Industrial biomass combustion point sources to estimate the amount of fuel consumption to subtract from the SEDS total.

Maryland has no facilities that report industrial biomass combustion as part of its point-source emissions. Point source subtraction is not necessary.

H. Sample Calculations

Sample calculations for VOC emissions from Industrial biomass combustion in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC Emissions for Industrial Biomass Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(38{,}556\ mmBtu \times 0.017\ lb/mmBtu)/2000$	0.33 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[4] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[5] EPA. 2016. SPECIATE v4.5. Fireplace wood combustion – pine wood. https://www.epa.gov/air-emissions-modeling/speciate

[6] E.H. Pechan and Associates, Inc. 2003. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Report. Durham, NC. Prepared for USEPA Emission Factor and Inventory Group.

APPENDIX

Table 1. Emissions Factors for Biomass Combustion in the Industrial Sector

SCC	Pollutant Code	POLLUTANT CODE DESCRIPTION	Emission Factors for Calculation	Factor Unit Numerator	Factor Unit Denominator	Reference
2102008000	VOC	Volatile Organic Compounds	0.017	LB	E6BTU	4; Section 1.6
2102008000	SO2	Sulfur Dioxide	0.025	LB	E6BTU	4; Section 1.6
2102008000	PM25-PRI	PM25 Primary (Filt + Cond)	0.447	LB	E6BTU	4; Section 1.6
2102008000	PM25-FIL	PM25 Filterable	0.43	LB	E6BTU	4; Section 1.6
2102008000	PM10-PRI	PM10 Primary (Filt + Cond)	0.517	LB	E6BTU	4; Section 1.6
2102008000	PM10-FIL	PM10 Filterable	0.5	LB	E6BTU	4; Section 1.6
2102008000	PM-CON	PM Condensible	0.017	LB	E6BTU	4; Section 1.6
2102008000	NOX	Nitrogen Oxides	0.22	LB	E6BTU	4; Section 1.6
2102008000	NH3	Ammonia	0.007	LB	E6BTU	6
2102008000	CO	Carbon Monoxide	0.6	LB	E6BTU	4; Section 1.6
2102008000	98862	Acetophenone	4.82237E-06	LB	E6BTU	5
2102008000	91576	2-Methylnaphthalene	1.85476E-05	LB	E6BTU	5
2102008000	91203	Naphthalene	0.000280687	LB	E6BTU	5
2102008000	90120	1-Methylnaphthalene	0.000013107	LB	E6BTU	5
2102008000	86737	Fluorene	5.49009E-06	LB	E6BTU	5
2102008000	85018	Phenanthrene	1.94131E-05	LB	E6BTU	5
2102008000	83329	Acenaphthene	2.49774E-06	LB	E6BTU	5
2102008000	832699	1-Methylphenanthrene	2.74504E-06	LB	E6BTU	5
2102008000	75070	Acetaldehyde	0.002107007	LB	E6BTU	5
2102008000	71432	Benzene	0.000473582	LB	E6BTU	5
2102008000	50000	Formaldehyde	0.00144053	LB	E6BTU	5
2102008000	208968	Acenaphthylene	0.000022999	LB	E6BTU	5
2102008000	206440	Fluoranthene	3.77134E-06	LB	E6BTU	5
2102008000	203123	Benzo(g,h,i)Fluoranthene	1.01394E-07	LB	E6BTU	5
2102008000	1330207	Xylenes (Mixed Isomers)	9.65711E-05	LB	E6BTU	5
2102008000	1319773	Cresol/Cresylic Acid (Mixed Isomers)	0.000580663	LB	E6BTU	5
2102008000	129000	Pyrene	2.31227E-06	LB	E6BTU	5
2102008000	123386	Propionaldehyde	0.000315309	LB	E6BTU	5
2102008000	123319	Hydroquinone	2.12679E-05	LB	E6BTU	5
2102008000	120809	Catechol	0.00038579	LB	E6BTU	5
2102008000	120127	Anthracene	4.25358E-06	LB	E6BTU	5
2102008000	108952	Phenol	0.000649166	LB	E6BTU	5
2102008000	108883	Toluene	0.000195368	LB	E6BTU	5

2102008000	107028	Acrolein	7.78999E-05	LB	E6BTU	5
2102008000	106990	1,3-Butadiene	0.000144671	LB	E6BTU	5
2102008000	100414	Ethyl Benzene	0.000028316	LB	E6BTU	5

INDUSTRIAL COAL COMBUSTION

A. Source Category Description

Industrial fuel consumption includes emissions from boilers, engines, and other combustion sources from the industrial sector that are not reported as point sources.

Table 1. 2023 NEI Industrial Coal Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types
2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/Subbituminous Coal	Total: All Boiler Types

B. Overview of Calculations

Industrial Coal Combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector, using data from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] industrial employment from the U.S. Census Bureau[2], and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 11--, 21--, 23--, 31--, 32-- and 33-- are used to apportion state-fuel to the county level based on the proportion of employment in the industrial sector to the total industrial sector state employment.

The total fuel consumption is adjusted to account for fuel used as an input to industrial processes where it is not combusted. Maryland assumes that 29.40% of industrial coal throughput is not combusted. This assumption is based on the EIA Manufacturing Energy Consumption Survey (MECS)[3], which reports both total fuel consumption and non-combustion use of fuel by Census region.

$$\boldsymbol{F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x} \times (1 - nc_{f,industrial})}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x
$nc_{f,x}$ = Fraction of fuel f used as an industrial input and is not combusted in the industrial sector

The SEDS data do not distinguish between anthracite and bituminous/subbituminous coal consumption estimates. The EIA table *"Domestic Distribution of U.S. Coal by Destination State, Consumer, Origin*

and Method of Transportation"[4] provides state-level coal distribution data for 2006 that is used to estimate the fraction of coal consumption that is anthracite and bituminous/subbituminous. In Maryland, the Anthracite ratio is 0.0710 and the Bituminous ratio is 0.929. The SEDS data on industrial and commercial coal consumption are split into consumption of anthracite and bituminous coal based on the following formula:

$$AF_{ant/bit,x} = AF_{coal,x} \times R_{ant/bit}$$

Where:

$AF_{ant/bit,x}$ = Adjusted anthracite or bituminous coal consumption *s* in sector *x*
$AF_{coal,x}$ = Total adjusted coal consumption in sector *x*
$R_{ant/bit}$ = Ratio of anthracite or bituminous coal to total coal, from Table 3

The 2023 NEI uses 2022 SEDS fuel consumption, 2021 employment, non-fuel consumption estimates, and coal distribution ratios to estimate county-level fuel consumption for coal industrial fuel combustion as shown in Table 2.

Table 2: 2023 NEI County Level Fuel Consumption for Industrial Coal Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Thousand Tons)	Non-Fuel Combustion	Non-Fuel Adjusted Bituminous Coal Consumption (Thousand Tons)	Non-Fuel Adjusted Anthracite Coal Consumption (Thousand Tons)
Allegany	24001	2,886	0.01107	425	29.4%	1.567	0.236
Anne Arundel	24003	33,165	0.12725			3.087	2.711
Baltimore	24005	38,098	0.14617			35.470	3.114
Calvert	24009	2,579	0.00990			40.746	0.211
Caroline	24011	1,819	0.00698			2.758	0.149
Carroll	24013	9,303	0.03569			1.945	0.760
Cecil	24015	5,909	0.02267			9.950	0.483
Charles	24017	3,827	0.01468			6.320	0.313
Dorchester	24019	3,532	0.01355			4.093	0.289
Frederick	24021	16,507	0.06333			3.777	1.349
Garrett	24023	1,812	0.00695			17.654	0.148
Harford	24025	10,313	0.03957			1.938	0.843
Howard	24027	17,254	0.06620			11.030	1.410
Kent	24029	1,161	0.00445			18.453	0.095
Montgomery	24031	32,072	0.12305			1.242	2.621
Prince Georges	24033	39,127	0.15012			34.301	3.198
Queen Annes	24035	2,788	0.01070			41.846	0.228
Saint Mary's	24037	2,271	0.00871			2.982	0.186
Somerset	24039	688	0.00264			2.429	0.056
Talbot	24041	1,673	0.00642			0.736	0.137
Washington	24043	9,108	0.03495			1.789	0.744
Wicomico	24045	3,923	0.01505			9.741	0.321
Worcester	24047	1,642	0.0063			4.196	0.134
Baltimore	24510	19,177	0.073578			8.541	0.236

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42[5] and a spreadsheet developed in 2010 by EPA and the Eastern Regional Technical Advisory Committee.[6] The emission factors for ammonia are taken from a report from EPA on ammonia emissions in the ICI sector. [7] SO2 Emission Factors are multiplied by the State Sulfur Content. In Maryland, the Anthracite Sulfur Content Industrial is 0.89%, and the Bituminous Sulfur Content is 1.6%.[8] PM10 emissions factors are multiplied by the State Ash Content for bituminous coal; in Maryland, that is 13.38%.[8]

Criteria air pollutant emission factors for coal industrial combustion are listed in Table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Industrial Coal Combustion

SCC	Description	Pollutant Code	Emissions Factor	Unit	Source
2102001000	Industrial Anthracite Coal	CO	0.6000	LB/TON	6
		NOX	9.0000		6
		PM10-PRI	0.08A + 1.1A		6
		PM25-PRI	0.08A + 0.48A		6
		SO2	38S		6
		VOC	0.3000		6
2102002000	Industrial Bituminous Coal	CO	5.0000		5
		NOX	11.0000		5
		PM10-PRI	13.0400		6
		PM25-PRI	2.4400		6
		SO2	38S		6
		VOC	0.0500		6

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 3)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 4 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from industrial coal combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, MDE utilizes the point source registry to locate industrial coal combustion point sources to estimate the amount of fuel consumption to subtract from the adjusted SEDS total. Facility level annual CO2 emissions are divided by an emission factor[9], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county *c* for source category *s*,
$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county *c* for source category *s*
$EF_{CO2,s}$ = CO_2 emissions factor for source category *s*

The point source employment estimates and non-combustion adjustment for industrial coal are outlined in Table 4 below.

Table 4: Point Source Consumption Adjustments for Industrial Coal Combustion

County Name	FIPS State and County Code	Bituminous Coal Consumption (Thousand Tons)	Anthracite Coal Consumption (Thousand Tons)	Point Source Consumption (Thousand Tons)	Point Source Adjusted Bituminous Coal Consumption (Thousand Tons)	Point Source Adjusted Anthracite Coal Consumption (Thousand Tons)
Allegany	24001	1.567	0.236	0	3.087	0.236
Anne Arundel	24003	3.087	2.711	0	35.470	2.711
Baltimore	24005	35.470	3.114	0	40.746	3.114
Calvert	24009	40.746	0.211	0	2.758	0.211
Caroline	24011	2.758	0.149	0	1.945	0.149
Carroll	24013	1.945	0.760	0	9.950	0.760
Cecil	24015	9.950	0.483	0	6.320	0.483
Charles	24017	6.320	0.313	0	4.093	0.313
Dorchester	24019	4.093	0.289	0	3.777	0.289
Frederick	24021	3.777	1.349	0	17.654	1.349
Garrett	24023	17.654	0.148	7.645352368	0.000	0.000
Harford	24025	1.938	0.843	0	11.030	0.843
Howard	24027	11.030	1.410	0	18.453	1.410
Kent	24029	18.453	0.095	0	1.242	0.095

Montgomery	24031	1.242	2.621	0	34.301	2.621
Prince George's	24033	34.301	3.198	0	41.846	3.198
Queen Anne's	24035	41.846	0.228	0	2.982	0.228
St. Mary's	24037	2.982	0.186	0	2.429	0.186
Somerset	24039	2.429	0.056	0	0.736	0.056
Talbot	24041	0.736	0.137	0	1.789	0.137
Washington	24043	1.789	0.744	0	9.741	0.744
Wicomico	24045	9.741	0.321	0	4.196	0.321
Worcester	24047	4.196	0.134	0	1.756	0.134
Baltimore City	24510	8.541	0.236	0.067285102	20.447	1.563

H. Sample Calculations

Sample calculations for VOC emissions from Industrial coal combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Industrial Coal Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1-Anthracite	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(2.71\ E3TON \times 1000 \times 0.3\ lbs/ton)/2000$	0.407 tons of VOC in 2023
1-Bituminous	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(35.47\ E3TON \times 1000 \times 0.05\ lbs/ton)/2000$	0.887 tons of VOC in 2023
			1.293 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[4] Energy Information Administration. 2008. "Domestic Distribution of U.S. Coal by Destination State, Consumer, Origin and Method of Transportation" http://www.eia.doe.gov/cneaf/coal/page/coaldistrib/coal_distributions.html

[5] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[6] EPA and Eastern Regional Technical Advisory Committee. 2010. Excel file: state_comparison_ERTAC_SS_version7_5_Mar 16 2010.xls

[7] R. Battye, W. Battye, C. Overcash, and S. Fudge. 1994. Development and Selection of Ammonia Emission Factors: Final Report. Durham, NC: EC/R Incorporated. Prepared for USEPA Office of Research and Development.

[8] U.S. Environmental Protection Agency. Wagon Wheel 2020 v7.1 Final - EPA Defaults – ICI Module: Sulfur and Ash Content of Fuels Table.

[9] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1 Emissions factors for Coal Combustion in the Industrial Sector. SO2 Emission Factors are multiplied by the State Sulfur Content. In Maryland, the Anthracite Sulfur Content Industrial is 0.89%, and the Bituminous Sulfur Content is 1.6%. PM emissions factors are multiplied by the State Ash Content for anthracite coal; in Maryland, that is 13.38%.

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102001000	85018	Phenanthrene	0.0068	LB	TON	5; Table 1.2-5
2102001000	91203	Naphthalene	0.13	LB	TON	5; Table 1.2-5
2102001000	92524	Biphenyl	0.025	LB	TON	5; Table 1.2-5
2102001000	7439921	Lead	0.00042	LB	TON	5; Table 1.2-3
2102001000	CO	Carbon Monoxide	0.6	LB	TON	6
2102001000	NH3	Ammonia	0.03	LB	TON	6
2102001000	NOX	Nitrogen Oxides	9	LB	TON	6
2102001000	PM10-FIL	PM10 Filterable	1.1A	LB	TON	6
2102001000	PM10-PRI	PM10 Primary (Filt + Cond)	0.08A + 1.1A	LB	TON	6
2102001000	PM25-FIL	PM2.5 Filterable	0.48A	LB	TON	6
2102001000	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.08A + 0.48A	LB	TON	6
2102001000	PM-CON	PM Condensible	0.08A	LB	TON	6
2102001000	SO2	Sulfur Dioxide	38S	LB	TON	6
2102001000	VOC	Volatile Organic Compounds	0.3	LB	TON	6
2102001000	7440382	Arsenic	0.00019	LB	TON	5
2102001000	7440417	Beryllium	0.00031	LB	TON	5
2102001000	7440439	Cadmium	0.000071	LB	TON	5
2102001000	7439965	Manganese	0.0036	LB	TON	5
2102001000	7439976	Mercury	0.00013	LB	TON	5
2102001000	7440020	Nickel	0.026	LB	TON	5
2102001000	7782492	Selenium	0.0013	LB	TON	5
2102002000	50000	Formaldehyde	0.00024	LB	TON	5; Table 1.1-14
2102002000	50328	Benzo[a]Pyrene	0.000000038	LB	TON	5; Table 1.1-13
2102002000	56553	Benz[a]Anthracene	0.00000008	LB	TON	5; Table 1.1-13
2102002000	60344	Methylhydrazine	0.00017	LB	TON	5; Table 1.1-14
2102002000	67663	Chloroform	0.000059	LB	TON	5; Table 1.1-14
2102002000	75003	Ethyl Chloride	0.000042	LB	TON	5; Table 1.1-14
2102002000	75252	Bromoform	0.000039	LB	TON	5; Table 1.1-14

2102002000	77781	Dimethyl Sulfate	0.000048	LB	TON	5; Table 1.1-14
2102002000	80626	Methyl Methacrylate	0.00002	LB	TON	5; Table 1.1-14
2102002000	83329	Acenaphthene	0.00000051	LB	TON	5; Table 1.1-13
2102002000	85018	Phenanthrene	0.0000027	LB	TON	5; Table 1.1-13
2102002000	86737	Fluorene	0.00000091	LB	TON	5; Table 1.1-13
2102002000	91203	Naphthalene	0.000013	LB	TON	5; Table 1.1-13
2102002000	92524	Biphenyl	0.0000017	LB	TON	5; Table 1.1-13
2102002000	98828	Cumene	0.0000053	LB	TON	5; Table 1.1-14
2102002000	100447	Benzyl Chloride	0.0007	LB	TON	5; Table 1.1-14
2102002000	106934	Ethylene Dibromide	0.0000012	LB	TON	5; Table 1.1-14
2102002000	108054	Vinyl Acetate	0.0000076	LB	TON	5; Table 1.1-14
2102002000	120127	Anthracene	0.00000021	LB	TON	5; Table 1.1-13
2102002000	121142	2,4-Dinitrotoluene	0.00000028	LB	TON	5; Table 1.1-14
2102002000	129000	Pyrene	0.00000033	LB	TON	5; Table 1.1-13
2102002000	191242	Benzo[g,h,i,]Perylene	0.000000027	LB	TON	5; Table 1.1-13
2102002000	193395	Indeno[1,2,3-c,d]Pyrene	0.000000061	LB	TON	5; Table 1.1-13
2102002000	206440	Fluoranthene	0.00000071	LB	TON	5; Table 1.1-13
2102002000	208968	Acenaphthylene	0.00000025	LB	TON	5; Table 1.1-13
2102002000	218019	Chrysene	0.0000001	LB	TON	5; Table 1.1-13
2102002000	532274	2-Chloroacetophenone	0.000007	LB	TON	5; Table 1.1-14
2102002000	1330207	Xylenes (Mixed Isomers)	0.000037	LB	TON	5; Table 1.1-14
2102002000	1634044	Methyl Tert-Butyl Ether	0.000035	LB	TON	5; Table 1.1-14
2102002000	3697243	5-Methylchrysene	0.000000022	LB	TON	5; Table 1.1-13
2102002000	7439921	Lead	0.00042	LB	TON	5; Table 1.2-3
2102002000	56832736	Benzofluoranthenes	0.00000011	LB	TON	5; Table 1.1-14
2102002000	CO	Carbon Monoxide	5	LB	TON	5; Table 1.1-3
2102002000	NH3	Ammonia	0.03	LB	TON	7
2102002000	NOX	Nitrogen Oxides	11	LB	TON	5; Table 1.1-3
2102002000	PM10-FIL	PM10 Filterable	12	LB	TON	6
2102002000	PM10-PRI	PM10 Primary (Filt + Cond)	13.04	LB	TON	6
2102002000	PM25-FIL	PM2.5 Filterable	1.4	LB	TON	6
2102002000	PM25-PRI	PM2.5 Primary (Filt + Cond)	2.44	LB	TON	6

2102002000	PM-CON	PM Condensible	1.04	LB	TON	6
2102002000	SO2	Sulfur Dioxide	38S	LB	TON	6
2102002000	VOC	Volatile Organic Compounds	0.05	LB	TON	6
2102002000	7440382	Arsenic	0.00041	LB	TON	5
2102002000	7440439	Cadmium	0.000051	LB	TON	5
2102002000	18540299	Chromium (VI)	0.0000312	LB	TON	5
2102002000	16065831	Chromium III	0.0002288	LB	TON	5

COMMERCIAL/INSTITUTIONAL DISTILLATE OIL COMBUSTION

A. Source Category Description

Commercial and Institutional fuel consumption includes emissions from boilers, engines, and other combustion sources from the commercial and institutional sectors that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Distillate Oil Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2103004001	Stationary Source Fuel Combustion	Commercial/ Institutional	Distillate Oil	Boilers
2103004002	Stationary Source Fuel Combustion	Commercial/ Institutional	Distillate Oil	IC Engines

B. Overview of Calculations

Commercial/Institutional Distillate Oil combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from Energy Information Administration (EIA) Form 821,[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Distillate fuel consumption is taken from EIA's Form 821 data, which reports distillate sales by state and sector, and oil type. The most recent EIA Form 821 data year is 2020. The 821 fuel consumption data is scaled to a more recent year, in this case 2022, using EIA SEDS.[3] MDE adjusts EIA Form 821 2020 data using a growth rate calculated based on EIA SEDS 2020-2022 data to estimate activity data for 2022.

$$F_{f,x,2022} = F_{f,x,2020} \times (1 + G_b)$$

Where:

$F_{f,x,2022}$ = Form 821 consumption of fuel *f* in sector *x* "grown" to 2022
$F_{f,x,2020}$ = Form 821 consumption of fuel *f* in sector *x* in 2020
G_b = (2022 SEDS consumption – 2020 SEDS consumption) / 2020 SEDS consumption

Table 2: 2020 EIA Form 821 Commercial Consumption Grown to 2022 Using Growth Rates Based on EIA SEDS DFCCP Consumption

SEDS Commercial Sector Energy Consumption Estimates, Maryland				
State	**MSN**	**2020**	**2022**	**Unit**
MD	DFCCP	1,199	1,271	Thousand Barrels
SEDS Growth Rate			8.67%	
EIA 821 Commercial Sector Energy Consumption Estimates, Maryland				
Product 2020		**2020**	**2020 Grown to 2022**	**Unit**
No.1 Distillate		0	0	Thousand Gallons
No. 2 Fuel Oil		19,467	21,156	
No.2 Ultra Low Sulfur Diesel		31,406	34,130	
No. 2 Low Sulfur Diesel		0	0	
No. 2 High Sulfur Diesel		0	0	

No. 4 Distillate	148	161	
Total	51,022	55,447	

The EIA Form 821 distillate oil consumption data include consumption estimates for equipment that are typically included in the nonroad inventory (ex. farming, logging, mining and construction equipment fuel use). To avoid double-counting distillate oil consumption, total fuel consumption is adjusted to account for the fraction of fuel consumed by nonroad mobile sources. This fraction is based on results from the National Mobile Inventory Model (NMIM), a precursor to EPA's Motor Vehicle Emission Simulator (MOVES). Per EPA, for commercial/institutional distillate oil combustion, 20% of No.1 distillate fuel consumption, 0% of No.2 fuel oil consumption, 100% of No.2 low sulfur distillate consumption, and 0% of No.4 distillate consumption is assumed to be from nonroad off-highway sources.[4] County level consumption is estimated using the following equation:

$$F_{f,c,x} = F_{f,x} \times (1 - SS_{f,x})$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$SS_{f,x}$ = Fraction of fuel f consumed by nonroad sources in sector x

Table 3: 2020 EIA Form 821 Commercial Consumption Grown to 2022 & Adjusted for Nonroad Fuel Consumption

Product 2020	2020 Grown to 2022 (Thousand Gallons)	NMIM Adjustment Factor (%)	2020 Grown to 2022 & Adjusted for Nonroad Consumption (Thousand Gallons)	Total Nonpoint Distillate Consumption (Thousand Gallons)
No.1 Distillate	0	20%	0	21,316
No. 2 Fuel Oil	21,156	0%	21,156	
No.2 Ultra Low Sulfur Diesel	34,130	100%	0	
No. 4 Distillate	161	0%	161	

The EIA Form 821 data report total distillate consumption, but the NEI requires emissions separately for boilers and engines, because there are substantially different emissions factors for distillate boilers and engines. MDE assumes that 95% of commercial distillate consumption is attributable to boilers and 5% is of consumption is attributable to engines. This is based on the EIA MECS and the EIA Commercial Building Energy Consumption Survey (CBECS).[5, 6]

$$AF_{boiler/engine,x} = AF_{distillate,x} \times R_{boiler/engine,x}$$

Where:

$AF_{boiler/engine,x}$ = Adjusted distillate consumption in boilers or engines in sector x
$AF_{distillate,x}$ = Total adjusted distillate consumption in sector x
$R_{boiler/engine,x}$ = Ratio of distillate consumption by boilers or engines in sector x

The EIA Form 821 adjusted fuel consumption is allocated to the counties using county-level employment data from the U.S. Census Bureau. County Business Pattern NAICS codes 2212//, 2213//, 42--, 44--, 51--, 52--, 53--,54--, 55--, 56--, 61--, 62--, 71--, 72--, and 81-- are used to apportion state-fuel to the county level based on the proportion of employment in the commercial sector to the total commercial sector state employment.

$$F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x}$$

Where:

$F_{f,c,x}$ = Consumption of fuel *f* in county *c* in sector *x*
$F_{f,x}$ = Consumption of fuel *f* in sector *x*
$a_{c,x}$ = Employment in county *c* in sector *x*
a_x = Employment in sector *x*

The NEI uses 2022 grown & nonroad adjusted EIA Form 821 fuel consumption and 2021 employment to estimate county-level fuel consumption for distillate oil commercial/institutional fuel combustion, as shown in Table 4.

Table 4: 2023 NEI County Level Fuel Consumption for Commercial/Institutional Distillate Oil Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIA Form 821 Grown to 2022 & Adjusted for Nonroad Fuel Consumption	County-Level Fuel Consumption for Boilers (Thousand Gallons)	County-Level Fuel Consumption for Engines (Thousand Gallons)
Allegany	24001	17,202	0.009345	21,316	189.24	9.96
Anne Arundel	24003	184,662	0.100319		2,031.51	106.92
Baltimore	24005	268,865	0.146063		2,957.85	155.68
Calvert	24009	14,130	0.007676		155.45	8.18
Caroline	24011	4,452	0.002419		48.98	2.58
Carroll	24013	38,796	0.021076		426.80	22.46
Cecil	24015	18,302	0.009943		201.34	10.60
Charles	24017	26,723	0.014517		293.99	15.47
Dorchester	24019	5,476	0.002975		60.24	3.17
Frederick	24021	69,590	0.037805		765.58	40.29
Garrett	24023	7,909	0.004297		87.01	4.58
Harford	24025	57,571	0.031276		633.35	33.33
Howard	24027	153,119	0.083183		1,684.50	88.66
Kent	24029	4,715	0.002561		51.87	2.73
Montgomery	24031	376,651	0.204618		4,143.63	218.09
Prince Georges	24033	200,372	0.108853		2,204.34	116.02
Queen Annes	24035	8,945	0.004859		98.41	5.18
Saint Mary's	24037	29,658	0.016112		326.28	17.17
Somerset	24039	2,944	0.001599		32.39	1.70
Talbot	24041	14,621	0.007943		160.85	8.47
Washington	24043	42,376	0.023021		466.19	24.54
Wicomico	24045	28,706	0.015595		315.80	16.62
Worcester	24047	17,370	0.009436		191.09	10.06
Baltimore City	24510	247,596	0.134508		2,723.87	143.36

D. Emission Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42.[7] The emissions factors for ammonia are taken from a report from EPA on ammonia emissions in the ICI sectors.[8] SO2 emission factors are multiplied by the State Sulfur Content. In Maryland the distillate sulfur content for commercial/institutional combustion is 0.0015%.[9]

Emissions factors for criteria air pollutants from commercial/institutional distillate oil combustion are listed in Table 5 below.

Table 5: 2023 NEI VOC emissions factors for Commercial/Institutional Distillate Oil Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2103004001	Commercial/ Institutional Distillate Oil (Boilers)	CO	5	LB/E3GAL	7
		NOX	20	LB/E3GAL	
		PM10-PRI	2.38	LB/E3GAL	Sum of PM-FIL and PM-CON emission factors
		PM25-PRI	2.13	LB/E3GAL	
		SO2	2S	LB/E3GAL	7
		VOC	0.34	LB/E3GAL	
2103004002	Commercial/ Institutional Distillate Oil (Engines)	CO	130	LB/E3GAL	
		NOX	604	LB/E3GAL	
		PM10-PRI	43.5	LB/E3GAL	Sum of PM-FIL and PM-CON emission factors
		PM25-PRI	43.5	LB/E3GAL	
		SO2	39.8	LB/E3GAL	7
		VOC	42	LB/E3GAL	

E. Controls

Emissions from commercial/institutional distillate oil combustion are controlled through Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection.[10] COMAR 03.03.05.04 requires that after July 1, 2019, the amount of sulfur in fuel is not to exceed 0.0015 percent by mass.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 4)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 5 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from commercial/institutional distillate oil combustion occurs from both point and

nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate commercial/institutional distillate oil combustion point sources to estimate the amount of fuel consumption to subtract from the EIA Form 821 total. Facility level annual CO2 emissions are divided by an emission factor[11], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county *c* for source category *s*, in thousands of gallons per year

$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county *c* for source category *s*, in tons per year

$EF_{CO2,s}$ = CO_2 emissions factor for source category *s*

The point source consumption estimates for distillate oil combustion are outlined in Table 4 below.

Table 4: Point Source Consumption Adjustment for Commercial/Institutional Distillate Oil Combustion

FIPS State and County Code	County Name	County-Level Fuel Consumption for Boilers (Thousand Gallons)	County-Level Fuel Consumption for Engines (Thousand Gallons)	Point Source Commercial Distillate Fuel Consumption (Thousand Gallons)	County-Level Fuel Consumption for Boilers (Thousand Gallons)	County-Level Fuel Consumption for Engines (Thousand Gallons)
24001	Allegany	189.24	9.96	0.00	189.24	9.96
24003	Anne Arundel	2,031.51	106.92	1,126.03	961.78	50.62
24005	Baltimore	2,957.85	155.68	1,345.47	1,679.66	88.40
24009	Calvert	155.45	8.18	3.60	152.03	8.00
24011	Caroline	48.98	2.58	0.00	48.98	2.58
24013	Carroll	426.80	22.46	27.85	400.35	21.07
24015	Cecil	201.34	10.60	35.11	167.99	8.84
24017	Charles	293.99	15.47	277.14	30.70	1.62
24019	Dorchester	60.24	3.17	0.00	60.24	3.17
24021	Frederick	765.58	40.29	104.01	666.77	35.09
24023	Garrett	87.01	4.58	0.00	87.01	4.58
24025	Harford	633.35	33.33	1,174.90	0.00	0.00
24027	Howard	1,684.50	88.66	251.08	1,445.97	76.10
24029	Kent	51.87	2.73	0.00	51.87	2.73
24031	Montgomery	4,143.63	218.09	142.51	4,008.25	210.96

24033	Prince George's	2,204.34	116.02	236.28	1,979.88	104.20
24035	Queen Anne's	98.41	5.18	0.00	98.41	5.18
24037	St. Mary's	326.28	17.17	73.38	256.56	13.50
24039	Somerset	32.39	1.70	6.79	25.94	1.37
24041	Talbot	160.85	8.47	12.43	149.04	7.84
24043	Washington	466.19	24.54	5.98	460.50	24.24
24045	Wicomico	315.80	16.62	89.25	231.01	12.16
24047	Worcester	191.09	10.06	0.00	191.09	10.06
24510	Baltimore City	2,723.87	143.36	86.48	2,641.71	139.04

H. Sample Calculations

Sample calculations for VOC emissions from commercial/institutional distillate oil combustion in Anne Arundel County, Maryland are included in the table below.

Table 6. Sample Calculations of VOC Emissions for Commercial/Institutional Distillate Oil Boiler Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(961.78\ E3GAL \times 0.34\ lb/E3GAL)/2000$	0.164 tons of VOC in 2023

I. References

[1] Energy Information Administration. Form 821: Distillate Fuel Oil and Kerosene Sales by End Use, 2020. https://www.eia.gov/dnav/pet/pet_cons_821use_dcu_SMD_a.htm

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[4] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx

[5] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[6] Energy Information Administration. 2015. Commercial Building Energy Consumption Survey, 2012 data. https://www.eia.gov/consumption/commercial/

[7] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[8] R. Battye, W. Battye, C. Overcash, and S. Fudge. 1994. Development and Selection of Ammonia Emission Factors: Final Report. Durham, NC: EC/R Incorporated. Prepared for USEPA Office of Research and Development.

[9] U.S. Environmental Protection Agency. Wagon Wheel 2020 v7.1 Final - EPA Defaults – ICI Module: Sulfur and Ash Content of Fuels Table.

[10] Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection. https://dsd.maryland.gov/Pages/COMARSearch.aspx

[11] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 2 Emissions Factors for Distillate Oil Combustion from Boilers and Engines in the Commercial and Institutional Sectors. SO2 emission factors are multiplied by the State Sulfur Content. In Maryland the distillate sulfur content for commercial/institutional combustion is 0.0015%.

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103004001	50000	Formaldehyde	0.048	LB	E3GAL	7; Table 1.3-8
2103004001	71432	Benzene	2.14E-04	LB	E3GAL	7; Table 1.3-9
2103004001	206440	Fluoranthene	4.84E-06	LB	E3GAL	7; Table 1.3-9
2103004001	7439921	Lead	0.00123	LB	E3GAL	7; Table 1.3-10
2103004001	CO	Carbon Monoxide	5	LB	E3GAL	7; Table 1.3-1
2103004001	NH3	Ammonia	0.8	LB	E3GAL	8
2103004001	NOX	Nitrogen Oxides	20	LB	E3GAL	7; Table 1.3-1
2103004001	PM10-FIL	PM10 Filterable	1.08	LB	E3GAL	7; Table 1.3-4 *Note the EPA factor of 1 lb/e3gal, when added to condensable 1.3lb/e3gal did not equal 2.38 lb/e3gal. MDE modified to 1.08 lb/e3gal
2103004001	PM10-PRI	PM10 Primary (Filt + Cond)	2.38	LB	E3GAL	Sum of PM10-FIL and PM-CON emission factors
2103004001	PM25-FIL	PM2.5 Filterable	0.83	LB	E3GAL	Sum of PM25-FIL and PM-CON emission factors *Note the EPA factor of 0.25 lb/e3gal, when added to condensable 1.3lb/e3gal did not equal 2.13 lb/e3gal. MDE modified to 0.83 lb/e3gal
2103004001	PM25-PRI	PM2.5 Primary (Filt + Cond)	2.13	LB	E3GAL	Sum of PM25-FIL and PM-CON emission factors
2103004001	PM-CON	PM Condensible	1.3	LB	E3GAL	7; Table 1.3-2
2103004001	SO2	Sulfur Dioxide	2S	LB	E3GAL	7; Table 1.3-1
2103004001	VOC	Volatile Organic Compounds	0.34	LB	E3GAL	7; Table 1.3-2
2103004002	50000	Formaldehyde	0.16166	LB	E3GAL	7; Table 3.3-2
2103004002	50328	Benzo[a]Pyrene	0.000025756	LB	E3GAL	7; Table 3.3-2
2103004002	53703	Dibenzo[a,h]Anthracene	0.000079871	LB	E3GAL	7; Table 3.3-2
2103004002	56553	Benz[a]Anthracene	0.00023016	LB	E3GAL	7; Table 3.3-2
2103004002	71432	Benzene	0.127821	LB	E3GAL	7; Table 3.3-2
2103004002	75070	Acetaldehyde	0.105079	LB	E3GAL	7; Table 3.3-2
2103004002	83329	Acenaphthene	0.00019454	LB	E3GAL	7; Table 3.3-2
2103004002	85018	Phenanthrene	0.0040278	LB	E3GAL	7; Table 3.3-2
2103004002	86737	Fluorene	0.0040004	LB	E3GAL	7; Table 3.3-2

2103004002	91203	Naphthalene	0.0116176	LB	E3GAL	7; Table 3.3-2
2103004002	106990	1,3-Butadiene	0.0053567	LB	E3GAL	7; Table 3.3-2
2103004002	107028	Acrolein	0.0126725	LB	E3GAL	7; Table 3.3-2
2103004002	108883	Toluene	0.056033	LB	E3GAL	7; Table 3.3-2
2103004002	120127	Anthracene	0.00025619	LB	E3GAL	7; Table 3.3-2
2103004002	129000	Pyrene	0.00065486	LB	E3GAL	7; Table 3.3-2
2103004002	191242	Benzo[g,h,i,]Perylene	0.000066993	LB	E3GAL	7; Table 3.3-2
2103004002	193395	Indeno[1,2,3-c,d]Pyrene	0.000051375	LB	E3GAL	7; Table 3.3-2
2103004002	205992	Benzo[b]Fluoranthene	1.36E-05	LB	E3GAL	7; Table 3.3-2
2103004002	206440	Fluoranthene	0.00104257	LB	E3GAL	7; Table 3.3-2
2103004002	207089	Benzo[k]Fluoranthene	0.000021235	LB	E3GAL	7; Table 3.3-2
2103004002	208968	Acenaphthylene	0.00069322	LB	E3GAL	7; Table 3.3-2
2103004002	218019	Chrysene	0.000048361	LB	E3GAL	7; Table 3.3-2
2103004002	1330207	Xylenes (Mixed Isomers)	0.039045	LB	E3GAL	7; Table 3.3-2
2103004002	CO	Carbon Monoxide	130	LB	E3GAL	7; Table 3.3-1
2103004002	NH3	Ammonia	0.8	LB	E3GAL	8
2103004002	NOX	Nitrogen Oxides	604	LB	E3GAL	7; Table 3.3-1
2103004002	PM10-FIL	PM10 Filterable	42.5	LB	E3GAL	7; Table 3.3-1
2103004002	PM10-PRI	PM10 Primary (Filt + Cond)	43.5	LB	E3GAL	Sum of PM10-FIL and PM-CON
2103004002	PM25-FIL	PM2.5 Filterable	42.5	LB	E3GAL	7; Table 3.3-1
2103004002	PM25-PRI	PM2.5 Primary (Filt + Cond)	43.5	LB	E3GAL	Sum of PM25-FIL and PM-CON
2103004002	PM-CON	PM Condensible	1	LB	E3GAL	Determined used PM Augmentation Tool
2103004002	SO2	Sulfur Dioxide	39.8	LB	E3GAL	7; Table 3.3-1
2103004002	VOC	Volatile Organic Compounds	42	LB	E3GAL	7; Table 3.3-1
2103004001	7440382	Arsenic	0.00132	LB	E3GAL	7
2103004001	7440417	Beryllium	0.0000278	LB	E3GAL	7
2103004001	7440439	Cadmium	0.000398	LB	E3GAL	7
2103004001	16065831	Chromium III	0.000693	LB	E3GAL	7
2103004001	7439965	Manganese	0.003	LB	E3GAL	7
2103004001	7439976	Mercury	0.000113	LB	E3GAL	7
2103004001	7440020	Nickel	0.0845	LB	E3GAL	7
2103004001	7782492	Selenium	0.000683	LB	E3GAL	7
2103004001	18540299	Chromium (VI)	0.000152	LB	E3GAL	7

INDUSTRIAL DISTILLATE OIL COMBUSTION

A. Source Category Description

Industrial fuel consumption includes emissions from boilers, engines, and other combustion sources from the industrial sector that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Distillate Oil Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2102004001	Stationary Source Fuel Combustion	Industrial	Distillate Oil	Boilers
2102004002	Stationary Source Fuel Combustion	Industrial	Distillate Oil	IC Engine

B. Overview of Calculations

Industrial Distillate Oil combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from Energy Information Administration (EIA) Form 821,[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Distillate fuel consumption is taken from EIA's Form 821 data, which reports distillate sales by state and sector, and oil type. The most recent EIA Form 821 data year is 2020. The 821 fuel consumption data is scaled to a more recent year, in this case 2022, using EIA SEDS.[3] MDE adjusts EIA Form 821 2020 data using a growth rate calculated based on EIA SEDS 2020-2022 data to estimate activity data for 2022.

$$F_{f,x,2022} = F_{f,x,2020} \times (1 + G_b)$$

Where:

$F_{f,x,2022}$ = Form 821 consumption of fuel *f* in sector *x* "grown" to 2022
$F_{f,x,2020}$ = Form 821 consumption of fuel *f* in sector *x* in 2020
G_b = (2022 SEDS consumption – 2020 SEDS consumption) / 2020 SEDS consumption

Table 2: 2020 EIA Form 821 Industrial Consumption Grown to 2022 Using Growth Rates Based on EIA SEDS DFCCP Consumption

SEDS Industrial Sector Energy Consumption Estimates, Maryland				
State	**MSN**	**2020**	**2022**	**Unit**
MD	DFICP	937	1,041	Thousand Barrels
SEDS Growth Rate			11.10%	
EIA 821 Industrial Sector Energy Consumption Estimates, Maryland				
Product 2020		**2020**	**2020 Grown to 2022**	**Unit**
No. 1 Distillate		0	0	Thousand Gallons
No. 2 Fuel Oil		233	259	
No. 2 Low Sulfur Diesel		5,441	6,045	
No. 2 High Sulfur Diesel		0	0	
No. 4 Distillate		0	0	

Total	5,674	6,304	

The EIA Form 821 distillate oil consumption data include consumption estimates for equipment that are typically included in the nonroad inventory (ex. farming, logging, mining and construction equipment fuel use). To avoid double-counting distillate oil consumption, total fuel consumption is adjusted to account for the fraction of fuel consumed by nonroad mobile sources. This fraction is based on results from the National Mobile Inventory Model (NMIM), a precursor to EPA's Motor Vehicle Emission Simulator (MOVES). Per EPA, for industrial distillate oil combustion, 40% of No.1 distillate fuel consumption, 0% of No.2 fuel oil consumption, 85% of No.2 low sulfur distillate consumption, and 0% of No.4 distillate consumption is assumed to be from nonroad off-highway sources.[4] County level consumption is estimated using the following equation:

$$F_{f,c,x} = F_{f,x} \times (1 - SS_{f,x})$$

Where:

$F_{f,c,x}$ = Consumption of fuel *f* in county *c* in sector *x*
$F_{f,x}$ = Consumption of fuel *f* in sector *x*
$SS_{f,x}$ = Fraction of fuel *f* consumed by nonroad sources in sector *x*

Table 3: 2020 EIA Form 821 Commercial Consumption Grown to 2022 & Adjusted for Nonroad Fuel Consumption

Product 2020	2020 Grown to 2022 (Thousand Gallons)	NMIM Adjustment Factor (%)	2020 Grown to 2022 & Adjusted for Nonroad Consumption (Thousand Gallons)	Total Nonpoint Distillate Consumption (Thousand Gallons)
No.1 Distillate	0	40%	0	1,165
No. 2 Fuel Oil	259	0%	259	
No.2 Low Sulfur Diesel	6,045	85%	907	
No. 4 Distillate	0	0%	0	

The EIA Form 821 data report total distillate consumption, but the NEI requires emissions separately for boilers and engines, because there are substantially different emissions factors for distillate boilers and engines. MDE assumes that 60% of commercial distillate consumption is attributable to boilers and 40% is of consumption is attributable to engines. This is based on the EIA MECS and the EIA Commercial Building Energy Consumption Survey (CBECS).[5, 6]

$$AF_{boiler/engine,x} = AF_{distillate,x} \times R_{boiler/engine,x}$$

Where:

$AF_{boiler/engine,x}$ = Adjusted distillate consumption in boilers or engines in sector *x*
$AF_{distillate,x}$ = Total adjusted distillate consumption in sector *x*
$R_{boiler/engine,x}$ = Ratio of distillate consumption by boilers or engines in sector *x*

The total fuel consumption is also adjusted to account for fuel used as an input to industrial processes where it is not combusted. Maryland assumes that 11.10% of industrial distillate throughput is not combusted. This assumption is based on the EIA Manufacturing Energy Consumption Survey (MECS)[7], which reports both total fuel consumption and non-combustion use of fuel by Census region.

Finally, the EIA Form 821 adjusted fuel consumption is allocated to the counties using county-level employment data from the U.S. Census Bureau. County Business Pattern NAICS codes 11--, 21--, 23--, 31--, 32-- and 33-- are used to apportion state-fuel to the county level based on the proportion of employment in the industrial sector to the total industrial sector state employment.

$$F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x} \times (1 - nc_{f,industrial})$$

Where:

$F_{f,c,x}$ = Consumption of fuel *f* in county *c* in sector *x*
$F_{f,x}$ = Consumption of fuel *f* in sector *x*
$a_{c,x}$ = Employment in county *c* in sector *x*
a_x = Employment in sector *x*
$nc_{f,x}$ = Fraction of fuel f used as an industrial input and is not combusted in the industrial sector

The NEI uses 2022 grown adjusted EIA Form 821 fuel consumption and 2021 employment to estimate county-level fuel consumption for distillate oil industrial fuel combustion, as shown in Table 4.

Table 4: 2023 NEI County Level Fuel Consumption for Industrial Distillate Oil Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIA Form 821 Grown to 2022 & Adjusted for Nonroad Fuel Consumption	Non-Fuel Reduction	County-Level Fuel Consumption for Boilers (Thousand Gallons)	County-Level Fuel Consumption for Engines (Thousand Gallons)
Allegany	24001	2,886	0.011073	1,165.60	11.10%	6.88	4.59
Anne Arundel	24003	33,165	0.127247			79.11	52.74
Baltimore	24005	38,098	0.146174			90.88	60.59
Calvert	24009	2,579	0.009895			6.15	4.10
Caroline	24011	1,819	0.006979			4.34	2.89
Carroll	24013	9,303	0.035694			22.19	14.79
Cecil	24015	5,909	0.022672			14.10	9.40
Charles	24017	3,827	0.014683			9.13	6.09
Dorchester	24019	3,532	0.013552			8.43	5.62
Frederick	24021	16,507	0.063334			39.38	26.25
Garrett	24023	1,812	0.006952			4.32	2.88
Harford	24025	10,313	0.039569			24.60	16.40
Howard	24027	17,254	0.0662			41.16	27.44
Kent	24029	1,161	0.004455			2.77	1.85
Montgomery	24031	32,072	0.123054			76.51	51.00
Prince Georges	24033	39,127	0.150122			93.34	62.22
Queen Annes	24035	2,788	0.010697			6.65	4.43
Saint Mary's	24037	2,271	0.008713			5.42	3.61
Somerset	24039	688	0.00264			1.64	1.09
Talbot	24041	1,673	0.006419			3.99	2.66
Washington	24043	9,108	0.034946			21.73	14.48
Wicomico	24045	3,923	0.015052			9.36	6.24

Worcester	24047	1,642	0.0063			3.92	2.61
Baltimore City	24510	19,177	0.073578			45.75	30.50

D. Emission Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42.[8] The emissions factors for ammonia are taken from a report from EPA on ammonia emissions in the ICI sectors.[9] SO2 emission factors are multiplied by the State Sulfur Content. In Maryland the distillate sulfur content for industrial combustion is 0.0015%.[10]

Emissions factors for criteria air pollutants from industrial distillate oil combustion are listed in Table 5 below.

Table 5: 2023 NEI VOC emissions factors for Commercial/Institutional Distillate Oil Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2102004001	Industrial Distillate Oil (Boilers)	CO	5	LB/E3GAL	8
		NOX	20	LB/E3GAL	
		PM10-PRI	5.9A + 1.3	LB/E3GAL	
		PM25-PRI	4.3A + 1.3	LB/E3GAL	
		SO2	142S	LB/E3GAL	
		VOC	0.2	LB/E3GAL	
2102004002	Industrial Distillate Oil (Engines)	CO	130	LB/E3GAL	
		NOX	604	LB/E3GAL	
		PM10-PRI	43.5	LB/E3GAL	Sum of PM-FIL and PM-CON emission factors
		PM25-PRI	40.85	LB/E3GAL	
		SO2	39.8	LB/E3GAL	8
		VOC	42	LB/E3GAL	

MDE utilized EPA's ICI Nonpoint Emissions Methodology and Operation (NEMO) document as a starting point for reviewing emission factors.[11] MDE believes that there may be an error in the particulate matter emission factors for distillate boilers, in that the formula depends on the ash content of the fuel; there is no ash in distillate oil. In this case, MDE accepted the emission factor from EPA's Wagon Wheel[12] output, thus setting PM2.5-PRI to 1.55 lb/thousand gallons, PM2.5-FIL to 0.25 lbs/thousand gallons, PM10-PRI to 2.3 lb/thousand gallons and PM10-FIL to 1 lb/gal.

E. Controls

Emissions from industrial distillate oil combustion are controlled through Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection.[13] COMAR 03.03.05.04 requires that after July 1, 2019, the amount of sulfur in fuel is not to exceed 0.0015 percent by mass.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel

consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 4)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 5 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from industrial distillate oil combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate industrial distillate oil combustion point sources to estimate the amount of fuel consumption to subtract from the EIA Form 821 total. Facility level annual CO2 emissions are divided by an emission factor[14], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county c for source category s, in thousands of gallons per year
$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county c for source category s, in tons per year
$EF_{CO2,s}$ = CO_2 emissions factor for source category s

The point source consumption estimates for distillate oil combustion are outlined in Table 4 below.

Table 4: Point Source Consumption Adjustment for Industrial Distillate Oil Combustion

FIPS State and County Code	County Name	County-Level Fuel Consumption for Boilers (Thousand Gallons)	County-Level Fuel Consumption for Engines (Thousand Gallons)	Point Source Industrial Distillate Fuel Consumption (Thousand Gallons)	County-Level Fuel Consumption for Boilers (Thousand Gallons)	County-Level Fuel Consumption for Engines (Thousand Gallons)
24001	Allegany	6.88	4.59	0.00	6.88	4.59
24003	Anne Arundel	79.11	52.74	106.14	15.43	10.29
24005	Baltimore	90.88	60.59	6.34	87.08	58.05
24009	Calvert	6.15	4.10	0.00	6.15	4.10
24011	Caroline	4.34	2.89	0.00	4.34	2.89

24013	Carroll	22.19	14.79	80.95	0.00	0.00
24015	Cecil	14.10	9.40	57.98	0.00	0.00
24017	Charles	9.13	6.09	1.30	8.35	5.57
24019	Dorchester	8.43	5.62	0.00	8.43	5.62
24021	Frederick	39.38	26.25	50.54	9.05	6.03
24023	Garrett	4.32	2.88	0.00	4.32	2.88
24025	Harford	24.60	16.40	47.08	0.00	0.00
24027	Howard	41.16	27.44	53.69	8.94	5.96
24029	Kent	2.77	1.85	0.00	2.77	1.85
24031	Montgomery	76.51	51.00	16.42	66.65	44.44
24033	Prince George's	93.34	62.22	25.36	78.12	52.08
24035	Queen Anne's	6.65	4.43	0.00	6.65	4.43
24037	St. Mary's	5.42	3.61	0.00	5.42	3.61
24039	Somerset	1.64	1.09	161.13	0.00	0.00
24041	Talbot	3.99	2.66	0.00	3.99	2.66
24043	Washington	21.73	14.48	0.00	21.73	14.48
24045	Wicomico	9.36	6.24	9.22	3.83	2.55
24047	Worcester	3.92	2.61	0.50	3.62	2.41
24510	Baltimore City	45.75	30.50	508.53	0.00	0.00

H. Sample Calculations

Sample calculations for VOC emissions from industrial distillate oil boiler combustion in Anne Arundel County, Maryland are included in the table below.

Table 6. Sample Calculations of VOC Emissions for Industrial Distillate Oil Boiler Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x}} = \boldsymbol{NPF_{f,c,x}} \times \boldsymbol{EF_{p,f,x}}$	$(15.43\ E3GAL \times 0.2\ lb/E3GAL)/2000$	0.00154 tons of VOC in 2023

I. References

[1] Energy Information Administration. Form 821: Distillate Fuel Oil and Kerosene Sales by End Use, 2020. https://www.eia.gov/dnav/pet/pet_cons_821use_dcu_SMD_a.htm

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[4] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx

[5] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[6] Energy Information Administration. 2015. Commercial Building Energy Consumption Survey, 2012 data. https://www.eia.gov/consumption/commercial/

[7] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[8] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[9] R. Battye, W. Battye, C. Overcash, and S. Fudge. 1994. Development and Selection of Ammonia Emission Factors: Final Report. Durham, NC: EC/R Incorporated. Prepared for USEPA Office of Research and Development.

[10] U.S. Environmental Protection Agency. Wagon Wheel 2020 v7.1 Final - EPA Defaults – ICI Module: Sulfur and Ash Content of Fuels Table.

[11] U.S. Environmental Protection Agency: *Industrial, Commercial, And Institutional Fuel Consumption Nonpoint Emissions Methodology and Operator* (NEMO). ICI NEMO.docx

[12] U.S. Environmental Protection Agency. Wagon Wheel 2020 v7.1 Final – SLT Input. Retrieved November 20, 2024. https://usepa.sharepoint.com/sites/NOMAD/Shared%20Documents/Forms/AllItems.aspx?csf=1&web=1&e=kyXPeE&sw=auth&CID=bb460a9b%2Dba4f%2D44fb%2D9d2a%2D29d02713cf31&FolderCTID=0x0120001B39A7DC83F463488F2958294EC6BC32&id=%2Fsites%2FNOMAD%2FShared%20Documents%2FWagon%20Wheel%2FWagon%20Wheel%202020%20v7%2E1%20Final&viewid=6f420189%2D05de%2D4f68%2Daebe%2D02cbe175fbb3.

[13] Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection. https://dsd.maryland.gov/Pages/COMARSearch.aspx

[14] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1. Emissions Factors for Distillate Oil Combustion from Boilers and Engines in the Industrial Sector. SO2 emission factors are multiplied by the State Sulfur Content. In Maryland the distillate sulfur content for industrial combustion is 0.0015%.

MDE utilized EPA's ICI Nonpoint Emissions Methodology and Operation (NEMO) document as a starting point for reviewing emission factors.11 MDE believes that there may be an error in the particulate matter emission factors for distillate boilers, in that the formula depends on the ash content of the fuel; there is no ash in distillate oil. In this case, MDE accepted the emission factor from EPA's Wagon Wheel12 output, thus setting PM2.5-PRI to 1.55 lb/thousand gallons, PM2.5-FIL to 0.25 lbs/thousand gallons, PM10-PRI to 2.3 lb/thousand gallons and PM10-FIL to 1 lb/gal

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2.102 E+09	50000	Formaldehyde	1.18E-03	LB	MMBTU	0.16166	LB	E3GAL	7; Table 3.3-2
2.102 E+09	50328	Benzo[a]Pyrene	1.88E-07	LB	MMBTU	2.576E-05	LB	E3GAL	7; Table 3.3-2
2.102 E+09	53703	Dibenzo[a,h]Anthracene	5.83E-07	LB	MMBTU	7.987E-05	LB	E3GAL	7; Table 3.3-2
2.102 E+09	56553	Benz[a]Anthracene	1.68E-06	LB	MMBTU	0.0002302	LB	E3GAL	7; Table 3.3-2
2.102 E+09	71432	Benzene	9.33E-04	LB	MMBTU	0.127821	LB	E3GAL	7; Table 3.3-2
2.102 E+09	75070	Acetaldehyde	7.67E-04	LB	MMBTU	0.105079	LB	E3GAL	7; Table 3.3-2
2.102 E+09	83329	Acenaphthene	5.06E-06	LB	MMBTU	0.0001945	LB	E3GAL	7; Table 3.3-2
2.102 E+09	85018	Phenanthrene	2.94E-05	LB	MMBTU	0.0040278	LB	E3GAL	7; Table 3.3-2
2.102 E+09	86737	Fluorene	2.92E-05	LB	MMBTU	0.0040004	LB	E3GAL	7; Table 3.3-2
2.102 E+09	91203	Naphthalene	8.48E-05	LB	MMBTU	0.0116176	LB	E3GAL	7; Table 3.3-2
2.102 E+09	106990	1,3-Butadiene	3.91E-05	LB	MMBTU	0.0053567	LB	E3GAL	7; Table 3.3-2
2.102 E+09	107028	Acrolein	9.25E-05	LB	MMBTU	0.0126725	LB	E3GAL	7; Table 3.3-2
2.102 E+09	108883	Toluene	4.09E-04	LB	MMBTU	0.056033	LB	E3GAL	7; Table 3.3-2
2.102 E+09	120127	Anthracene	1.87E-06	LB	MMBTU	0.0002562	LB	E3GAL	7; Table 3.3-2
2.102 E+09	129000	Pyrene	4.78E-06	LB	MMBTU	0.0006549	LB	E3GAL	7; Table 3.3-2
2.102 E+09	191242	Benzo[g,h,i,]Perylene	4.89E-07	LB	MMBTU	6.699E-05	LB	E3GAL	7; Table 3.3-2

2.102 E+09	193395	Indeno[1,2,3-c,d]Pyrene	3.75E-07	LB	MMBTU	5.138E-05	LB	E3GAL	7; Table 3.3-2
2.102 E+09	205992	Benzo[b]Fluoranthene	9.91E-08	LB	MMBTU	1.36E-05	LB	E3GAL	7; Table 3.3-2
2.102 E+09	206440	Fluoranthene	7.61E-06	LB	MMBTU	0.0010426	LB	E3GAL	7; Table 3.3-2
2.102 E+09	207089	Benzo[k]Fluoranthene	1.55E-07	LB	MMBTU	2.124E-05	LB	E3GAL	7; Table 3.3-2
2.102 E+09	208968	Acenaphthylene	5.06E-06	LB	MMBTU	0.0006932	LB	E3GAL	7; Table 3.3-2
2.102 E+09	218019	Chrysene	3.53E-07	LB	MMBTU	4.836E-05	LB	E3GAL	7; Table 3.3-2
2.102 E+09	1330207	Xylenes (Mixed Isomers)	2.85E-04	LB	MMBTU	0.039045	LB	E3GAL	7; Table 3.3-2
2.102 E+09	CO	Carbon Monoxide	0.95	LB	MMBTU	130	LB	E3GAL	7; Table 3.3-1
2.102 E+09	NH3	Ammonia				0.8	LB	E3GAL	9
2.102 E+09	NOX	Nitrogen Oxides	4.41	LB	MMBTU	604	LB	E3GAL	7; Table 3.3-1
2.102 E+09	PM10-FIL	PM10 Filterable	0.31	LB	MMBTU	42.5	LB	E3GAL	7; Table 3.3-1
2.102 E+09	PM10-PRI	PM10 Primary (Filt + Cond)				43.5	LB	E3GAL	Sum of PM10-FIL and PM-CON
2.102 E+09	PM25-FIL	PM2.5 Filterable				39.8	LB	E3GAL	Determined used PM Augmentation Tool
2.102 E+09	PM25-PRI	PM2.5 Primary (Filt + Cond)				40.8	LB	E3GAL	Sum of PM25-FIL and PM-CON
2.102 E+09	PM-CON	PM Condensible				1	LB	E3GAL	Determined used PM Augmentation Tool
2.102 E+09	SO2	Sulfur Dioxide	0.29	LB	MMBTU	39.8	LB	E3GAL	7; Table 3.3-1
2.102 E+09	VOC	Volatile Organic Compounds	0.36	LB	MMBTU	42	LB	E3GAL	7; Table 3.3-1

RESIDENTIAL DISTILLATE COMBUSTION

A. Source Category Description

Residential fuel combustion includes the combustion of fuel, including coal, distillate oil, kerosene, natural gas, and liquefied propane gas (LPG) to heat homes. Common uses of energy associated with this category include space heating, water heating, and cooking.

Table 1. 2023 NEI Residential Distillate Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2104004000	Stationary Source Fuel Combustion	Residential	Distillate	Total: All Boiler Types

B. Overview of Calculations

Residential Distillate Combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] House Heating Fuel Data from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and 5-year county-level House Heating Fuel Data from the U.S. Census' American Community Survey.[2] County-level estimates of the number of houses that heat with distillate are used to apportion state-level fuel consumption.

For most fuels, the fuel type in SEDS matches well to the fuel type used in the Census data. However, the Census data reports only for total fuel oil, which does not distinguish between distillate fuel oil and kerosene. Therefore, the ratio of distillate fuel oil versus kerosene in the heating fuel oil mix, is used to determine the fraction of homes in each county that use distillate fuel oil.

$$R_{dfo} = \frac{FC_{dfo}}{FC_{dfo} + FC_{ker}}$$

Where:

R_{dfo} = ratio of residential distillate fuel oil to total distillate fuel oil and kerosene
FC_{dfo} = fuel consumption of distillate fuel oil from SEDS, in thousand barrels
FC_{ker} = fuel consumption of kerosene from SEDS, in thousand barrels

Then, the ratio of distillate fuel oil to total fuel oil is used to determine how many housing units in each county use distillate fuel oil or kerosene.

$$HU_{dfo,c} = HU_{fo,c} \times R_{dfo}$$

Where:

$HU_{dfo,c}$ = housing units in county c using distillate fuel oil as the primary heating fuel

$HU_{fo,c}$ = housing units in county *c* using any fuel oil as primary heating fuel
R_{dfo} = ratio of residential distillate fuel oil to total distillate fuel oil and kerosene

To distribute the state-level energy consumption data for residential distillate fuel oil, the ratio of county-level housing units using distillate fuel oil as primary heating fuel to state-level housing units distillate fuel oil is calculated. This ratio is used to distribute state-level fuel consumption to the county level.

$$R_{f,c} = \frac{HU_{dfo,c}}{HU_{dfo,s}}$$

Where:

$R_{dfo,c}$ = ratio of homes in county *c* to homes in state *s* that use distillate fuel oil as primary heating fuel
$HU_{dfo,c}$ = housing units in county *c* using distillate fuel oil as the primary heating fuel
$HU_{dfo,s}$ = housing units in state *s* using distillate fuel oil as primary heating fuel

The state-level fuel consumption of residential distillate fuel oil from SEDS is multiplied by the county-level ratio of homes using each fuel type. The 2023 NEI uses 2022 SEDS fuel consumption and 2022 adjusted county-level home heating fuel data to estimate county-level fuel consumption for residential distillate fuel combustion, as shown in Table 2

Table 2: 2023 NEI County Level Fuel Consumption for Residential Distillate Combustion

Ratio of Distillate vs. Distillate + Kerosene Fuel Consumption from SEDS						
Distillate Residential Fuel Consumption (Thousand Barrels)						2,530
Kerosene Residential Fuel Consumption (Thousand Barrels						28
Ratio of Distillate vs. Distillate & Kerosene Fuel Consumption						99%
County Name	**State County FIPs**	**Housing Units Using Fuel oil, kerosene, etc.as Primary Heating Fuel**	**Ratio of Residential Distillate Fuel to Total Distillate Fuel Oil and Kerosene**	**Housing Units Using Distillate Fuel Oil as the Primary Heating Fuel**	**Ratio of County Homes Using Distillate as primary Heating Fuel**	**Residential Distillate Consumption (Thousand Gallons)**
Allegany	24001	2,839		2,808	2%	1,768.93
Anne Arundel	24003	19,637		19,422	12%	12,235.49
Baltimore	24005	24,847		24,575	15%	15,481.75
Calvert	24009	3,434		3,396	2%	2,139.67
Caroline	24011	1,985		1,963	1%	1,236.82
Carroll	24013	12,119		11,986	7%	7,551.15
Cecil	24015	7,720	99%	7,635	5%	4,810.20
Charles	24017	7,651		7,567	4%	4,767.21
Dorchester	24019	2,225		2,201	1%	1,386.36
Frederick	24021	10,229		10,117	6%	6,373.52
Garrett	24023	3,125		3,091	2%	1,947.14
Harford	24025	10,735		10,617	6%	6,688.80
Howard	24027	5,450		5,390	3%	3,395.80

Kent	24029	1,298		1,284	1%	808.76
Montgomery	24031	10,338		10,225	6%	6,441.43
Prince Georges	24033	11,053		10,932	6%	6,886.94
Queen Annes	24035	2,487		2,460	1%	1,549.61
Saint Mary's	24037	1,057		6,900	4%	4,346.63
Somerset	24039	6,976		1,045	1%	658.60
Talbot	24041	1,600		1,582	1%	996.93
Washington	24043	10,686		10,569	6%	6,658.27
Wicomico	24045	3,364		3,327	2%	2,096.05
Baltimore City	24510	1,495		1,479	1%	931.51
State Total		170,529	N/A	168,672	100%	106,260

D. Emissions Factors

The emissions factors for residential fuel combustion criteria air pollutants, except ammonia, are from AP-42.[3], The ammonia emissions factor is from EPA's Estimating Ammonia Emissions from Anthropogenic Sources.[4] In some cases HAP emissions factors are from a memorandum to EPA called "Baseline Emission Inventory of HAP Emissions from MACT Sources – Interim Final Report".[5] SO2 Emission Factors are multiplied by the State Sulfur Content.[6]

Criteria air pollutant emission factors for residential fuel combustion are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Residential Distillate Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2104004000	Residential Distillate	CO	5	LB/E3GAL	[3]
		NOX	18		
		PM10-PRI	2.38		
		PM25-PRI	2.13		
		SO2	142S		
		VOC	0.713		

E. Controls

Emissions from residential distillate oil combustion are controlled through Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection.[6] 10 COMAR 03.03.05.04 requires that after July 1, 2019, the amount of sulfur in fuel is not to exceed 0.0015 percent by mass.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x

$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type *f* in county *c* in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant *p,* fuel type *f*, and sector *x* (Table 3 & Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for emissions from residential distillate combustion; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from residential distillate combustion in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC Emissions for Residential Distillate Combustion in Anne Arundel County.

Equation	Values for Anne Arundel County	Result
$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(12{,}235.49\ E3GAL \times 0.713\ lbs/E3GAL)/2000$	4.36 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. American Community Survey (ACS) Data Product B25040. House Heating Fuel Data (2022, 5-Year Estimate). https://data.census.gov/all?q=b25040

[3] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[4] U.S. Environmental Protection Agency. 2004. Emission Inventory Improvement Program. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report. Prepared by E.H. Pechan and Associates, Inc. Research Triangle Park, NC. https://www.epa.gov/sites/production/files/2015-08/documents/eiip_areasourcesnh3.pdf

[5] Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. Environmental Protection Agency/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources – Interim Final Report," September 18, 1998. November 13, 1998.

[6] Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection. https://dsd.maryland.gov/Pages/COMARSearch.aspx

APPENDIX

Table 1 Emissions factors for Distillate Combustion in the Residential Sector. Distillate Fuel Oil in Maryland is not to exceed 0.0015 percent Sulfur by mass.

SCC	Pollutant Code	Name	Original Factor Numeric Value	MDE Derived Formula	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference (Source; Table)
2104004000	CO	CARBON MONOXIDE	5		5	LB	E3GAL	3; 1.3-1
2104004000	NOX	NITROGEN OXIDES	18		18	LB	E3GAL	3; 1.3-1
2104004000	PM-CON	PRIMARY PM CONDENSIBLE	1.3		1.3	LB	E3GAL	3; 1.3-2
2104004000	PM10-PRI	PRIMARY PM10	2.38		2.38	LB	E3GAL	PM10 Filt + PM Cond
2104004000	PM10-FIL	PRIMARY PM10, FILTERABLE	1.08		1.08	LB	E3GAL	3; 1.3-7
2104004000	PM25-PRI	PRIMARY PM2.5	2.13		2.13	LB	E3GAL	PM25 Filt + PM Cond
2104004000	PM25-FIL	PRIMARY PM2.5, FILTERABLE	0.83		0.83	LB	E3GAL	3; 1.3-7
2104004000	SO2	SULFUR DIOXIDE	7.1 (500 ppm or 0.05% Sulfur assumed by EPA)	142S, where S is % Sulfur by mass	0.00213 (0.0015% Sulfur assumed by MDE)	LB	E3GAL	3; 1.3-1
2104004000	VOC	VOLATILE ORGANIC COMPOUNDS	0.713		0.713	LB	E3GAL	3; 1.3-3
2104004000	83329	ACENAPHTHENE	0.0000211		0.0000211	LB	E3GAL	3; 1.3-9
2104004000	208968	ACENAPHTHYLENE	0.000000253		0.000000253	LB	E3GAL	3; 1.3-9
2104004000	75070	ACETALDEHYDE	0.00492		0.00492	LB	E3GAL	5
2104004000	NH3	AMMONIA	1		1	LB	E3GAL	4; III-1
2104004000	120127	ANTHRACENE	0.00000122		0.00000122	LB	E3GAL	3; 1.3-9
2104004000	7440382	ARSENIC	0.000562		0.000562	LB	E3GAL	5
2104004000	56553	BENZ[A]ANTHRACENE	0.00000401		0.00000401	LB	E3GAL	3; 1.3-9
2104004000	71432	BENZENE	0.000214		0.000214	LB	E3GAL	3; 1.3-9
2104004000	191242	BENZO[G,H,I,]PERYLENE	0.00000226		0.00000226	LB	E3GAL	3; 1.3-9
2104004000	7440417	BERYLLIUM	0.0004214		0.0004214	LB	E3GAL	5
2104004000	7440439	CADMIUM	0.0004214		0.0004214	LB	E3GAL	5
2104004000	18540299	Chromium (VI)	0.000075854		0.000075854	LB	E3GAL	EPA HAP Augmentation Tool
2104004000	16065831	Chromium III	0.000346		0.000346	LB	E3GAL	EPA HAP Augmentation Tool
2104004000	218019	CHRYSENE	0.00000238		0.00000238	LB	E3GAL	3; 1.3-9
2104004000	53703	DIBENZO[A,H]ANTHRACENE	0.00000167		0.00000167	LB	E3GAL	3; 1.3-9
2104004000	206440	FLUORANTHENE	0.00000484		0.00000484	LB	E3GAL	3; 1.3-9
2104004000	86737	FLUORENE	0.00000447		0.00000447	LB	E3GAL	3; 1.3-9

2104004000	50000	FORMALDEHYDE	0.033		0.033	LB	E3GAL	3; 1.3-9
2104004000	193395	INDENO[1,2,3-C,D]PYRENE	0.00000214		0.00000214	LB	E3GAL	3; 1.3-9
2104004000	7439921	LEAD	0.001264		0.001264	LB	E3GAL	5
2104004000	7439965	MANGANESE	0.0008428		0.0008428	LB	E3GAL	5
2104004000	7439976	MERCURY	0.0004214		0.0004214	LB	E3GAL	5
2104004000	91203	NAPHTHALENE	0.00113		0.00113	LB	E3GAL	3; 1.3-9
2104004000	7440020	NICKEL	0.0004214		0.0004214	LB	E3GAL	5
2104004000	85018	PHENANTHRENE	0.0000105		0.0000105	LB	E3GAL	3; 1.3-9
2104004000	129000	PYRENE	0.00000425		0.00000425	LB	E3GAL	3; 1.3-9
2104004000	7782492	SELENIUM	0.002107		0.002107	LB	E3GAL	5

COMMERCIAL/INSTITUTIONAL KEROSENE COMBUSTION

A. Source Category Description

Commercial and Institutional fuel consumption includes emissions from boilers, engines, and other combustion sources from the commercial and institutional sectors that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Kerosene Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2103011000	Stationary Source Fuel Combustion	Commercial/ Institutional	Kerosene	Total: All Combustor Types

B. Overview of Calculations

Commercial/Institutional Kerosene combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 2212//, 2213//, 42--, 44--, 51--, 52--, 53--,54--, 55--, 56--, 61--, 62--, 71--, 72--, and 81-- are used to apportion state-fuel to the county level based on the proportion of employment in the commercial sector to the total commercial sector state employment.

$$F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for kerosene commercial/institutional fuel combustion, as shown in Table 2.

Table 2: 2023 NEI County Level Fuel Consumption for Commercial/Institutional Kerosene Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Thousand Gallons)	Fuel Consumption (Thousand Gallons)
Allegany	24001	17,202	0.009345	336.00	3.14

Anne Arundel	24003	184,662	0.100319		33.71
Baltimore	24005	268,865	0.146063		49.08
Calvert	24009	14,130	0.007676		2.58
Caroline	24011	4,452	0.002419		0.81
Carroll	24013	38,796	0.021076		7.08
Cecil	24015	18,302	0.009943		3.34
Charles	24017	26,723	0.014517		4.88
Dorchester	24019	5,476	0.002975		1.00
Frederick	24021	69,590	0.037805		12.70
Garrett	24023	7,909	0.004297		1.44
Harford	24025	57,571	0.031276		10.51
Howard	24027	153,119	0.083183		27.95
Kent	24029	4,715	0.002561		0.86
Montgomery	24031	376,651	0.204618		68.75
Prince Georges	24033	200,372	0.108853		36.57
Queen Annes	24035	8,945	0.004859		1.63
Saint Mary's	24037	29,658	0.016112		5.41
Somerset	24039	2,944	0.001599		0.54
Talbot	24041	14,621	0.007943		2.67
Washington	24043	42,376	0.023021		7.74
Wicomico	24045	28,706	0.015595		5.24
Worcester	24047	17,370	0.009436		3.17
Baltimore City	24510	247,596	0.134508		45.19

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) kerosene fuel consumption sectors are from AP-42.[3] The emissions factors for ammonia are taken from a Pechan report on ammonia emissions in the ICI sectors.[4] SO2 Emission Factors are multiplied by the State Sulfur Content. In Maryland, the kerosene sulfur content for commercial/institutional combustion is 0.00015.%.[5] The emissions factors for hazardous air pollutants from (HAP) are taken from EPA's 2002 NEI Documentation.[6]

Criteria pollutant emission factors for commercial/institutional kerosene are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Commercial/Institutional Kerosene Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2103011000	Commercial/Institutional Kerosene	CO	5	LB/E3GAL	[3]
2103011000	Commercial/Institutional Kerosene	NOX	20	LB/E3GAL	
2103011000	Commercial/Institutional Kerosene	PM10-PRI	2.34	LB/E3GAL	
2103011000	Commercial/Institutional Kerosene	PM25-PRI	2.1	LB/E3GAL	
2103011000	Commercial/Institutional Kerosene	SO2	142S	LB/E3GAL	
2103011000	Commercial/Institutional Kerosene	VOC	0.34	LB/E3GAL	

E. Controls

Emissions from kerosene commercial/institutional fuel combustion are controlled through Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection.[7] COMAR 03.03.05.04 requires that after July 1, 2019, the amount of sulfur in fuel is not to exceed 0.0015 percent by mass.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from commercial/intuitional kerosene combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, MDE utilizes the point source registry to locate commercial/institutional kerosene combustion point sources to estimate the amount of fuel consumption to subtract from the SEDS total.

Maryland has no facilities that report commercial/institutional kerosene combustion as part of its point-source emissions. Point source subtraction is unnecessary.

H. Sample Calculations

Sample calculations for VOC emissions from commercial/institutional kerosene combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Commercial/Institutional Kerosene Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(33.71\ E3GAL \times 0.34\ lb/E3GAL)/2000$	0.00573 tons of VOC in 2023

I. References

1 Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

2 U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[4] E.H. Pechan and Associates, Inc. 2003. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Report. Durham, NC. Prepared for USEPA Emission Factor and Inventory Group.

[5] U.S. Environmental Protection Agency. Wagon Wheel 2020 v7.1 Final - EPA Defaults – ICI Module: Sulfur and Ash Content of Fuels Table.

[6] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx.

[7] Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection. https://dsd.maryland.gov/Pages/COMARSearch.aspx

APPENDIX

Table 1 Emissions Factors for Kerosene Fuel Consumption in the Commercial and Institutional Sector

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2.1E+09	50000	Formaldehyde	0.0324	LB	E3GAL	3; Table 1.3-9
2.1E+09	53703	Dibenzo[a,h]Anthracene	1.62E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	56553	Benz[a]Anthracene	3.92E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	71432	Benzene	0.000203	LB	E3GAL	3; Table 1.3-9
2.1E+09	75070	Acetaldehyde	0.004725	LB	E3GAL	2002 NEI Documentation
2.1E+09	83329	Acenaphthene	2.03E-05	LB	E3GAL	3; Table 1.3-9
2.1E+09	85018	Phenanthrene	1.01E-05	LB	E3GAL	3; Table 1.3-9
2.1E+09	86737	Fluorene	4.32E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	91203	Naphthalene	0.001094	LB	E3GAL	3; Table 1.3-9
2.1E+09	120127	Anthracene	1.17E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	129000	Pyrene	4.05E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	191242	Benzo[g,h,i,]Perylene	2.16E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	193395	Indeno[1,2,3-c,d]Pyrene	2.03E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	206440	Fluoranthene	4.73E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	208968	Acenaphthylene	2.43E-07	LB	E3GAL	3; Table 1.3-9
2.1E+09	218019	Chrysene	2.3E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	7439921	Lead	0.001215	LB	E3GAL	3; Table 1.3-11
2.1E+09	56832736	Benzofluoranthenes	1.49E-06	LB	E3GAL	3; Table 1.3-9
2.1E+09	CO	Carbon Monoxide	5	LB	E3GAL	3; Table 1.3-1
2.1E+09	NH3	Ammonia	0.8	LB	E3GAL	4
2.1E+09	NOX	Nitrogen Oxides	20	LB	E3GAL	3; Table 1.3-1
2.1E+09	PM10-FIL	PM10 Filterable	1.08	LB	E3GAL	3; Table 1.3-7
2.1E+09	PM10-PRI	PM10 Primary (Filt + Cond)	2.34	LB	E3GAL	Sum of PM10-FIL and PM-CON
2.1E+09	PM25-FIL	PM2.5 Filterable	0.83	LB	E3GAL	3; Table 1.3-7
2.1E+09	PM25-PRI	PM2.5 Primary (Filt + Cond)	2.1	LB	E3GAL	Sum of PM25-FIL and PM-CON
2.1E+09	PM-CON	PM Condensible	1.3	LB	E3GAL	3; Table 1.3-2
2.1E+09	SO2	Sulfur Dioxide	142S	LB	E3GAL	3; Table 1.3-1
2.1E+09	VOC	Volatile Organic Compounds	0.34	LB	E3GAL	3; Table 1.3-3
2.1E+09	7440382	Arsenic	0.00054	LB	E3GAL	3

2.1E+09	7440417	Beryllium	0.000405	LB	E3GAL	3
2.1E+09	7440439	Cadmium	0.000405	LB	E3GAL	3
2.1E+09	18540299	Chromium (VI)	7.29E-05	LB	E3GAL	3
2.1E+09	16065831	Chromium III	0.000332	LB	E3GAL	3
2.1E+09	7439965	Manganese	0.00081	LB	E3GAL	3
2.1E+09	7439976	Mercury	0.000405	LB	E3GAL	3
2.1E+09	7440020	Nickel	0.000405	LB	E3GAL	3
2.1E+09	7782492	Selenium	0.002025	LB	E3GAL	3

INDUSTRIAL KEROSENE COMBUSTION

A. Source Category Description

Industrial fuel consumption includes emissions from boilers, engines, and other combustion sources from the commercial and institutional sectors that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Kerosene Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2102011000	Stationary Source Fuel Combustion	Industrial	Kerosene	Total: All Combustor Types

B. Overview of Calculations

Industrial Kerosene combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] industrial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 11--, 21--, 23--, 31--, 32-- and 33-- are used to apportion state-fuel to the county level based on the proportion of employment in the industrial sector to the total industrial sector state employment.

The total fuel consumption is adjusted to account for fuel used as an input to industrial processes where it is not combusted. Maryland assumes that 0% of industrial kerosene throughput is not combusted. This assumption is based on the EIA Manufacturing Energy Consumption Survey (MECS)[3], which reports both total fuel consumption and non-combustion use of fuel by Census region.

$$\boldsymbol{F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x} \times (1 - nc_{f,industrial})}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x
$nc_{f,x}$ = Fraction of fuel f used as an industrial input and is not combusted in the industrial sector

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for kerosene industrial fuel combustion, as shown in Table 2.

Table 2: 2023 NEI County Level Fuel Consumption for Industrial Kerosene Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Thousand Gallons)	Non-Fuel Combustion	Fuel Consumption (Thousand Gallons)
Allegany	24001	2,886	0.011073	42.00	0%	0.47
Anne Arundel	24003	33,165	0.127247			5.34
Baltimore	24005	38,098	0.146174			6.14
Calvert	24009	2,579	0.009895			0.42
Caroline	24011	1,819	0.006979			0.29
Carroll	24013	9,303	0.035694			1.50
Cecil	24015	5,909	0.022672			0.95
Charles	24017	3,827	0.014683			0.62
Dorchester	24019	3,532	0.013552			0.57
Frederick	24021	16,507	0.063334			2.66
Garrett	24023	1,812	0.006952			0.29
Harford	24025	10,313	0.039569			1.66
Howard	24027	17,254	0.0662			2.78
Kent	24029	1,161	0.004455			0.19
Montgomery	24031	32,072	0.123054			5.17
Prince Georges	24033	39,127	0.150122			6.31
Queen Annes	24035	2,788	0.010697			0.45
Saint Mary's	24037	2,271	0.008713			0.37
Somerset	24039	688	0.00264			0.11
Talbot	24041	1,673	0.006419			0.27
Washington	24043	9,108	0.034946			1.47
Wicomico	24045	3,923	0.015052			0.63
Worcester	24047	1,642	0.0063			0.26
Baltimore City	24510	19,177	0.073578			3.09

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) kerosene fuel consumption sectors are from AP-42[4] and the Eastern Regional Technical Advisory Committee[5]. SO2 Emission Factors are multiplied by the State Sulfur Content. In Maryland, the kerosene sulfur content for industrial combustion is 0.00015.%.[6]

Criteria pollutant emission factors for industrial kerosene are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Industrial Kerosene Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2102011000	Industrial Kerosene	CO	4.82	LB/E3GAL	[5]
		NOX	19.29	LB/E3GAL	
		PM10-PRI	2.21	LB/E3GAL	
		PM25-PRI	1.49	LB/E3GAL	
		SO2	142S	LB/E3GAL	
		VOC	0.19	LB/E3GAL	

E. Controls

Emissions from kerosene industrial fuel combustion are controlled through Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection.[7] COMAR 03.03.05.04 requires that after July 1, 2019, the amount of sulfur in fuel is not to exceed 0.0015 percent by mass.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant *p* from fuel type *f* in county *c* in sector *x*
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type *f* in county *c* in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant *p,* fuel type *f*, and sector *x* (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from industrial kerosene combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate industrial kerosene combustion point sources to estimate the amount of fuel consumption to subtract from the SEDS total. Facility level annual CO2 emissions are divided by an emission factor[8], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county *c* for source category *s*, in thousands of gallons per year
$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county *c* for source category *s*, in tons per year
$EF_{CO2,s}$ = CO_2 emissions factor for source category *s*

The point source consumption estimates for distillate oil combustion are outlined in Table 4 below.

Table 4: Point Source Consumption Adjustment for Industrial Kerosene Combustion

FIPS State and County Code	County Name	Fuel Consumption (Thousand Gallons)	Point Source Fuel Consumption Reduction (Thousand Gallons)	Point Source Adjusted Fuel Consumption (Thousand Gallons)
24001	Allegany	0.47	0.00	0.47
24003	Anne Arundel	5.34	0.00	5.34
24005	Baltimore	6.14	0.00	6.14
24009	Calvert	0.42	0.00	0.42
24011	Caroline	0.29	0.00	0.29
24013	Carroll	1.50	0.00	1.50
24015	Cecil	0.95	0.00	0.95
24017	Charles	0.62	0.00	0.62
24019	Dorchester	0.57	0.00	0.57
24021	Frederick	2.66	0.00	2.66
24023	Garrett	0.29	0.00	0.29
24025	Harford	1.66	0.00	1.66
24027	Howard	2.78	0.00	2.78
24029	Kent	0.19	0.00	0.19
24031	Montgomery	5.17	0.00	5.17
24033	Prince George's	6.31	0.00	6.31
24035	Queen Anne's	0.45	0.00	0.45
24037	St. Mary's	0.37	0.00	0.37
24039	Somerset	0.11	0.00	0.11
24041	Talbot	0.27	0.00	0.27
24043	Washington	1.47	2.87	0.00
24045	Wicomico	0.63	0.00	0.63
24047	Worcester	0.26	0.00	0.26
24510	Baltimore City	3.09	0.00	3.09

H. Sample Calculations

Sample calculations for VOC emissions from industrial kerosene combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Industrial Kerosene Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x}} = \boldsymbol{NPF_{f,c,x}} \times \boldsymbol{EF_{p,f,x}}$	$(5.34\ E3GAL \times 0.19\ lb/\ E3GAL)/2000$	0.000508 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[4] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[5] EPA and Eastern Regional Technical Advisory Committee. 2010. Excel file: state_comparison_ERTAC_SS_version7_5_Mar 16 2010.xls

[6] U.S. Environmental Protection Agency. Wagon Wheel 2020 v7.1 Final - EPA Defaults – ICI Module: Sulfur and Ash Content of Fuels Table.

[7] Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection. https://dsd.maryland.gov/Pages/COMARSearch.aspx

[8] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1 Emissions Factors for Kerosene Fuel Consumption in the Industrial Sector

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102011000	129000	PYRENE	0.00000405	LB	E3GAL	4; Table 1.3-9
2102011000	206440	FLUORANTHENE	0.000004725	LB	E3GAL	4; Table 1.3-9
2102011000	50000	FORMALDEHYDE	0.0324	LB	E3GAL	4; Table 1.3-9
2102011000	71432	BENZENE	0.0002025	LB	E3GAL	4; Table 1.3-9
2102011000	75070	ACETALDEHYDE	0.004725	LB	E3GAL	4; Table 1.3-9
2102011000	85018	PHENANATHRENE	0.000010125	LB	E3GAL	4; Table 1.3-9
2102011000	86737	FLUORENE	0.00000432	LB	E3GAL	4; Table 1.3-9
2102011000	91203	NAPHTHALENE	0.0010935	LB	E3GAL	4; Table 1.3-9
2102011000	CO	CARBON MONOXIDE	4.82	LB	E3GAL	5
2102011000	NH3	AMMONIA	0.77	LB	E3GAL	5
2102011000	NOX	NITROGEN OXIDES	19.29	LB	E3GAL	5
2102011000	PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	0.96	LB	E3GAL	5
2102011000	PM10-PRI	PRIMARY PM10, PRIMARY	2.21	LB	E3GAL	5
2102011000	PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	0.24	LB	E3GAL	5
2102011000	PM25-PRI	PRIMARY PM25, PRIMARY	1.49	LB	E3GAL	5
2102011000	PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	1.25	LB	E3GAL	5
2102011000	SO2	SULFUR DIOXIDE	142S	LB	E3GAL	5
2102011000	VOC	VOLATILE ORGANIC COMPOUNDS	0.19	LB	E3GAL	5
2102011000	83329	Acenaphthene	0.00002025	LB	E3GAL	4; Table 1.3-9
2102011000	7782492	Selenium	0.002025	LB	E3GAL	4
2102011000	7440439	Cadmium	0.000405	LB	E3GAL	4
2102011000	7440417	Beryllium	0.000405	LB	E3GAL	4
2102011000	7440382	Arsenic	0.00054	LB	E3GAL	4
2102011000	7440020	Nickel	0.000405	LB	E3GAL	4
2102011000	7439976	Mercury	0.000405	LB	E3GAL	4
2102011000	7439965	Manganese	0.00081	LB	E3GAL	4
2102011000	7439921	Lead	0.001215	LB	E3GAL	4; Table 1.3-9
2102011000	56832736	Benzofluoranthenes	0.000001485	LB	E3GAL	4; Table 1.3-9
2102011000	56553	Benz[a]Anthracene	0.000003915	LB	E3GAL	4; Table 1.3-9

2102011000	53703	Dibenzo[a,h]Anthracene	0.00000162	LB	E3GAL	4; Table 1.3-9
2102011000	218019	Chrysene	0.000002295	LB	E3GAL	4; Table 1.3-9
2102011000	208968	Acenaphthylene	0.000000243	LB	E3GAL	4; Table 1.3-9
2102011000	193395	Indeno[1,2,3-c,d]Pyrene	0.000002025	LB	E3GAL	4; Table 1.3-9
2102011000	191242	Benzo[g,h,i,]Perylene	0.00000216	LB	E3GAL	4; Table 1.3-9
2102011000	18540299	Chromium (VI)	0.0000729	LB	E3GAL	4
2102011000	16065831	Chromium III	0.0003321	LB	E3GAL	4
2102011000	120127	Anthracene	1.1745E-06	LB	E3GAL	4; Table 1.3-9

RESIDENTIAL KEROSENE COMBUSTION

A. Source Category Description

Residential fuel combustion includes the combustion of fuel, including coal, distillate oil, kerosene, natural gas, and liquefied propane gas (LPG) to heat homes. Common uses of energy associated with this category include space heating, water heating, and cooking.

Table 1. 2023 NEI Residential Kerosene Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2104011000	Stationary Source Fuel Combustion	Residential	Kerosene	Total: All Heater Types

B. Overview of Calculations

Residential Kerosene Combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] House Heating Fuel Data from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS[1], and 5-year county-level House Heating Fuel Data from the U.S. Census' American Community Survey.[2] County-level estimates of the number of houses that heat with kerosene are used to apportion state-level fuel consumption.

For most fuels, the fuel type in SEDS matches well to the fuel type used in the Census data. However, the Census data reports only for total fuel oil, which does not distinguish between distillate fuel oil and kerosene. Therefore, the ratio of distillate fuel oil versus kerosene in the heating fuel oil mix, is used to determine the fraction of homes in each county that use kerosene.

$$R_{ker} = \frac{FC_{ker}}{FC_{dfo} + FC_{ker}}$$

Where:

R_{ker} = ratio of residential distillate fuel oil to total distillate fuel oil and kerosene
FC_{dfo} = fuel consumption of distillate fuel oil from SEDS, in thousand barrels
FC_{ker} = fuel consumption of kerosene from SEDS, in thousand barrels

Then, the ratio of kerosene to total fuel oil is used to determine how many housing units in each county use distillate fuel oil or kerosene.

$$HU_{ker,c} = HU_{fo,c} \times R_{ker}$$

Where:

$HU_{ker,c}$ = housing units in county c using kerosene as the primary heating fuel
$HU_{fo,c}$ = housing units in county c using any fuel oil as primary heating fuel
R_{ker} = ratio of residential kerosene to total distillate fuel oil and kerosene

To distribute the state-level energy consumption data for residential kerosene, the ratio of county-level housing units using kerosene as primary heating fuel to state-level housing units kerosene is calculated. This ratio is used to distribute state-level fuel consumption to the county level.

$$R_{ker,c} = \frac{HU_{ker,c}}{HU_{ker,s}}$$

Where:

$R_{ker,c}$ = ratio of homes in county c to homes in state s that use kerosene as primary heating fuel
$HU_{ker,c}$ = housing units in county c using kerosene as the primary heating fuel
$HU_{ker,s}$ = housing units in state s using kerosene as primary heating fuel

The state-level fuel consumption of residential kerosene from SEDS is multiplied by the county-level ratio of homes using each fuel type. The 2023 NEI uses 2022 SEDS fuel consumption and 2022 adjusted county-level home heating fuel data to estimate county-level fuel consumption for residential distillate fuel combustion, as shown in Table 2

Table 2: 2023 NEI County Level Fuel Consumption for Residential Kerosene Combustion

Ratio of Kerosene vs. Distillate + Kerosene Fuel Consumption from SEDS						
Kerosene Residential Fuel Consumption (Thousand Barrels)						28
Distillate Residential Fuel Consumption (Thousand Barrels)						2,530
Ratio of Kerosene vs Distillate & Kerosene Fuel Consumption						1%
County Name	**State County FIPs**	**Houses using Fuel oil, kerosene, etc. as Primary Heating Fuel**	**Kerosene Fuel to Total Distillate Fuel Oil and Kerosene**	**Housing Units Using Kerosene as the Primary Heating Fuel**	**Ratio of County Homes Using Kerosene as primary Heating Fuel**	**Consumption (Thousand Barrels)**
Allegany	24001	2,839		28	0.017	0.466
Anne Arundel	24003	19,637		196	0.115	3.224
Baltimore	24005	24,847		248	0.146	4.080
Calvert	24009	3,434		34	0.020	0.564
Caroline	24011	1,985		20	0.012	0.326
Carroll	24013	12,119		121	0.071	1.990
Cecil	24015	7,720		77	0.045	1.268
Charles	24017	7,651	1%	77	0.045	1.256
Dorchester	24019	2,225		22	0.013	0.365
Frederick	24021	10,229		102	0.060	1.679
Garrett	24023	3,125		31	0.018	0.513
Harford	24025	10,735		107	0.063	1.763
Howard	24027	5,450		55	0.032	0.895
Kent	24029	1,298		13	0.008	0.213
Montgomery	24031	10,338		103	0.061	1.697

Prince Georges	24033	11,053		111	0.065	1.815
Queen Annes	24035	2,487		25	0.015	0.408
Saint Mary's	24037	1,057		70	0.041	1.145
Somerset	24039	6,976		11	0.006	0.174
Talbot	24041	1,600		16	0.009	0.263
Washington	24043	10,686		107	0.063	1.754
Wicomico	24045	3,364		34	0.020	0.552
Baltimore City	24510	1,495		15	0.009	0.245
State Total		170,529	N/A	1705	1	28

D. Emissions Factors

The emissions factors for residential fuel combustion criteria pollutants, except ammonia, are from AP-42.[3] The ammonia emissions factor is from EPA's *Estimating Ammonia Emissions from Anthropogenic Sources*.[4] In some cases, HAP emissions factors are from a memorandum to EPA called "*Baseline Emission Inventory of HAP Emissions from MACT Sources – Interim Final Report*".[5] SO2 Emission Factors are multiplied by the State Sulfur Content.[6]

Criteria air pollutant emission factors for residential fuel combustion are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Residential Kerosene Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2104011000	Residential Kerosene	CO	202.5	LB/E3BBL	[3]
		NOX	729		
		PM10-PRI	96.4		
		PM25-PRI	86.3		
		SO2	5740S		
		VOC	28.4		

E. Controls

Emissions from residential kerosene oil combustion are controlled through Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection.[6] 10 COMAR 03.03.05.04 requires that after July 1, 2019, the amount of sulfur in fuel is not to exceed 0.0015 percent by mass.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for emissions from residential kerosene combustion; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from residential kerosene combustion in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC Emissions for Residential Kerosene Combustion in Anne Arundel County.

Equation	Values for Anne Arundel County	Result
$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(3.224110\ E3BBL \times 28.4\ lbs/E3BBL)/2000$	0.04578 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. American Community Survey (ACS) Data Product B25040. House Heating Fuel Data (2022, 5-Year Estimate). https://data.census.gov/all?q=b25040

[3] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[4] U.S. Environmental Protection Agency. 2004. Emission Inventory Improvement Program. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report. Prepared by E.H. Pechan and Associates, Inc. Research Triangle Park, NC. https://www.epa.gov/sites/production/files/2015-08/documents/eiip_areasourcesnh3.pdf

[5] Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. Environmental Protection Agency/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources – Interim Final Report," September 18, 1998. November 13, 1998.

[6] Code of Maryland Regulations (COMAR) 03.03.05: Motor Fuel Inspection. https://dsd.maryland.gov/Pages/COMARSearch.aspx

APPENDIX

Table 1 Emissions factors for Kerosene Combustion in the Residential Sector. Kerosene Fuel Oil in Maryland is not to exceed 0.0015 percent Sulfur by mass.

SCC	Pollutant Code	Name	Original Factor Numeric Value (EPA)	MDE Derived Formula	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference (Source; Table)
2104011000	CO	CARBON MONOXIDE	202.5		202.5	LB	E3BBL	3; 1.3-1
2104011000	NOX	NITROGEN OXIDES	729		729	LB	E3BBL	3; 1.3-1
2104011000	PM-CON	PRIMARY PM CONDENSIBLE	52.7		52.7	LB	E3BBL	3; 1.3-2
2104011000	PM10-PRI	PRIMARY PM10	96.4		96.4	LB	E3BBL	PM 10 Filt + PM25 Cond
2104011000	PM10-FIL	PRIMARY PM10, FILTERABLE	43.7		43.7	LB	E3BBL	3; 1.3-7
2104011000	PM25-PRI	PRIMARY PM2.5	86.3		86.3	LB	E3BBL	PM 10 Filt + PM25 Cond
2104011000	PM25-FIL	PRIMARY PM2.5, FILTERABLE	33.6		33.6	LB	E3BBL	3; 1.3-7
2104011000	SO2	SULFUR DIOXIDE	287.6	5740S, where S is % Sulfur by mass	0.0861 (assuming 0.0015% Sulfur)	LB	E3BBL	3; 1.3-1. Assumes a sulfur content of 500 ppm. 500ppm = 0.05% Sulfur by mass. 5740=287/0.05
2104011000	VOC	VOLATILE ORGANIC COMPOUNDS	28.4		28.4	LB	E3BBL	3; 1.3-3
2104011000	83329	ACENAPHTHENE	0.000853		0.000853	LB	E3BBL	3; 1.3-9
2104011000	208968	ACENAPHTHYLENE	0.0000102		0.0000102	LB	E3BBL	3; 1.3-9
2104011000	75070	ACETALDEHYDE	0.199		0.199	LB	E3BBL	5
2104011000	NH3	AMMONIA	40.5		40.5	LB	E3BBL	4; III-1
2104011000	120127	ANTHRACENE	0.0000495		0.0000495	LB	E3BBL	3; 1.3-9
2104011000	7440382	ARSENIC	0.0228		0.0228	LB	E3BBL	5
2104011000	56553	BENZ[A]ANTHRACENE	0.000165		0.000165	LB	E3BBL	3; 1.3-9
2104011000	71432	BENZENE	0.00853		0.00853	LB	E3BBL	3; 1.3-9
2104011000	191242	BENZO[G,H,I,]PERYLENE	0.000091		0.000091	LB	E3BBL	3; 1.3-9
2104011000	7440417	BERYLLIUM	0.017		0.017	LB	E3BBL	5
2104011000	7440439	CADMIUM	0.017		0.017	LB	E3BBL	5
2104011000	18540299	Chromium (VI)	0.00307		0.00307	LB	E3BBL	EPA HAP Augmentation Tool
2104011000	16065831	Chromium III	0.014		0.014	LB	E3BBL	EPA HAP Augmentation Tool
2104011000	218019	CHRYSENE	0.0000967		0.0000967	LB	E3BBL	3; 1.3-9

2104011000	53703	DIBENZO[A,H]ANTHRACENE	0.0000683		0.0000683	LB	E3BBL	3; 1.3-9
2104011000	206440	FLUORANTHENE	0.000199		0.000199	LB	E3BBL	3; 1.3-9
2104011000	86737	FLUORENE	0.000182		0.000182	LB	E3BBL	3; 1.3-9
2104011000	50000	FORMALDEHYDE	1.365		1.365	LB	E3BBL	3; 1.3-9
2104011000	193395	INDENO[1,2,3-C,D]PYRENE	0.0000853		0.0000853	LB	E3BBL	3; 1.3-9
2104011000	7439921	LEAD	0.051		0.051	LB	E3BBL	5
2104011000	7439965	MANGANESE	0.034		0.034	LB	E3BBL	5
2104011000	7439976	MERCURY	0.017		0.017	LB	E3BBL	5
2104011000	91203	NAPHTHALENE	0.046		0.046	LB	E3BBL	3; 1.3-9
2104011000	7440020	NICKEL	0.017		0.017	LB	E3BBL	5
2104011000	85018	PHENANTHRENE	0.000427		0.000427	LB	E3BBL	3; 1.3-9
2104011000	129000	PYRENE	0.000171		0.000171	LB	E3BBL	3; 1.3-9
2104011000	7782492	SELENIUM	0.085		0.085	LB	E3BBL	5

COMMERCIAL/INSTITUTIONAL LIQUIFIED PETROLEUM GAS COMBUSTION

A. Source Category Description

Commercial and Institutional fuel consumption includes emissions from boilers, engines, and other combustion sources from the commercial and institutional sectors that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Liquified Petroleum Gas Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2103007000	Stationary Source Fuel Combustion	Commercial/ Institutional	Liquified Petroleum Gas (LPG)	Total: All Combustor Types

B. Overview of Calculations

Commercial/institutional liquified petroleum gas combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using total fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 2212//, 2213//, 42--, 44--, 51--, 52--, 53--,54--, 55--, 56--, 61--, 62--, 71--, 72--, and 81-- are used to apportion state-fuel to the county level based on the proportion of employment in the commercial sector to the total commercial sector state employment.

The SEDS Liquefied Petroleum Gas (LPG) consumption data includes consumption estimates for equipment that are typically included in the nonroad inventory (ex. farming, logging, mining and construction equipment fuel use). To avoid double-counting LPG consumption, total fuel consumption is adjusted to account for the fraction of fuel consumed by nonroad mobile sources. This fraction is based on results from the National Mobile Inventory Model (NMIM), a precursor to EPA's Motor Vehicle Emission Simulator (MOVES). Per EPA, for commercial/institutional liquified petroleum gas combustion, 17.72% of total fuel consumption is assumed to be from nonroad sources.[3] County level consumption is estimated using the following equation:

$$F_{f,c,x} = F_{f,x} \times (1 - SS_{f,x}) \times \frac{a_{c,x}}{a_x}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$SS_{f,x}$ = Fraction of fuel f consumed by nonroad sources in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for liquified petroleum gas commercial/institutional fuel combustion, as shown in Table 2.

Table 2: 2023 NEI County Level Fuel Consumption for Commercial/Institutional Liquified Petroleum Gas Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Thousand Barrels)	Nonroad Consumption (%)	Non-Road Adjusted Fuel Consumption (Thousand Barrels)
Allegany	24001	17,202	0.009345	868	17.72%	6.67
Anne Arundel	24003	184,662	0.100319			71.65
Baltimore	24005	268,865	0.146063			104.32
Calvert	24009	14,130	0.007676			5.48
Caroline	24011	4,452	0.002419			1.73
Carroll	24013	38,796	0.021076			15.05
Cecil	24015	18,302	0.009943			7.10
Charles	24017	26,723	0.014517			10.37
Dorchester	24019	5,476	0.002975			2.12
Frederick	24021	69,590	0.037805			27.00
Garrett	24023	7,909	0.004297			3.07
Harford	24025	57,571	0.031276			22.34
Howard	24027	153,119	0.083183			59.41
Kent	24029	4,715	0.002561			1.83
Montgomery	24031	376,651	0.204618			146.14
Prince Georges	24033	200,372	0.108853			77.74
Queen Annes	24035	8,945	0.004859			3.47
Saint Mary's	24037	29,658	0.016112			11.51
Somerset	24039	2,944	0.001599			1.14
Talbot	24041	14,621	0.007943			5.67
Washington	24043	42,376	0.023021			16.44
Wicomico	24045	28,706	0.015595			11.14
Worcester	24047	17,370	0.009436			6.74
Baltimore City	24510	247,596	0.134508			96.06

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42[4] and a spreadsheet developed in 2010 by EPA and the Eastern Regional Technical Advisory Committee.[5] The emissions factors for hazardous air pollutants (HAP) are taken from EPA's 2002 NEI Documentation.[6]

Criteria air pollutant emissions factors for commercial/institutional liquified petroleum gas combustion are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Commercial/Institutional Liquified Petroleum Gas

Combustion

SCC	Description	Pollutant Code	Emissions Factor	Unit	Source
2103007000	Commercial/Institutional Liquified Petroleum Gas	CO	334.74	LB/E3BBL	[5]
2103007000	Commercial/Institutional Liquified Petroleum Gas	NOX	597.66	LB/E3BBL	
2103007000	Commercial/Institutional Liquified Petroleum Gas	PM10-PRI	2.1	LB/E3BBL	
2103007000	Commercial/Institutional Liquified Petroleum Gas	PM25-PRI	1.68	LB/E3BBL	
2103007000	Commercial/Institutional Liquified Petroleum Gas	SO2	2.52	LB/E3BBL	
2103007000	Commercial/Institutional Liquified Petroleum Gas	VOC	21.84	LB/E3BBL	

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emissions factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from commercial/intuitional LPG combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate commercial/institutional LPG combustion point sources to estimate the amount of fuel consumption to subtract from the nonroad-adjusted SEDS total. Facility level annual CO2 emissions are divided by an emission factor[7], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county *c* for source category *s*,
$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county *c* for source category *s*
$EF_{CO2,s}$ = CO_2 emissions factor for source category *s*

The point source consumption estimates for commercial/institutional liquified petroleum gas are outlined in Table 4 below.

Table 4: Point Source Employment Adjustment for Commercial/Institutional Liquified Petroleum Gas Combustion

County Name	FIPS State and County Code	Nonroad Adjusted Fuel Consumption (E3BBL)	Point Source Fuel Consumption Reduction (E3BBL)	Point Source Adjusted Fuel Consumption (E3BBL)
Allegany	24001	6.67	0.00	6.67
Anne Arundel	24003	71.65	0.00	71.65
Baltimore	24005	104.32	0.00	104.32
Calvert	24009	5.48	0.00	5.48
Caroline	24011	1.73	0.00	1.73
Carroll	24013	15.05	0.00	15.05
Cecil	24015	7.10	0.00	7.10
Charles	24017	10.37	0.40	9.97
Dorchester	24019	2.12	0.00	2.12
Frederick	24021	27.00	0.00	27.00
Garrett	24023	3.07	0.00	3.07
Harford	24025	22.34	0.03	22.31
Howard	24027	59.41	5.68	53.73
Kent	24029	1.83	0.00	1.83
Montgomery	24031	146.14	0.00	146.14
Prince George's	24033	77.74	0.20	77.54
Queen Anne's	24035	3.47	0.00	3.47
St. Mary's	24037	11.51	0.00	11.51
Somerset	24039	1.14	0.00	1.14
Talbot	24041	5.67	0.00	5.67
Washington	24043	16.44	0.00	16.44
Wicomico	24045	11.14	0.00	11.14
Worcester	24047	6.74	0.00	6.74
Baltimore City	24510	96.06	0.00	96.06

H. Sample Calculations

Sample calculations for VOC emissions from commercial/institutional liquified petroleum gas combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Commercial/Institutional Liquified Petroleum Gas Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x}} = \boldsymbol{NPF_{f,c,x}} \times \boldsymbol{EF_{p,f,x}}$	$(71.65\ E3BBL \times 21.84\ lb/E3BBL)/2000$	0.782 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx

[4] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[5] EPA and Eastern Regional Technical Advisory Committee. 2010. Excel file: state_comparison_ERTAC_SS_version7_5_Mar 16 2010.xls

[6] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx.

[7] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1 Emissions Factors for Liquified Petroleum Gas Combustion in the Commercial and Institutional Sector

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2.103E+09	50000	Formaldehyde	0.2877	LB	E3BBL	0.0068498	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	71432	Benzene	0.007672	LB	E3BBL	0.0001827	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	75070	Acetaldehyde	4.99E-05	LB	E3BBL	1.19E-06	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	85018	Phenanthrene	6.52E-06	LB	E3BBL	1.55E-06	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	86737	Fluorene	1.07E-05	LB	E3BBL	2.56E-07	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	91203	Naphthalene	0.0023399	LB	E3BBL	5.57E-05	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	129000	Pyrene	1.92E-05	LB	E3BBL	4.57E-07	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	206440	Fluoranthene	1.15E-05	LB	E3BBL	2.74E-07	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	7439921	Lead	0.0018266	LB	E3BBL	4.35E-05	LB	E3GAL	6, 2002 NEI Documentation
2.103E+09	CO	Carbon Monoxide				7.97	LB	E3GAL	5
2.103E+09	NH3	Ammonia				0.05	LB	E3GAL	5
2.103E+09	NOX	Nitrogen Oxides				14.23	LB	E3GAL	5
2.103E+09	PM10-FIL	PM10 Filterable				0.02	LB	E3GAL	5
2.103E+09	PM10-PRI	PM10 Primary (Filt + Cond)				0.05	LB	E3GAL	5
2.103E+09	PM25-FIL	PM2.5 Filterable				0.01	LB	E3GAL	5
2.103E+09	PM25-PRI	PM2.5 Primary (Filt + Cond)				0.04	LB	E3GAL	5
2.103E+09	PM-CON	PM Condensible				0.03	LB	E3GAL	5
2.103E+09	SO2	Sulfur Dioxide				0.06	LB	E3GAL	5
2.103E+09	VOC	Volatile Organic Compounds				0.52	LB	E3GAL	5

INDUSTRIAL LIQUIFIED PETROLEUM GAS COMBUSTION

A. Source Category Description

Industrial fuel consumption includes emissions from boilers, engines, and other combustion sources from the commercial and institutional sectors that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Liquified Petroleum Gas Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2102007000	Stationary Source Fuel Combustion	Industrial	Liquified Petroleum Gas (LPG)	Total: All Combustor Types

B. Overview of Calculations

Industrial liquified petroleum gas combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using total fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 11--, 21--, 23--, 31--, 32-- and 33-- are used to apportion state-fuel to the county level based on the proportion of employment in the commercial sector to the total commercial sector state employment.

The SEDS Liquefied Petroleum Gas (LPG) consumption data includes consumption estimates for equipment that are typically included in the nonroad inventory (ex. farming, logging, mining and construction equipment fuel use). To avoid double-counting LPG consumption, total fuel consumption is adjusted to account for the fraction of fuel consumed by nonroad mobile sources. This fraction is based on results from the National Mobile Inventory Model (NMIM), a precursor to EPA's Motor Vehicle Emission Simulator (MOVES). Per EPA, for industrial liquified petroleum gas combustion, 8.72% of total fuel consumption is assumed to be from nonroad sources.[3]

The total fuel consumption is also adjusted to account for fuel used as an input to industrial processes where it is not combusted. Maryland assumes that 98.90% of industrial LPG throughput is not combusted. This assumption is based on the EIA Manufacturing Energy Consumption Survey (MECS)[4], which reports both total fuel consumption and non-combustion use of fuel by Census region.

County level consumption is estimated using the following equation:

$$\boldsymbol{F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x} \times (1 - SS_{f,x}) \times (1 - nc_{f,industrial})}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x

$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x
$SS_{f,x}$ = Fraction of fuel f consumed by nonroad sources in sector x
$nc_{f,x}$ = Fraction of fuel f used as an industrial input and is not combusted in the industrial sector

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for liquified petroleum gas industrial fuel combustion, as shown in Table 2.

Table 2: 2023 County Level Fuel Consumption for Industrial Liquified Petroleum Gas Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Thousand Barrels)	Nonroad Consumption (%)	Non-combustion (%)	Fuel Consumption (Thousand Barrels)
Allegany	24001	2,886	0.011073	521	8.72%	98.90%	0.0579
Anne Arundel	24003	33,165	0.127247				0.6657
Baltimore	24005	38,098	0.146174				0.7647
Calvert	24009	2,579	0.009895				0.0518
Caroline	24011	1,819	0.006979				0.0365
Carroll	24013	9,303	0.035694				0.1867
Cecil	24015	5,909	0.022672				0.1186
Charles	24017	3,827	0.014683				0.0768
Dorchester	24019	3,532	0.013552				0.0709
Frederick	24021	16,507	0.063334				0.3313
Garrett	24023	1,812	0.006952				0.0364
Harford	24025	10,313	0.039569				0.2070
Howard	24027	17,254	0.0662				0.3463
Kent	24029	1,161	0.004455				0.0233
Montgomery	24031	32,072	0.123054				0.6437
Prince Georges	24033	39,127	0.150122				0.7853
Queen Annes	24035	2,788	0.010697				0.0560
Saint Mary's	24037	2,271	0.008713				0.0456
Somerset	24039	688	0.00264				0.0138
Talbot	24041	1,673	0.006419				0.0336
Washington	24043	9,108	0.034946				0.1828
Wicomico	24045	3,923	0.015052				0.0787
Worcester	24047	1,642	0.0063				0.0330
Baltimore City	24510	19,177	0.073578				0.3849

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from a spreadsheet developed in 2010 by EPA and the Eastern Regional Technical Advisory Committee.[5]

Criteria air pollutant emissions factors for industrial liquified petroleum gas combustion are listed in table 3 below.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Industrial Liquified Petroleum Gas Combustion

SCC	Description	Pollutant Code	Emissions Factor	Unit	Source
2102007000	Industrial Liquified Petroleum Gas	CO	334.74	LB/E3BBL	[5]
		NOX	597.66		
		PM10-PRI	2.1		
		PM25-PRI	1.68		
		SO2	2.52		
		VOC	21.84		

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emissions factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant *p* from fuel type *f* in county *c* in sector *x*
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type *f* in county *c* in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant *p,* fuel type *f*, and sector *x* (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from industrial LPG combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate industrial LPG combustion point sources to estimate the amount of fuel consumption to subtract from the nonroad-adjusted SEDS total. Facility level annual CO2 emissions are divided by an emission factor[6], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county *c* for source category *s*,

$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county *c* for source category *s*
$EF_{CO2,s}$ = CO_2 emissions factor for source category *s*

The point source consumption estimates for industrial liquified petroleum gas are outlined in Table 4 below.

Table 4: Point Source Employment Adjustment for Industrial Liquified Petroleum Gas Combustion

County Name	FIPS State and County Code	Nonroad Adjusted Fuel Consumption (E3BBL)	Point Source Fuel Consumption Reduction (E3BBL)	Point Source Adjusted Fuel Consumption (E3BBL)
Allegany	24001	0.0579	0.00	0.0579
Anne Arundel	24003	0.6657	0.00	0.6657
Baltimore	24005	0.7647	0.00	0.7647
Calvert	24009	0.0518	0.00	0.0518
Caroline	24011	0.0365	3.98	0.0000
Carroll	24013	0.1867	0.00	0.1867
Cecil	24015	0.1186	0.00	0.1186
Charles	24017	0.0768	0.00	0.0768
Dorchester	24019	0.0709	0.00	0.0709
Frederick	24021	0.3313	16.34	0.0000
Garrett	24023	0.0364	0.00	0.0364
Harford	24025	0.2070	0.00	0.2070
Howard	24027	0.3463	11.56	0.0000
Kent	24029	0.0233	0.00	0.0233
Montgomery	24031	0.6437	0.00	0.6437
Prince George's	24033	0.7853	0.00	0.7853
Queen Anne's	24035	0.0560	0.00	0.0560
St. Mary's	24037	0.0456	0.00	0.0456
Somerset	24039	0.0138	0.00	0.0138
Talbot	24041	0.0336	0.00	0.0336
Washington	24043	0.1828	13.38	0.0000
Wicomico	24045	0.0787	0.00	0.0787
Worcester	24047	0.0330	0.00	0.0330
Baltimore City	24510	0.3849	0.00	0.3849

H. Sample Calculations

Sample calculations for VOC emissions from industrial liquified petroleum gas combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Industrial Liquified Petroleum Gas Combustion in Anne Arundel

County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(0.6657\ E3BBL \times 21.84\ lb/E3BBL)/2000$	0.0073 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx

[4] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[5] EPA and Eastern Regional Technical Advisory Committee. 2010. Excel file: state_comparison_ERTAC_SS_version7_5_Mar 16 2010.xls

[6] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

RESIDENTIAL LIQUIFIED PETROLEUM GAS (LPG) COMBUSTION

A. Source Category Description

Residential fuel combustion includes the combustion of fuel, including coal, distillate oil, kerosene, natural gas, and liquefied propane gas (LPG) to heat homes. Common uses of energy associated with this category include space heating, water heating, and cooking.

Table 1. 2023 NEI Residential Liquified petroleum gas Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2104007000	Stationary Source Fuel Combustion	Residential	Liquified Petroleum Gas	Total: All Combustor Types

B. Overview of Calculations

Residential Liquified Petroleum Gas (LPG) Combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] House Heating Fuel Data from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS[1], and 5-year county-level House Heating Fuel Data from the U.S. Census' American Community Survey.[2] County-level estimates of the number of houses that heat with LPG are used to apportion state-level fuel consumption.

To distribute the state-level energy consumption data for residential LPG, the ratio of county-level housing units using LPG as primary heating fuel to state-level housing units LPG is calculated. This ratio is used to distribute state-level fuel consumption to the county level.

$$R_{LPG,c} = \frac{HU_{LPG,c}}{HU_{LPG,s}}$$

Where:

$R_{LPG,c}$ = ratio of homes in county c to homes in state s that use LPG as primary heating fuel
$HU_{LPG,c}$ = housing units in county c using LPG as the primary heating fuel
$HU_{LPG,s}$ = housing units in state s using LPG as primary heating fuel

The state-level fuel consumption of residential LPG from SEDS is multiplied by the county-level ratio of homes using each fuel type. The 2023 NEI uses 2022 SEDS fuel consumption and 2022 adjusted county-level home heating fuel data to estimate county-level fuel consumption for residential LPG fuel combustion, as shown in Table 2

Table 2: 2023 NEI County Level Fuel Consumption for Residential LPG Combustion

County Name	State County FIPs	Housing Units Using Bottled, Tank, or LP Gas as Primary Heating Fuel	Ratio of County Homes Using Bottled, Tank, or LP Gas Heating as Primary Heating Fuel	State Consumption (Thousand Barrels)	County Consumption (Thousand Barrels)
Allegany	24001	1,093	0.012891583	1744	22.48
Anne Arundel	24003	6,536	0.077090017		134.44
Baltimore	24005	8,431	0.099440932		173.42
Calvert	24009	2,359	0.027823646		48.52
Caroline	24011	1,771	0.020888375		36.43
Carroll	24013	2,968	0.035006605		61.05
Cecil	24015	7,527	0.088778543		154.83
Charles	24017	2,333	0.027516984		47.99
Dorchester	24019	1,182	0.01394131		24.31
Frederick	24021	3,848	0.045385922		79.15
Garrett	24023	2,224	0.026231364		45.75
Harford	24025	5,420	0.063927156		111.49
Howard	24027	2,953	0.034829685		60.74
Kent	24029	1,530	0.018045858		31.47
Montgomery	24031	6,025	0.071062936		123.93
Prince Georges	24033	4,863	0.05735752		100.03
Queen Annes	24035	3,244	0.038261936		66.73
Saint Mary's	24037	3,140	0.03703529		64.59
Somerset	24039	1,447	0.017066899		29.76
Talbot	24041	1,388	0.016371013		28.55
Washington	24043	2,874	0.033897905		59.12
Wicomico	24045	4,465	0.052663238		91.84
Baltimore City	24510	2,956	0.034865069		60.80
State Total		84,784	1		N/A

D. Emissions Factors

The emissions factors for residential fuel combustion criteria air pollutants are from EPA's Residential Heating Nonpoint Emissions Methodology Operator (NEMO) instructions.[3]

Criteria air pollutant emission factors for residential fuel combustion are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Residential Liquified Petroleum Gas Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2104007000	Residential Liquified Petroleum Gas	CO	159.6	LB/E3BBL	[3]
		NOX	562.8		
		PM10-PRI	2.07		
		PM25-PRI	1.71		
		SO2	2.39		
		VOC	21.91		

E. Controls

There are no controls for Residential LPG Combustion.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for emissions from residential LPG combustion; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from residential liquified petroleum gas combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Residential Liquified Petroleum Gas Combustion in Anne Arundel County.

Equation	Values for Anne Arundel County	Result
$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(134.44\ E3BBL \times 21.91\ lbs/E3BBL)/2000$	1.472845 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. American Community Survey (ACS) Data Product B25040. House Heating Fuel Data (2022, 5-Year Estimate). https://data.census.gov/all?q=b25040

[3] U.S. Environmental Protection Agency. Residential Heating NEMO 2017 FINAL_4-2 update. https://usepa.sharepoint.com/:w:/r/sites/NEI/Shared%20Documents/General/NEI%20Resource%20Library/NEMOs/Residential%20Heating%20NEMO.docx?d=wd0aef055ed1f4b43891776f08e9c5730&csf=1&web=1&e=zSzbMP

APPENDIX

Table 1 Emissions factors for Liquified Petroleum Gas Combustion in the Residential Sector.

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2104007000	50000	FORMALDEHYDE	0.310000	LB	E3BBL	3
2104007000	71432	BENZENE	0.008780	LB	E3BBL	3
2104007000	75070	ACETALDEHYDE	0.000054	LB	E3BBL	3
2104007000	85018	PHENANTHRENE	0.000071	LB	E3BBL	3
2104007000	86737	FLUORENE	0.000012	LB	E3BBL	3
2104007000	91203	NAPHTHALENE	0.002550	LB	E3BBL	3
2104007000	129000	PYRENE	0.000021	LB	E3BBL	3
2104007000	206440	FLUORANTHENE	0.000013	LB	E3BBL	3
2104007000	CO	CARBON MONOXIDE	159.600000	LB	E3BBL	3
2104007000	NH3	AMMONIA	1.950000	LB	E3BBL	3
2104007000	NOX	NITROGEN OXIDES	562.800000	LB	E3BBL	3
2104007000	PM10-FIL	PRIMARY PM10, FILTERABLE	0.800000	LB	E3BBL	3
2104007000	PM10-PRI	PRIMARY PM10	2.070000	LB	E3BBL	3
2104007000	PM25-FIL	PRIMARY PM2.5, FILTERABLE	0.440000	LB	E3BBL	3
2104007000	PM25-PRI	PRIMARY PM2.5	1.710000	LB	E3BBL	3
2104007000	PM-CON	PRIMARY PM CONDENSIBLE	1.270000	LB	E3BBL	3
2104007000	SO2	SULFUR DIOXIDE	2.390000	LB	E3BBL	3
2104007000	VOC	VOLATILE ORGANIC COMPOUNDS	21.910000	LB	E3BBL	3
2104007000	7439921	Lead	0.001827	LB	E3BBL	

COMMERCIAL/INSTITUTIONAL NATURAL GAS COMBUSTION

A. Source Category Description

Commercial and Institutional fuel consumption includes emissions from boilers, engines, and other combustion sources from the commercial and institutional sectors that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Natural Gas Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2103006000	Stationary Source Fuel Combustion	Commercial/ Institutional	Natural Gas	Total: Boilers and IC Engines

B. Overview of Calculations

Commercial/Institutional Natural Gas Combustion emissions in the 2023 National Emissions Inventory are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 2212//, 2213//, 42--, 44--, 51--, 52--, 53--,54--, 55--, 56--, 61--, 62--, 71--, 72--, and 81-- are used to apportion state-fuel to the county level based on the proportion of employment in the commercial sector to the total commercial sector state employment.

$$F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for natural gas commercial/institutional fuel combustion, as shown in Table 2.

Table 2: 2023 County Level Fuel Consumption for Commercial/Institutional Natural Gas Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Million Cubic Feet)	Fuel Consumption (Million Cubic Feet)
Allegany	24001	17,202	0.009345	73,916	690.75
Anne Arundel	24003	184,662	0.100319		7,415.17
Baltimore	24005	268,865	0.146063		10,796.37

Calvert	24009	14,130	0.007676		567.40
Caroline	24011	4,452	0.002419		178.77
Carroll	24013	38,796	0.021076		1,557.87
Cecil	24015	18,302	0.009943		734.92
Charles	24017	26,723	0.014517		1,073.07
Dorchester	24019	5,476	0.002975		219.89
Frederick	24021	69,590	0.037805		2,794.41
Garrett	24023	7,909	0.004297		317.59
Harford	24025	57,571	0.031276		2,311.78
Howard	24027	153,119	0.083183		6,148.55
Kent	24029	4,715	0.002561		189.33
Montgomery	24031	376,651	0.204618		15,124.55
Prince Georges	24033	200,372	0.108853		8,046.01
Queen Annes	24035	8,945	0.004859		359.19
Saint Mary's	24037	29,658	0.016112		1,190.93
Somerset	24039	2,944	0.001599		118.22
Talbot	24041	14,621	0.007943		587.11
Washington	24043	42,376	0.023021		1,701.62
Wicomico	24045	28,706	0.015595		1,152.70
Worcester	24047	17,370	0.009436		697.50
Baltimore City	24510	247,596	0.134508		9,942.30

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42[3], a spreadsheet developed in 2010 by EPA and the Eastern Regional Technical Advisory Committee[4], and EPA's 2002 NEI Documentation.[5]

Criteria air pollutant emissions factors for commercial/institutional natural gas combustion are listed in table 3 below.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Commercial/Institutional Natural Gas Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2103006000	Commercial/Institutional Natural Gas	CO	84	LB/E6FT3	[4]
		NOX	100		
		PM10-PRI	0.52		
		PM25-PRI	0.43		
		SO2	0.6		
		VOC	5.5		

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel

consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from commercial/intuitional natural gas combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate commercial/institutional natural gas combustion point sources to estimate the amount of fuel consumption to subtract from the SEDS total. Facility level annual CO2 emissions are divided by an emission factor[6], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county c for source category s, in million cubic feet per year
$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county c for source category s, in tons per year
$EF_{CO2,s}$ = CO_2 emissions factor for source category s

The point source consumption estimates for natural gas combustion are outlined in Table 4 below.

Table 4: Point Source Consumption Adjustment for Commercial/Institutional Natural Gas Combustion

County Name	FIPS State and County Code	Fuel Consumption (E6FT3)	Point Source Fuel Consumption Reduction (E6FT3)	Point Source Adjusted Fuel Consumption (E6FT3)
Allegany	24001	690.75	0.58	690.17
Anne Arundel	24003	7,415.17	1,002.23	6,412.94
Baltimore	24005	10,796.37	1,006.69	9,789.68
Calvert	24009	567.40	17,737.07	0.00
Caroline	24011	178.77	0.00	178.77
Carroll	24013	1,557.87	2.89	1,554.97

Cecil	24015	734.92	2,602.41	0.00
Charles	24017	1,073.07	445.69	627.38
Dorchester	24019	219.89	405.63	0.00
Frederick	24021	2,794.41	1,212.47	1,581.95
Garrett	24023	317.59	91.68	225.91
Harford	24025	2,311.78	1,228.37	1,083.41
Howard	24027	6,148.55	972.58	5,175.97
Kent	24029	189.33	0.00	189.33
Montgomery	24031	15,124.55	6,514.20	8,610.35
Prince George's	24033	8,046.01	3,493.43	4,552.57
Queen Anne's	24035	359.19	0.00	359.19
St. Mary's	24037	1,190.93	163.49	1,027.44
Somerset	24039	118.22	0.00	118.22
Talbot	24041	587.11	0.00	587.11
Washington	24043	1,701.62	87.48	1,614.14
Wicomico	24045	1,152.70	681.18	471.52
Worcester	24047	697.50	0.00	697.50
Baltimore City	24510	9,942.30	5,933.54	4,008.76

H. Sample Calculations

Sample calculations for VOC emissions from commercial/institutional natural gas combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Commercial/Institutional Natural Gas Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(6{,}412.94\ E6FT3 \times 5.5\ lb/E6FT3)/2000$	17.64 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[4] EPA and Eastern Regional Technical Advisory Committee. 2010. Excel file: state_comparison_ERTAC_SS_version7_5_Mar 16 2010.xls

[5] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx.

[6] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1 Emissions Factors for Natural Gas Combustion in the Commercial and Institutional Sector

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103006000	50000	Formaldehyde	7.50E-02	LB	E6FT3	3; Table 1.4-3
2103006000	71432	Benzene	0.0021	LB	E6FT3	3; Table 1.4-3
2103006000	75070	Acetaldehyde	1.37E-05	LB	E6FT3	2002 NEI Documentation
2103006000	85018	Phenanthrene	1.70E-05	LB	E6FT3	3; Table 1.4-3
2103006000	86737	Fluorene	2.80E-06	LB	E6FT3	3; Table 1.4-3
2103006000	91203	Naphthalene	6.10E-04	LB	E6FT3	3; Table 1.4-3
2103006000	129000	Pyrene	5.00E-06	LB	E6FT3	3; Table 1.4-3
2103006000	206440	Fluoranthene	3.00E-06	LB	E6FT3	37; Table 1.4-3
2103006000	7439921	Lead	0.0005	LB	E6FT3	3; Table 1.4-2
2103006000	CO	Carbon Monoxide	84	LB	E6FT3	4
2103006000	NH3	Ammonia	0.49	LB	E6FT3	4
2103006000	NOX	Nitrogen Oxides	100	LB	E6FT3	4
2103006000	PM10-FIL	PM10 Filterable	0.2	LB	E6FT3	4
2103006000	PM10-PRI	PM10 Primary (Filt + Cond)	0.52	LB	E6FT3	4
2103006000	PM25-FIL	PM2.5 Filterable	0.11	LB	E6FT3	4
2103006000	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.43	LB	E6FT3	4
2103006000	PM-CON	PM Condensible	0.32	LB	E6FT3	4
2103006000	SO2	Sulfur Dioxide	0.6	LB	E6FT3	4
2103006000	VOC	Volatile Organic Compounds	5.5	LB	E6FT3	4

INDUSTRIAL NATURAL GAS COMBUSTION

A. Source Category Description

Industrial fuel consumption includes emissions from boilers, engines, and other combustion sources from the Industrial sectors that are not reported as point sources.

Table 1. 2023 NEI Industrial Natural Gas Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines

B. Overview of Calculations

Industrial Natural Gas Combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] industrial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS 11--, 21--, 23--, 31--, 32-- and 33-- are used to apportion state-fuel to the county level based on the proportion of employment in the industrial sector to the total industrial sector state employment.

The total fuel consumption is adjusted to account for fuel used as an input to industrial processes where it is not combusted. Maryland assumes that 13.3% of industrial natural gas throughput is not combusted. This assumption is based on the EIA Manufacturing Energy Consumption Survey (MECS)[3], which reports both total fuel consumption and non-combustion use of fuel by Census region.

$$\boldsymbol{F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x} \times (1 - nc_{f,industrial})}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x
$nc_{f,x}$ = Fraction of fuel f used as an industrial input and is not combusted in the industrial sector

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for natural gas Industrial fuel combustion, as shown in Table 2.

Table 2: 2023 NEI County Level Fuel Consumption for Industrial Natural Gas Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Million Cubic Feet)	Non-Fuel Combustion	Non-Fuel Adjusted Natural Gas Combustion (Million Cubic Feet)
Allegany	24001	2,886	0.011073	16,190	13.3%	155.43
Anne Arundel	24003	33,165	0.127247			1,786.14
Baltimore	24005	38,098	0.146174			2,051.81
Calvert	24009	2,579	0.009895			138.89
Caroline	24011	1,819	0.006979			97.96
Carroll	24013	9,303	0.035694			501.02
Cecil	24015	5,909	0.022672			318.24
Charles	24017	3,827	0.014683			206.11
Dorchester	24019	3,532	0.013552			190.22
Frederick	24021	16,507	0.063334			889.00
Garrett	24023	1,812	0.006952			97.59
Harford	24025	10,313	0.039569			555.42
Howard	24027	17,254	0.0662			929.23
Kent	24029	1,161	0.004455			62.53
Montgomery	24031	32,072	0.123054			1,727.27
Prince Georges	24033	39,127	0.150122			2,107.23
Queen Annes	24035	2,788	0.010697			150.15
Saint Mary's	24037	2,271	0.008713			122.31
Somerset	24039	688	0.00264			37.05
Talbot	24041	1,673	0.006419			90.10
Washington	24043	9,108	0.034946			490.52
Wicomico	24045	3,923	0.015052			211.28
Worcester	24047	1,642	0.0063			88.43
Baltimore City	24510	19,177	0.073578			1,032.80

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42[4], a spreadsheet developed in 2010 by EPA and the Eastern Regional Technical Advisory Committee[5], and EPA's 2002 NEI Documentation.[6]

Criteria air pollutant emissions factors for Industrial natural gas combustion are listed in table 3 below.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Industrial Natural Gas Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2102006000	Industrial Natural Gas	CO	84	LB/E6FT3	[5]
		NOX	100		
		PM10-PRI	0.54		
		PM25-PRI	0.43		
		SO2	0.6		
		VOC	5.5		

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from industrial natural gas combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate Industrial natural gas combustion point sources to estimate the amount of fuel consumption to subtract from the SEDS total. Facility level annual CO2 emissions are divided by an emission factor[7], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county c for source category s, in million cubic feet per year
$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county c for source category s, in tons per year
$EF_{CO2,s}$ = CO_2 emissions factor for source category s

The point source consumption estimates for natural gas combustion are outlined in Table 4 below.

Table 4: Point Source Consumption Adjustment for Industrial Natural Gas Combustion

County Name	FIPS State and County Code	Fuel Consumption (E6FT3)	Point Source Fuel Consumption Reduction (E6FT3)	Point Source Adjusted Fuel Consumption (E6FT3)
Allegany	24001	155.43	24.53	130.89

Anne Arundel	24003	1,786.14	522.48	1,263.66
Baltimore	24005	2,051.81	229.91	1,821.90
Calvert	24009	138.89	4,001.71	0.00
Caroline	24011	97.96	0.00	97.96
Carroll	24013	501.02	122.74	378.28
Cecil	24015	318.24	238.02	80.22
Charles	24017	206.11	10.38	195.73
Dorchester	24019	190.22	152.25	37.96
Frederick	24021	889.00	467.10	421.91
Garrett	24023	97.59	270.62	0.00
Harford	24025	555.42	411.33	144.09
Howard	24027	929.23	1,708.41	0.00
Kent	24029	62.53	0.00	62.53
Montgomery	24031	1,727.27	270.76	1,456.51
Prince George's	24033	2,107.23	489.04	1,618.19
Queen Anne's	24035	150.15	0.00	150.15
St. Mary's	24037	122.31	0.00	122.31
Somerset	24039	37.05	0.00	37.05
Talbot	24041	90.10	0.00	90.10
Washington	24043	490.52	11.79	478.73
Wicomico	24045	211.28	526.10	0.00
Worcester	24047	88.43	63.60	24.83
Baltimore City	24510	1,032.80	2,510.78	0.00

H. Sample Calculations

Sample calculations for VOC emissions from Industrial natural gas combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Industrial Natural Gas Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(1{,}263.66\ E6FT3 \times 5.5\ lb/E6FT3)/2000$	3.475 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[4] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[5] EPA and Eastern Regional Technical Advisory Committee. 2010. Excel file: state_comparison_ERTAC_SS_version7_5_Mar 16 2010.xls

[6] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx.

[7] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1. Emissions Factors for Natural Gas Combustion in the Industrial Sector

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102006000	50000	Formaldehyde	0.075	LB	E6FT3	4; Table 1.4-3
2102006000	71432	Benzene	0.0021	LB	E6FT3	4; Table 1.4-3
2102006000	75070	Acetaldehyde	1.365E-05	LB	E6FT3	6; 2002 NEI Documentation
2102006000	85018	Phenanthrene	0.0000175	LB	E6FT3	4; Table 1.4-3
2102006000	86737	Fluorene	2.80E-06	LB	E6FT3	4; Table 1.4-3
2102006000	91203	Naphthalene	6.10E-04	LB	E6FT3	4; Table 1.4-3
2102006000	129000	Pyrene	5.00E-06	LB	E6FT3	4; Table 1.4-3
2102006000	206440	Fluoranthene	3.00E-06	LB	E6FT3	4; Table 1.4-3
2102006000	7439921	Lead	0.0005	LB	E6FT3	4; Table 1.4-2
2102006000	CO	Carbon Monoxide	84	LB	E6FT3	5
2102006000	NH3	Ammonia	3.2	LB	E6FT3	5
2102006000	NOX	Nitrogen Oxides	100	LB	E6FT3	5
2102006000	PM10-FIL	PM10 Filterable	0.2	LB	E6FT3	5
2102006000	PM10-PRI	PM10 Primary (Filt + Cond)	0.54	LB	E6FT3	5
2102006000	PM25-FIL	PM2.5 Filterable	0.11	LB	E6FT3	5
2102006000	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.43	LB	E6FT3	5
2102006000	PM-CON	PM Condensible	0.32	LB	E6FT3	5
2102006000	SO2	Sulfur Dioxide	0.6	LB	E6FT3	5
2102006000	VOC	Volatile Organic Compounds	5.5	LB	E6FT3	5

RESIDENTIAL NATURAL GAS COMBUSTION

A. Source Category Description

Residential fuel combustion includes the combustion of fuel, including coal, distillate oil, kerosene, natural gas, and liquefied propane gas (LPG) to heat homes. Common uses of energy associated with this category include space heating, water heating, and cooking.

Table 1. 2023 NEI Industrial Natural Gas Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2104006000	Stationary Source Fuel Combustion	Residential	Natural Gas	Total: All Combustor Types

B. Overview of Calculations

Residential Natural Gas Combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] House Heating Fuel Data from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS[1], and 5-year county-level House Heating Fuel Data from the U.S. Census' American Community Survey.[2] County-level estimates of the number of houses that heat with natural gas are used to apportion state-level fuel consumption.

To distribute the state-level energy consumption data for residential natural gas, the ratio of county-level housing units using natural gas as primary heating fuel to state-level housing units natural gas is calculated. This ratio is used to distribute state-level fuel consumption to the county level.

$$\boldsymbol{R_{f,c} = \frac{HU_{ng,c}}{HU_{ng,s}}}$$

Where:

$R_{ng,c}$ = ratio of homes in county c to homes in state s that use natural gas as primary heating fuel
$HU_{ng,c}$ = housing units in county c using natural gas as the primary heating fuel
$HU_{ng,s}$ = housing units in state s using natural gas as primary heating fuel

The state-level fuel consumption of residential natural gas from SEDS is multiplied by the county-level ratio of homes using each fuel type. The 2023 NEI uses 2022 SEDS fuel consumption and 2022 adjusted county-level home heating fuel data to estimate county-level fuel consumption for residential natural gas fuel combustion, as shown in Table 2.

Table 2: 2023 NEI County Level Fuel Consumption for Residential Natural Gas Combustion

County Name	State County FIPs	County-Level Housing Units Using Nat Gas as Primary Heating Fuel	State-Level Housing Units Using Nat Gas as Primary Heating Fuel	Ratio of County Housing Units to State	State Consumption (Million Cubic Feet)	County Combustion (Million Cubic Feet)
Allegany	24001	13,711	1,004,509	0.013649	82,532	1,126.52
Anne Arundel	24003	82,440		0.08207		6,773.40
Baltimore	24005	171,493		0.170723		14,090.13
Calvert	24009	1,869		0.001861		153.56
Caroline	24011	437		0.000435		35.90
Carroll	24013	13,120		0.013061		1,077.96
Cecil	24015	6,973		0.006942		572.91
Charles	24017	15,012		0.014945		1,233.41
Dorchester	24019	1,826		0.001818		150.03
Frederick	24021	32,720		0.032573		2,688.33
Garrett	24023	1,714		0.001706		140.82
Harford	24025	38,108		0.037937		3,131.01
Howard	24027	50,785		0.050557		4,172.57
Kent	24029	135		0.000134		11.09
Montgomery	24031	203,276		0.202364		16,701.47
Prince Georges	24033	182,996		0.182175		15,035.23
Queen Annes	24035	555		0.000553		45.60
Saint Mary's	24037	5,100		0.005077		419.02
Somerset	24039	301		0.0003		24.73
Talbot	24041	3,086		0.003072		253.55
Washington	24043	12,899		0.012841		1,059.80
Wicomico	24045	7,235		0.007203		594.44
Worcester	24047	3,448		0.003433		283.29
Baltimore City	24510	155,270		0.154573		12,757.22

D. Emissions Factors

The emissions factors for residential fuel combustion criteria air pollutants, except ammonia, are from AP-42.[3], The ammonia emissions factor is from EPA's *Estimating Ammonia Emissions from Anthropogenic Sources*.[4] In some cases HAP emissions factors are from a memorandum to EPA called "*Baseline Emission Inventory of HAP Emissions from MACT Sources – Interim Final Report*".[5] Particulate matter emissions factors came from EPA's technical support document for the Version 6.3, 2011 Emissions Modeling Platform[6] and a spreadsheet developed by Roy Huntley[7].

Criteria air pollutant emission factors for residential fuel combustion are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1.

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Residential Natural Gas Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2104006000	Residential Natural Gas	CO	40	LB/E6FT3	[3]
		NOX	94		[3]
		PM10-PRI	0.52		[6]
		PM25-PRI	0.43		[6]
		SO2	0.6		[3]
		VOC	5.5		[3]

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for emissions from residential natural gas combustion; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from residential natural gas combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Residential Natural Gas Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}}$	$(6{,}773.40\ E6FT3 \times 5.5\ lb/E6FT3)/2000$	18.62684129 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. American Community Survey (ACS) Data Product B25040. House Heating Fuel Data (2022, 5-Year Estimate). https://data.census.gov/all?q=b25040

[3] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[4] U.S. Environmental Protection Agency. 2004. Emission Inventory Improvement Program. *Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report*. Prepared by E.H. Pechan and Associates, Inc. Research Triangle Park, NC. https://www.epa.gov/sites/production/files/2015-08/documents/eiip_areasourcesnh3.pdf

[5] Porter, Fred, U.S. Environmental Protection Agency, Emission Standards Division. Note to Anne Pope, U.S. Environmental Protection Agency/Emissions Monitoring and Analysis Division. Comments on Industrial Boiler information in the "Baseline Emission Inventory of HAP Emissions from MACT Sources – Interim Final Report," September 18, 1998. November 13, 1998.

[6] U.S. Environmental Protection Agency. 2016. Technical Support Document (TSD) Preparation of Emissions Inventories for the Version 6.3, 2011 Emissions Modeling Platform. Prepared by U.S. Environmental Protection Agency Office of Air and Radiation Office of Air Quality Planning and Standards Air Quality Assessment Division. https://www.epa.gov/sites/production/files/2016-09/documents/2011v6_3_2017_emismod_tsd_aug2016_final.pdf

[7] Huntley, Roy. 2012. Spreadsheet: "natgas_procgas_lpg_pm_efs_not_ap42_032012_revisions.xls"

APPENDIX

Table 1. Emissions Factors for Natural Gas Combustion in the Residential Sector

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2104006000	129000	PYRENE	0.000005	LB	E6FT3	3
2104006000	206440	FLUORANTHENE	0.000003	LB	E6FT3	3
2104006000	50000	FORMALDEHYDE	0.075	LB	E6FT3	3
2104006000	71432	BENZENE	0.00221	LB	E6FT3	5
2104006000	75070	ACETALDEHYDE	0.0000137	LB	E6FT3	5
2104006000	85018	PHENANTHRENE	0.000017	LB	E6FT3	3
2104006000	86737	FLUORENE	0.0000028	LB	E6FT3	3
2104006000	91203	NAPHTHALENE	0.00061	LB	E6FT3	3
2104006000	CO	CARBON MONOXIDE	40	LB	E6FT3	3
2104006000	NOX	NITROGEN OXIDES	94	LB	E6FT3	3
2104006000	PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	0.2	LB	E6FT3	6
2104006000	PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	0.11	LB	E6FT3	6
2104006000	PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	0.32	LB	E6FT3	7
2104006000	PM10-PRI	PM10 Primary (Filt + Cond)	0.52	LB	E6FT3	6
2104006000	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.43	LB	E6FT3	6
2104006000	SO2	SULFUR DIOXIDE	0.6	LB	E6FT3	3
2104006000	VOC	VOLATILE ORGANIC COMPOUNDS	5.5	LB	E6FT3	3
2104006000	NH3	AMMONIA	20	LB	E6FT3	4
2104006000	7439921	LEAD	0.0005	LB	E6FT3	

COMMERCIAL/INSTITUTIONAL RESIDUAL OIL COMBUSTION

A. Source Category Description

Commercial and Institutional fuel consumption includes emissions from boilers, engines, and other combustion sources from the commercial and institutional sectors that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Residual Oil Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2103005000	Stationary Source Fuel Combustion	Commercial/ Institutional	Residual Oil	Total: All Boiler Types

B. Overview of Calculations

Commercial/institutional residual oil combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 2212//, 2213//, 42--, 44--, 51--, 52--, 53--,54--, 55--, 56--, 61--, 62--, 71--, 72--, and 81-- are used to apportion state-fuel to the county level based on the proportion of employment in the commercial sector to the total commercial sector state employment.

$$F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for commercial/institutional residual oil combustion, as shown in Table 2.

Table 2: 2023 County Level Fuel Consumption for Commercial/Institutional Residual Oil Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Thousand Barrels)	Fuel Consumption (Thousand Barrels)
Allegany	24001	17,202	0.009345	5	0.05
Anne Arundel	24003	184,662	0.100319		0.50
Baltimore	24005	268,865	0.146063		0.73

Calvert	24009	14,130	0.007676		0.04
Caroline	24011	4,452	0.002419		0.01
Carroll	24013	38,796	0.021076		0.11
Cecil	24015	18,302	0.009943		0.05
Charles	24017	26,723	0.014517		0.07
Dorchester	24019	5,476	0.002975		0.01
Frederick	24021	69,590	0.037805		0.19
Garrett	24023	7,909	0.004297		0.02
Harford	24025	57,571	0.031276		0.16
Howard	24027	153,119	0.083183		0.42
Kent	24029	4,715	0.002561		0.01
Montgomery	24031	376,651	0.204618		1.02
Prince Georges	24033	200,372	0.108853		0.54
Queen Annes	24035	8,945	0.004859		0.02
Saint Mary's	24037	29,658	0.016112		0.08
Somerset	24039	2,944	0.001599		0.01
Talbot	24041	14,621	0.007943		0.04
Washington	24043	42,376	0.023021		0.12
Wicomico	24045	28,706	0.015595		0.08
Worcester	24047	17,370	0.009436		0.05
Baltimore City	24510	247,596	0.134508		0.67

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42[3] and a spreadsheet developed in 2010 by EPA and the Eastern Regional Technical Advisory Committee.[4]

SO2 and filterable PM emission factors are multiplied by the state sulfur content. In Maryland, the sulfur content for commercial/institutional residual oil combustion is either 1% or 2% depending on the county%.[5] Primary PM emissions are estimated by adding condensable and filterable PM.

The emissions factors for hazardous air pollutants from (HAP) are taken from EPA's 2002 NEI Documentation.[6]

Criteria air pollutant emissions factors for commercial/institutional residual oil are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Commercial/Institutional Residual Oil Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2103005000	Commercial/Institutional Residual Oil	CO	210	LB/E3BBL	4
		NOX	2310		
		PM-CON	63		
		PM10-FIL	5.17(1.12*S+0.37)		
		PM10-PRI	PM10-FIL + PM-CON		
		PM25-FIL	1.92(1.12*S+0.37)		
		PM25-PRI	PM25-FIL + PM-CON		
		SO2	157S		

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
		VOC	47.46		

E. Controls

Emissions from residual commercial/institutional fuel combustion are controlled through Code of Maryland Regulations (COMAR) 26.11.09.07: Control of Sulfur Oxides from Fuel Burning Equipment.[7] COMAR 26.11.09.07 limits sulfur content in fuel burning equipment in Maryland to 1 or 2% depending on the county. Sulfur is limited to 1% in Baltimore City and Anne Arundel, Baltimore, Carroll, Harford, Howard, Montgomery, and Prince Georges counties. Sulfur is limited to 2% in the rest of the state.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant *p* from fuel type *f* in county *c* in sector *x*
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type *f* in county *c* in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant *p,* fuel type *f*, and sector *x* (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from commercial/intuitional residual oil combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate commercial/institutional residual oil combustion point sources to estimate the amount of fuel consumption to subtract from the SEDS total. Facility level annual CO2 emissions are divided by an emission factor[8], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county *c* for source category *s*, in thousands of barrels per year
$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county *c* for source category *s*, in tons per year
$EF_{CO2,s}$ = CO_2 emissions factor for source category *s*

The point source consumption estimates for commercial/institutional residual oil are outlined in Table 4 below.

Table 4: Point Source Consumption Adjustment for Commercial/Institutional Residual Oil Combustion

County Name	FIPS State and County Code	Fuel Consumption (Thousand Barrels)	Point Source Fuel Consumption Reduction (Thousand Barrels)	Point Source Adjusted Fuel Consumption (Thousand Barrels)
Allegany	24001	0.05	0.00	0.05
Anne Arundel	24003	0.50	0.46	0.05
Baltimore	24005	0.73	0.00	0.73
Calvert	24009	0.04	0.00	0.04
Caroline	24011	0.01	0.00	0.01
Carroll	24013	0.11	0.00	0.11
Cecil	24015	0.05	0.00	0.05
Charles	24017	0.07	0.00	0.07
Dorchester	24019	0.01	0.00	0.01
Frederick	24021	0.19	0.00	0.19
Garrett	24023	0.02	0.00	0.02
Harford	24025	0.16	0.00	0.16
Howard	24027	0.42	0.00	0.42
Kent	24029	0.01	8.03	0.00
Montgomery	24031	1.02	0.00	1.02
Prince George's	24033	0.54	0.00	0.54
Queen Anne's	24035	0.02	0.00	0.02
St. Mary's	24037	0.08	0.00	0.08
Somerset	24039	0.01	0.00	0.01
Talbot	24041	0.04	0.00	0.04
Washington	24043	0.12	0.00	0.12
Wicomico	24045	0.08	0.00	0.08
Worcester	24047	0.05	0.00	0.05
Baltimore City	24510	0.67	7.89	0.00

H. Sample Calculations

Sample calculations for VOC emissions from commercial/institutional residual oil combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Commercial/Institutional Residual Oil Combustion in Anne Arundel

County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x}} = \boldsymbol{NPF_{f,c,x}} \times \boldsymbol{EF_{p,f,x}}$	$(0.05\ E3BBL\ \times 47.46\ lb/E3BBL)/2000$	0.001092 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[4] EPA and Eastern Regional Technical Advisory Committee. 2010. Excel file: state_comparison_ERTAC_SS_version7_5_Mar 16 2010.xls

[5] Code of Maryland Regulations (COMAR) 26.11.09.07: Control of Sulfur Oxides from Fuel Burning Equipment. https://dsd.maryland.gov/Pages/COMARSearch.aspx

[6] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx.

[7] Code of Maryland Regulations (COMAR) 26.11.09.07: Control of Sulfur Oxides from Fuel Burning Equipment. https://dsd.maryland.gov/Pages/COMARSearch.aspx

[8] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1 Emissions Factors for Residual Oil Combustion in the Commercial and Institutional Sectors

SCC	Pollutant Code	Name	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103005000	50000	Formaldehyde	0.033	LB	E3GAL	1.386	LB	E3BBL	3; Table 1.3-9
2103005000	53703	Dibenzo[a,h]Anthracene	1.67E-06	LB	E3GAL	7.01E-05	LB	E3BBL	3; Table 1.3-9
2103005000	56553	Benz[a]Anthracene	4.01E-06	LB	E3GAL	0.000168	LB	E3BBL	3 Table 1.3-9
2103005000	71432	Benzene	0.000214	LB	E3GAL	0.008988	LB	E3BBL	3; Table 1.3-9
2103005000	75070	Acetaldehyde	0.00525	LB	E3GAL	0.2205	LB	E3BBL	6; 2002 NEI Documentation
2103005000	83329	Acenaphthene	2.11E-05	LB	E3GAL	0.000886	LB	E3BBL	3; Table 1.3-9
2103005000	85018	Phenanthrene	1.05E-05	LB	E3GAL	0.000441	LB	E3BBL	3; Table 1.3-9
2103005000	86737	Fluorene	4.7E-06	LB	E3GAL	0.000197	LB	E3BBL	3; Table 1.3-9
2103005000	91203	Naphthalene	0.0013	LB	E3GAL	0.0546	LB	E3BBL	3; Table 1.3-9
2103005000	120127	Anthracene	1.22E-06	LB	E3GAL	5.12E-05	LB	E3BBL	3; Table 1.3-9
2103005000	129000	Pyrene	4.25E-06	LB	E3GAL	0.000179	LB	E3BBL	3; Table 1.3-9
2103005000	191242	Benzo[g,h,i,]Perylene	2.43E-06	LB	E3GAL	0.000102	LB	E3BBL	3; Table 1.3-9
2103005000	193395	Indeno[1,2,3-c,d]Pyrene	2.14E-06	LB	E3GAL	8.99E-05	LB	E3BBL	3; Table 1.3-9
2103005000	206440	Fluoranthene	4.84E-06	LB	E3GAL	0.000203	LB	E3BBL	3; Table 1.3-9
2103005000	208968	Acenaphthylene	2.11E-07	LB	E3GAL	8.86E-06	LB	E3BBL	3; Table 1.3-9
2103005000	218019	Chrysene	2.38E-06	LB	E3GAL	1E-04	LB	E3BBL	3; Table 1.3-9
2103005000	7439921	Lead	0.001233	LB	E3GAL	0.051786	LB	E3BBL	3; Table 1.3-10
2103005000	56832736	Benzofluoranthenes	1.48E-06	LB	E3GAL	6.22E-05	LB	E3BBL	3; Table 1.3-9
2103005000	CO	Carbon Monoxide	5	LB	E3GAL	210	LB	E3BBL	4
2103005000	NH3	Ammonia	0.8	LB	E3GAL	33.6	LB	E3BBL	4
2103005000	NOX	Nitrogen Oxides	55	LB	E3GAL	2310	LB	E3BBL	4
2103005000	PM10-FIL	PM10 Filterable	5.17(1.12*S+0.37)	LB	E3GAL	5.17(1.12*S+0.37)*42	LB	E3BBL	4
2103005000	PM10-PRI	PM10 Primary (Filt + Cond)		LB	E3GAL	PM10 Filterable+ PM Condensible	LB	E3BBL	4
2103005000	PM25-FIL	PM2.5 Filterable	1.92(1.12*S+0.37)	LB	E3GAL	1.92(1.12*S+0.37)*42	LB	E3BBL	4

2103005000	PM25-PRI	PM2.5 Primary (Filt + Cond)		LB	E3GAL	PM2.5 Filterable+PM Condensible	LB	E3BBL	4
2103005000	PM-CON	PM Condensible	1.5	LB	E3GAL	63	LB	E3BBL	4
2103005000	SO2	Sulfur Dioxide	157S	LB	E3GAL	157S*42	LB	E3BBL	4
2103005000	VOC	Volatile Organic Compounds	1.13	LB	E3GAL	47.46	LB	E3BBL	4
2103005000	7440382	Arsenic	0.00141	LB	E3GAL	0.05922	LB	E3BBL	3
2103005000	7440417	Beryllium	0.00003	LB	E3GAL	0.00126	LB	E3BBL	7
2103005000	7440439	Cadmium	0.00042	LB	E3GAL	0.01764	LB	E3BBL	7
2103005000	18540299	Chromium (VI)	0.000162	LB	E3GAL	0.006804	LB	E3BBL	7
2103005000	16065831	Chromium III	0.000738	LB	E3GAL	0.030996	LB	E3BBL	7
2103005000	7439965	Manganese	0.00315	LB	E3GAL	0.1323	LB	E3BBL	7
2103005000	7439976	Mercury	0.000122	LB	E3GAL	0.005103	LB	E3BBL	7
2103005000	7440020	Nickel	0.09	LB	E3GAL	3.78	LB	E3BBL	7
2103005000	7782492	Selenium	0.000735	LB	E3GAL	0.03087	LB	E3BBL	7

INDUSTRIAL RESIDUAL OIL COMBUSTION

A. Source Category Description

Industrial fuel consumption includes emissions from boilers, engines, and other combustion sources from the industrial sector that are not reported as point sources.

Table 1. 2023 NEI Commercial/Institutional Residual Oil Combustion SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types

B. Overview of Calculations

Industrial residual oil combustion emissions in the 2023 National Emissions Inventory (NEI) are estimated using fuel consumption by sector from the Energy Information Administration (EIA) State Energy Data System (SEDS),[1] commercial employment from the U.S. Census Bureau,[2] and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state-level fuel consumption from SEDS, and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS codes 11--, 21--, 23--, 31--, 32-- and 33-- are used to apportion state-fuel to the county level based on the proportion of employment in the commercial sector to the total industrial sector state employment.

The total fuel consumption is adjusted to account for fuel used as an input to industrial processes where it is not combusted. Maryland assumes that 81.80% of industrial coal throughput is not combusted. This assumption is based on the EIA Manufacturing Energy Consumption Survey (MECS)[3], which reports both total fuel consumption and non-combustion use of fuel by Census region.

$$\boldsymbol{F_{f,c,x} = F_{f,x} \times \frac{a_{c,x}}{a_x} \times (1 - nc_{f,industrial})}$$

Where:

$F_{f,c,x}$ = Consumption of fuel f in county c in sector x
$F_{f,x}$ = Consumption of fuel f in sector x
$a_{c,x}$ = Employment in county c in sector x
a_x = Employment in sector x
$nc_{f,x}$ = Fraction of fuel f used as an industrial input and is not combusted in the industrial sector

The NEI uses 2022 SEDS fuel consumption and 2021 employment to estimate county-level fuel consumption for industrial residual oil combustion, as shown in Table 2.

Table 2: 2023 County Level Fuel Consumption for Industrial Residual Oil Combustion

County Name	State County FIPs	Employment	Employment Fraction	EIS SEDS Consumption (Thousand Barrels)	Non-Fuel Consumption	Fuel Consumption (Thousand Barrels)
Allegany	24001	2,886	0.011073	9	81.80%	0.0181
Anne Arundel	24003	33,165	0.127247			0.2084
Baltimore	24005	38,098	0.146174			0.2394
Calvert	24009	2,579	0.009895			0.0162
Caroline	24011	1,819	0.006979			0.0114
Carroll	24013	9,303	0.035694			0.0585
Cecil	24015	5,909	0.022672			0.0371
Charles	24017	3,827	0.014683			0.0241
Dorchester	24019	3,532	0.013552			0.0222
Frederick	24021	16,507	0.063334			0.1037
Garrett	24023	1,812	0.006952			0.0114
Harford	24025	10,313	0.039569			0.0648
Howard	24027	17,254	0.0662			0.1084
Kent	24029	1,161	0.004455			0.0073
Montgomery	24031	32,072	0.123054			0.2016
Prince Georges	24033	39,127	0.150122			0.2459
Queen Annes	24035	2,788	0.010697			0.0175
Saint Mary's	24037	2,271	0.008713			0.0143
Somerset	24039	688	0.00264			0.0043
Talbot	24041	1,673	0.006419			0.0105
Washington	24043	9,108	0.034946			0.0572
Wicomico	24045	3,923	0.015052			0.0247
Worcester	24047	1,642	0.0063			0.0103
Baltimore City	24510	19,177	0.073578			0.1205

D. Emissions Factors

The emissions factors for Industrial, Commercial and Institutional (ICI) fuel consumption sectors are from AP-42[4] and a spreadsheet developed in 2010 by EPA and the Eastern Regional Technical Advisory Committee.[5]

SO2 and filterable PM emission factors are multiplied by the state sulfur content. In Maryland, the sulfur content for industrial residual oil combustion is either 1% or 2% depending on the county.[6] Primary PM emissions are estimated by adding condensable and filterable PM.

The emissions factors for hazardous air pollutants from (HAP) are taken from EPA's 2002 NEI Documentation.[7]

Criteria air pollutant emissions factors for industrial residual oil are listed in table 3 below. HAP emissions factors for this source category are included in Appendix Table 1

Table 3: 2023 NEI Criteria Pollutant Emissions Factors for Industrial Residual Oil Combustion

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2102005000	Industrial Residual Oil	CO	210	LB/E3BBL	[5]
		NOX	2310		
		PM-CON	63		
		PM10-FIL	7.17(1.12*S+0.37)*42		
		PM10-PRI	PM10-FIL + PM-CON		
		PM25-FIL	4.67(1.12*S+0.37)*42		
		PM25-PRI	PM25-FIL + PM-CON		
		SO2	157S+42		
		VOC	11.76		

E. Controls

Emissions from residual industrial fuel combustion are controlled through Code of Maryland Regulations (COMAR) 26.11.09.07: Control of Sulfur Oxides from Fuel Burning Equipment.[8] COMAR 26.11.09.07 limits sulfur content in fuel burning equipment in Maryland to 1 or 2% depending on the county. Sulfur is limited to 1% in Baltimore City and Anne Arundel, Baltimore, Carroll, Harford, Howard, Montgomery, and Prince Georges counties. Sulfur is limited to 2% in the rest of the state.

F. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors for that sector.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x}$$

Where:

$E_{p,f,c,x}$ = Annual emissions of pollutant p from fuel type f in county c in sector x
$NPF_{f,c,x}$ = Nonpoint source consumption of fuel type f in county c in sector x (Table 2)
$EF_{p,f,x}$ = Emissions factor for pollutant p, fuel type f, and sector x (Table 3 & Appendix Table 1)

G. Point Source Subtraction

Since emissions from industrial residual oil combustion occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted.

To accomplish this task, MDE utilizes the point source registry to locate industrial residual oil combustion point sources to estimate the amount of fuel consumption to subtract from the SEDS total. Facility level annual CO2 emissions are divided by an emission factor[9], which yields the amount of fuel in the county associated with the point source emissions. The county-level fuel consumption is then adjusted downward by the amount of fuel consumed by point sources. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel adjustment for point source subtraction is calculated as follows:

$$NP_{f,c} = Ep_{CO2c,s} \times 2000 \,/\, EF_{CO2,s}$$

Where:

$NP_{f,c}$ = Nonpoint source fuel consumption in county *c* for source category *s*, in thousands of barrels per year

$Ep_{CO2,c,s}$ = Annual point CO_2 emissions for the identified point sources in county *c* for source category *s*, in tons per year

$EF_{CO2,s}$ = CO_2 emissions factor for source category *s*

The point source consumption estimates for industrial residual oil are outlined in Table 4 below.

Table 4: Point Source Consumption Adjustment for Industrial Residual Oil Combustion

County Name	FIPS State and County Code	Fuel Consumption (Thousand Barrels)	Point Source Fuel Consumption Reduction (Thousand Barrels)	Point Source Adjusted Fuel Consumption (Thousand Barrels)
Allegany	24001	0.0181	0.00	0.0181
Anne Arundel	24003	0.2084	0.00	0.2084
Baltimore	24005	0.2394	0.00	0.2394
Calvert	24009	0.0162	0.00	0.0162
Caroline	24011	0.0114	0.00	0.0114
Carroll	24013	0.0585	0.00	0.0585
Cecil	24015	0.0371	0.00	0.0371
Charles	24017	0.0241	0.00	0.0241
Dorchester	24019	0.0222	0.00	0.0222
Frederick	24021	0.1037	0.00	0.1037
Garrett	24023	0.0114	0.00	0.0114
Harford	24025	0.0648	0.00	0.0648
Howard	24027	0.1084	0.00	0.1084
Kent	24029	0.0073	0.00	0.0073
Montgomery	24031	0.2016	0.00	0.2016
Prince George's	24033	0.2459	0.00	0.2459
Queen Anne's	24035	0.0175	0.00	0.0175
St. Mary's	24037	0.0143	0.00	0.0143
Somerset	24039	0.0043	0.00	0.0043
Talbot	24041	0.0105	0.00	0.0105
Washington	24043	0.0572	0.00	0.0572
Wicomico	24045	0.0247	0.00	0.0247
Worcester	24047	0.0103	12.36	0.0000
Baltimore City	24510	0.1205	24.30	0.0000

H. Sample Calculations

Sample calculations for VOC emissions from industrial residual oil combustion in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC Emissions for Industrial Residual Oil Combustion in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{p,f,c,x}} = \boldsymbol{NPF_{f,c,x}} \times \boldsymbol{EF_{p,f,x}}$	$(0.2084\ E3BBL\ \times 11.76\ lb/E3BBL)/2000$	0.00122 tons of VOC in 2023

I. References

[1] Energy Information Administration. 2024. State Energy Data System, 2022 data. https://www.eia.gov/state/seds/

[2] U.S. Census Bureau. 2024. 2021 County Business Patterns. https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html

[3] Energy Information Administration. 2018. Manufacturing Energy Consumption Survey, 2014 data. https://www.eia.gov/consumption/manufacturing/

[4] U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed

[5] EPA and Eastern Regional Technical Advisory Committee. 2010. Excel file: state_comparison_ERTAC_SS_version7_5_Mar 16 2010.xls

[6] Code of Maryland Regulations (COMAR) 26.11.09.07: Control of Sulfur Oxides from Fuel Burning Equipment. https://dsd.maryland.gov/Pages/COMARSearch.aspx

[7] U.S. Environmental Protection Agency. 2017. Industrial, Commercial, and Institutional Fuel Consumption NEMO. https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/ICI%20NEMO%20FINAL_4-2%20updated.docx.

[8] Code of Maryland Regulations (COMAR) 26.11.09.07: Control of Sulfur Oxides from Fuel Burning Equipment. https://dsd.maryland.gov/Pages/COMARSearch.aspx

[9] Energy Information Administration. Carbon Dioxide Emissions Coefficients. September 18, 2024. https://www.eia.gov/environment/emissions/co2_vol_mass.php

APPENDIX

Table 1 Emissions Factors for Residual Oil Combustion in the Industrial Sector

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Factor Unit Numerator	Original Factor Unit Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102005000	129000	PYRENE	0.00000425	LB	E3GAL	0.0001785	LB	E3BBL	4; Table 1.3-9
2102005000	206440	FLUORANTHENE	0.00000484	LB	E3GAL	0.00020328	LB	E3BBL	4; Table 1.3-9
2102005000	50000	FORMALDEHYDE	0.033	LB	E3GAL	1.386	LB	E3BBL	4; Table 1.3-9
2102005000	71432	BENZENE	0.000214	LB	E3GAL	0.008988	LB	E3BBL	4; Table 1.3-9
2102005000	75070	ACETALDEHYDE	0.00525	LB	E3GAL	0.2205	LB	E3BBL	7
2102005000	85018	PHENANATHRENE	0.0000105	LB	E3GAL	0.000441	LB	E3BBL	4; Table 1.3-9
2102005000	86737	FLUORENE	0.0000047	LB	E3GAL	0.0001974	LB	E3BBL	4; Table 1.3-9
2102005000	91203	NAPHTHALENE	0.0013	LB	E3GAL	0.0546	LB	E3BBL	4; Table 1.3-9
2102005000	CO	CARBON MONOXIDE	5	LB	E3GAL	210	LB	E3BBL	5
2102005000	NH3	AMMONIA	0.8	LB	E3GAL	33.6	LB	E3BBL	5
2102005000	NOX	NITROGEN OXIDES	55	LB	E3GAL	2310	LB	E3BBL	5
2102005000	PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	7.17(1.12S+0.37)	LB	E3GAL	7.17(1.12S+0.37)*42	LB	E3BBL	5
2102005000	PM10-PRI	PRIMARY PM10, PRIMARY	7.17(1.12S+0.37)+1.5	LB	E3GAL	(PM10 Filterable+ PM Condensible)	LB	E3BBL	5
2102005000	PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	4.67(1.12S+0.37)	LB	E3GAL	4.67(1.12S+0.37)*42	LB	E3BBL	5
2102005000	PM25-PRI	PRIMARY PM2.5, PRIMARY	4.67(1.12S+0.37)+1.5	LB	E3GAL	(PM2.5 Filterable + PM Condensible)	LB	E3BBL	5
2102005000	PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	1.5	LB	E3GAL	63	LB	E3BBL	5
2102005000	SO2	SULFUR DIOXIDE	157S	LB	E3GAL	157S*42	LB	E3BBL	5
2102005000	VOC	VOLATILE ORGANIC COMPOUNDS	0.28	LB	E3GAL	11.76	LB	E3BBL	5
2102005000	7439921	LEAD	0.001233	LB	E3GAL	0.051786	LB	E3BBL	4; Table 1.3-10
2102005000	83329	Acenaphthene	0.0000211	LB	E3GAL	0.0008862	LB	E3BBL	4; Table 1.3-9
2102005000	7782492	Selenium	0.000735	LB	E3GAL	0.03087	LB	E3BBL	4
2102005000	7440439	Cadmium	0.00042	LB	E3GAL	0.01764	LB	E3BBL	4
2102005000	7440417	Beryllium	0.00003	LB	E3GAL	0.00126	LB	E3BBL	4
2102005000	7440382	Arsenic	0.00141	LB	E3GAL	0.05922	LB	E3BBL	4
2102005000	7440020	Nickel	0.09	LB	E3GAL	3.78	LB	E3BBL	4

2102005000	7439976	Mercury	0.0001215	LB	E3GAL	0.005103	LB	E3BBL	4
2102005000	7439965	Manganese	0.00315	LB	E3GAL	0.1323	LB	E3BBL	4
2102005000	56832736	Benzofluoranthenes	0.00000148	LB	E3GAL	0.00006216	LB	E3BBL	4; Table 1.3-9
2102005000	56553	Benz[a]Anthracene	0.00000401	LB	E3GAL	0.00016842	LB	E3BBL	4; Table 1.3-9
2102005000	53703	Dibenzo[a,h]Anthracene	0.00000167	LB	E3GAL	0.00007014	LB	E3BBL	4; Table 1.3-9
2102005000	218019	Chrysene	0.00000238	LB	E3GAL	0.00009996	LB	E3BBL	4; Table 1.3-9
2102005000	208968	Acenaphthylene	0.000000211	LB	E3GAL	0.000008862	LB	E3BBL	4; Table 1.3-9
2102005000	193395	Indeno[1,2,3-c,d]Pyrene	0.00000214	LB	E3GAL	0.00008988	LB	E3BBL	4; Table 1.3-9
2102005000	191242	Benzo[g,h,i,]Perylene	0.000002426	LB	E3GAL	0.000101892	LB	E3BBL	4; Table 1.3-9
2102005000	18540299	Chromium (VI)	0.000162	LB	E3GAL	0.006804	LB	E3BBL	4
2102005000	16065831	Chromium III	0.000738	LB	E3GAL	0.030996	LB	E3BBL	4
2102005000	120127	Anthracene	0.00000122	LB	E3GAL	0.00005124	LB	E3BBL	4; Table 1.3-9

GASOLINE MARKETING - TANK TRUCKS IN TRANSIT

A. Source Category Description

Emissions from gasoline distribution occur as gasoline vapors are released into the atmosphere. Gasoline distribution emissions occur under a variety of conditions (including: 1) bulk terminals; 2) pipeline facilities; 3) bulk plants; 4) tank trucks; and 5) unloading at service stations). Breathing losses from tank trucks during the transport of gasoline are caused by leaking delivery trucks, pressure in the tanks, and thermal effects on the vapor and on the liquid.

Table 1: 2023 NEI Stage I Gasoline – Tank Trucks in Transit

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline

B. Overview of Calculations

Tank trucks in transit Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using gasoline consumption and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated using speciation profiles from Hester et al. with the exception of benzene. [1] Speciation profiles for benzene emissions from bulk plants are based on county-specific refueling emissions data from MOVES. [2] .

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

The activity data for Tank Trucks in Transit is county-level total gasoline consumption. The Comptroller for the State of Maryland, Gasoline Tax Division, provides annual gallons of gasoline sold in the State.[3] The statewide total gallons of fuel sold is allocated to the county using the percentage of total registered vehicles in each county. Vehicle registration data is collected from the Maryland Department of Transportation, Motor Vehicle Administration and provided to Maryland Department of the Environment Mobile Sources Control Program. County-level throughput is adjusted by a factor of 1.09 to account for gasoline that is transported more than once in a given area (i.e. transported from bulk terminal to bulk plant and then from bulk plant to service station).[4] The 2023 NEI uses 2023 fuel consumption estimates, as shown in Table 2.

Table 2: 2023 County Level Fuel Consumption

County Name	State County FIPs	Total Gasoline Sold in MD (Gallons)	Registered Vehicles in MD	Registered Vehicles per County	Gasoline Consumption (Thousand Gallons)	Multi-Location Transport Factor	Total Gasoline Transported by Tank Trucks (Thousand Gallons)
Allegany	24001			56,350	29,683		32,355
Anne Arundel	24003			542,133	285,578		311,280

Baltimore	24005			648,563	341,642		372,390
Calvert	24009			84,308	44,411		48,408
Caroline	24011			39,419	20,765		22,633
Carroll	24013			167,900	88,444		96,404
Cecil	24015			88,029	46,371		50,544
Charles	24017			147,799	77,856		84,863
Dorchester	24019			29,505	15,542		16,941
Frederick	24021			248,648	130,980		142,768
Garrett	24023	2,547,654,857	4,836,394	28,430	14,976	1.09	16,324
Harford	24025			229,294	120,785		131,655
Howard	24027			270,743	142,619		155,454
Kent	24029			18,727	9,865		10,753
Montgomery	24031			785,671	413,866		451,114
Prince Georges	24033			692,524	364,799		397,631
Queen Annes	24035			52,009	27,397		29,862
Saint Mary's	24037			105,976	55,825		60,849
Somerset	24039			17,891	9,424		10,273
Talbot	24041			38,791	20,434		22,273
Washington	24043			130,568	68,779		74,969
Wicomico	24045			85,366	44,968		49,015
Worcester	24047			56,124	29,564		32,225
Baltimore City	24510			271,626	143,084		155,961

D. Emissions Factors

The VOC emissions factor for tank trucks in transit is 0.06 pounds of VOC per 1,000 gallons of gasoline.[5] The VOC emission factor is the sum of the individual emission factors reported in the Gasoline Distribution EIIP guidance document for gasoline-filled trucks (traveling to service station/bulk plant for delivery) and vapor-filled trucks (traveling to bulk terminal/plant for reloading).

VOC emission factors for all underground storage tank breathing and emptying are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factor for Tank Trucks in Transit

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2505030120	Tank Trucks in Transit	VOC	0.06	lb/kgal	[5]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from Tank Trucks in Transit are calculated by multiplying county-level gasoline consumption by the VOC emission factor.

$$E_{VOC,c,ttt} = EF_{VOC,ttt} \times \frac{GC_{c,t}}{\mathbf{2,000\ pounds\ to\ tons\ conversion}}$$

Where:

$E_{VOC,c,ttt}$ = Annual VOC emissions in county *c* from Tank Trucks in Transit, in tons per year
$EF_{VOC,ttt}$ = Emissions factor for VOC from Tank Trucks in Transit, in pounds per 1,000 gallons (Table 3)
$GC_{c,t}$ = Gasoline consumption for county *c* for Tank Trucks in Transit, in thousand gallons (Section C)

HAP emissions are estimated using the VOC emissions and HAP speciation factors (See Table 1 in Appendix).

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s*

G. Point Source Subtraction

Since emissions from underground Tank Trucks in Transit occur from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Maryland has no facilities that report underground storage tank breathing and emptying emissions as part of its point-source emissions. Point-source subtraction is unnecessary.

H. Sample Calculations

Sample calculations for VOC emissions from Tank Trucks in Transit in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Tank Trucks in Transit in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,ttt}} = GC_{c,s} \times \boldsymbol{EF_{VOC,ttt}}$	$\left(311{,}280\ kgal \times 0.06 \frac{lb/kgal}{2000}\right)$	9.34 tons of VOC in 2023

I. References

[1] Hester, Charles, MACTEC, Inc. Memorandum from Charles Hester, MACTEC, Inc., to Stephen Shedd, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, "Review of Data on HAP Content in Gasoline," May 18, 2006.

[2] U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Chapter 7: Liquid Storage Tanks," Office of Air Quality Planning and Standards, Emission Inventory Group, September 1997.

[3] Comptroller of Maryland Revenue Administration Division Motor Fuel Tax Comparative Statement of Gallons Sold for Calendar Year 2022 and 2021. https://www.marylandtaxes.gov/reports/static-files/revenue/motorfuel/gallonssold/gallonsoldFY2022-2023.pdf.

[4] Cavalier, Julia, MACTEC, Inc., personal communication, "RE: Percentage of Gasoline Transported Twice By Truck," with Stephen Shedd, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, July 6, 2004.

[5] Eastern Research Group, Inc., "Volume III: Chapter 11, Gasoline Marketing (Stage I and Stage II), Revised Final," prepared for the Emission Inventory Improvement Program, January 2001.

APPENDIX

Table 1. HAP speciation factors for Gasoline Marketing Stage 1 Tank Trucks in Transit. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor
250503120	Tank Trucks in Transit	71432	Benzene	0.002886931
250503120	Tank Trucks in Transit	91203	Naphthalene	0.000002700
250503120	Tank Trucks in Transit	98828	Cumene	0.000120000
250503120	Tank Trucks in Transit	100414	Ethyl Benzene	0.000530000
250503120	Tank Trucks in Transit	108883	Toluene	0.014000000
250503120	Tank Trucks in Transit	110543	n-Hexane	0.018000000
250503120	Tank Trucks in Transit	540841	2,2,4-Trimethylpentane	0.007500000
250503120	Tank Trucks in Transit	1330207	Xylenes	0.005600000

Table 2. Point-Nonpoint Crosswalk for Tank Truck in Transit

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40400154	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Tank Truck Vapor Leaks	2505030120	Storage and Transport; Tank Trucks in Transit, Gasoline
40400254	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Tank Truck Vapor Losses	2505030120	Storage and Transport; Tank Trucks in Transit, Gasoline
40600162	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Loaded with Fuel (Transit Losses)	2505030120	Storage and Transport; Tank Trucks in Transit, Gasoline
40600163	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Return with Vapor (Transit Losses)	2505030120	Storage and Transport; Tank Trucks in Transit, Gasoline

GASOLINE MARKETING – TANK TRUCK UNLOADING

A. Source Category Description

Emissions from gasoline distribution occur as gasoline vapors are released into the atmosphere. Gasoline distribution emissions occur under a variety of conditions (including: 1) bulk terminals; 2) pipeline facilities; 3) bulk plants; 4) tank trucks; and 5) unloading at service stations). Gasoline service station unloading (i.e. tank truck unloading) emissions occur when gasoline vapors are displaced from storage tanks during unloading of gasoline from tank trucks.

Table 1: 2023 NEI Stage I Gasoline – Tank Truck Unloading SCC.

SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2501060053	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Balanced Submerged Filling
2501060051	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Submerged Filling

B. Overview of Calculations

Tank Truck Unloading Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using gasoline consumption and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated using speciation profiles from Hester et al. with the exception of benzene.[1] Speciation profiles for benzene emissions are based on county-specific emissions data from MOVES.[2]

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

The activity data for tank truck unloading is county-level total gasoline consumption. The Comptroller for the State of Maryland, Gasoline Tax Division, provides annual gallons of gasoline sold in the State.[3] The statewide total gallons of fuel sold is allocated to the county using the percentage of total registered vehicles in each county. Vehicle registration data is collected from the Maryland Department of Transportation, Motor Vehicle Administration and provided to Maryland Department of the Environment Mobile Sources Control Program. The 2023 NEI uses 2022 fuel consumption estimates, as shown in Table 2.

Table 2: 2022 County Level Fuel Consumption

County Name	State County FIPs	Total Gasoline Sold in MD (Gallons)	Registered Vehicles in MD	Registered Vehicles per County	Gasoline Consumption (thousand gallons)
Allegany	24001			56,350	29,683
Anne Arundel	24003			542,133	285,578
Baltimore	24005			648,563	341,642
Calvert	24009			84,308	44,411
Caroline	24011			39,419	20,765
Carroll	24013			167,900	88,444
Cecil	24015			88,029	46,371

Charles	24017	2,547,654,857	4,836,394	147,799	77,856
Dorchester	24019			29,505	15,542
Frederick	24021			248,648	130,980
Garrett	24023			28,430	14,976
Harford	24025			229,294	120,785
Howard	24027			270,743	142,619
Kent	24029			18,727	9,865
Montgomery	24031			785,671	413,866
Prince Georges	24033			692,524	364,799
Queen Annes	24035			52,009	27,397
Saint Mary's	24037			105,976	55,825
Somerset	24039			17,891	9,424
Talbot	24041			38,791	20,434
Washington	24043			130,568	68,779
Wicomico	24045			85,366	44,968
Worcester	24047			56,124	29,564
Baltimore City	24510			271,626	143,084

D. Emissions Factors

The VOC emissions factor for tank truck unloading is 0.3 pounds per 1,000 gallons throughput for balanced submerged filling and 7.3 pounds per 1,000 gallons throughput for submerged filling. The VOC emissions factors for tank truck unloading is recommended by the AP-42 Section 5.2: Transportation and Marketing of Petroleum Liquids.[4] The VOC emission factor is then adjusted with county-specific monthly average temperature and true vapor pressure values.

VOC emission factors for all underground storage tank breathing and emptying are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Tank Truck Unloading

County Name	State County FIPs	Balanced Submerged Emission Factor (lb/kgal)	Submerged Emission Factor (lb/kgal)
Allegany	24001	0.318904178077	7.760001666537
Anne Arundel	24003	0.308884750905	7.516195605361
Baltimore	24005	0.297670525189	7.243316112937
Calvert	24009	0.309647667695	7.534759913914
Caroline	24011	0.343225731123	8.351826123984
Carroll	24013	0.290452348744	7.067673819437
Cecil	24015	0.294420006769	7.164220164710
Charles	24017	0.310151061654	7.547009166909
Dorchester	24019	0.351852346697	8.561740436303
Frederick	24021	0.292649736063	7.121143577522
Garrett	24023	0.298844131040	7.271873855298
Harford	24025	0.294773877841	7.172831027459
Howard	24027	0.297517488415	7.239592218101
Kent	24029	0.301806532286	7.343958952304
Montgomery	24031	0.299046379512	7.276795234783
Prince Georges	24033	0.305088842107	7.423828491280

Queen Annes	24035	0.302947634220	7.371725766009
Saint Mary's	24037	0.352783631820	8.584401707622
Somerset	24039	0.355509214840	8.650724227776
Talbot	24041	0.346342081225	8.427657309801
Washington	24043	0.327441397421	7.967740670586
Wicomico	24045	0.351918214882	8.563343228786
Worcester	24047	0.352687957598	8.582073634877
Baltimore City	24510	0.310359986607	7.552093007425

E. Controls

Controls are reflected in the VOC emissions factor. Under the Clean Air Act, counties included in an ozone nonattainment area in Maryland are required to use reformulated gasoline or RFG. RFG is specially formulated to reduce emissions from automobiles. At a minimum, RFG must have an oxygen content of at least 2% by weight, must have a benzene content no greater than 1% by volume and not contain any heavy metals. Covered areas in Maryland are Baltimore City and the counties of Anne Arundel, Baltimore, Calvert, Carroll, Cecil, Charles, Frederick, Harford, Howard, Kent, Montgomery, Prince George's and Queen Anne's.[5]

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

Emissions are further multiplied by a fuel filling technology fraction. All underground storage tanks within nonattainment areas in the state of Maryland are required to use vapor-balance submerged filling methods. In Nonattainment and transport region counties, it is assumed that 91% of gasoline dispensed is attributable to balanced submerged filling and 9% is attributable to submerged filling, based on a study of Stage I compliance performed by MDE. In the remaining counties, it is assumed that 80% of gasoline dispensed is attributable to balanced submerged filling and 20% is attributable to submerged filling.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times SCC\ Fraction}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)
SCC Fraction = Fuel Filling Technology Fraction

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix).

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year

$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

G. Point Source Subtraction

Since emissions from tank truck unloading occur from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Point source subtraction for this sector is completed at the county level through adjusting fuel consumption. Facility level annual emissions from the mapped SCCs are divided by the *uncontrolled* emission factor, which yields the fuel consumption in the county associated with the source category. The county fuel consumption is then adjusted downward by the number of gallons. Nonpoint emissions are then estimated using the point source adjusted fuel consumption. The resultant emissions represent emissions only associated with nonpoint activity.

The fuel consumption adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{f,c} = Ep_{VOC,c,s} \times 2000 \,/\, EF_{VOC,s}}$$

Where:

$NP_{s,c}$ = Nonpoint source fuel consumption in county c for source category s, in kgal per year
$Ep_{VOC,c,s}$ = Annual point VOC emissions for the mapped SCCs in county c for source category s, in tons per year
$EF_{VOC,s}$ = Uncontrolled VOC emissions factor for source category s

The point source fuel consumption estimates for tank truck unloading is outlined in Table 4 below.

Table 4: Point Source Gasoline Consumption Adjustment for Tank Truck Unloading

FIPS State and County Code	County Name	County Type	Point Source VOC (Tons)	Total County Thousand Gallons for Facilities	Gasoline Consumption (thousand gallons)
24001	Allegany	County	0.00	0	29,683
24003	Anne Arundel	County	0.00	0	285,578
24005	Baltimore	County	0.37	193.6086178	341,448
24009	Calvert	County	0.00	0	44,411
24011	Caroline	County	0.00	0	20,765
24013	Carroll	County	0.00	0	88,444
24015	Cecil	County	0.14	74.38353202	46,296
24017	Charles	County	0.73	371.635542	77,484
24019	Dorchester	County	0.00	0	15,542
24021	Frederick	County	0.00	0	130,980
24023	Garrett	County	0.34	177.4204246	14,799
24025	Harford	County	0.00	0	120,785

24027	Howard	County	0.97	517.2009101	142,101
24029	Kent	County	0.00	0	9,865
24031	Montgomery	County	0.00	0	413,866
24033	Prince George's	County	0.91	472.252431	364,327
24035	Queen Anne's	County	0.00	0	27,397
24037	St. Mary's	County	5.48	2450.435922	53,374
24039	Somerset	County	0.00	0	9,424
24041	Talbot	County	0.00	0	20,434
24043	Washington	County	0.00	0	68,779
24045	Wicomico	County	0.00	0	44,968
24047	Worcester	County	0.00	0	29,564
24510	Baltimore	City	0.00	0	143,084

H. Sample Calculations

Sample calculations for VOC emissions from tank truck unloading, submerged filling in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Tank Truck Unloading, Submerged Filling (scc: 2501060051) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s}} = \boldsymbol{A_{c,s}} \times \boldsymbol{EF_{VOC,s}} \times \boldsymbol{Fraction}$	$285{,}578\text{kgal} \times 7.516\ lb\ VOC/Kgal \times 0.09 \times \frac{1\ ton}{2000\ lbs}$	96.6 tons of VOC in 2023

I. References

[1] Hester, Charles, MACTEC, Inc. Memorandum from Charles Hester, MACTEC, Inc., to Stephen Shedd, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, "Review of Data on HAP Content in Gasoline," May 18, 2006.

[2] U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Chapter 7: Liquid Storage Tanks," Office of Air Quality Planning and Standards, Emission Inventory Group, September 1997.

[3] Comptroller of Maryland Revenue Administration Division Motor Fuel Tax Comparative Statement of Gallons Sold for Calendar Year 2022 and 2021. https://www.marylandtaxes.gov/reports/static-files/revenue/motorfuel/gallonssold/gallonsoldFY2021-2022.pdf.

[4] U.S. Environmental Protection Agency. AP-42 Section 5.2: Transportation and Marketing of Petroleum Liquids. https://www.epa.gov/sites/default/files/2020-09/documents/5.2_transportation_and_marketing_of_petroleum_liquids.pdf

[5] 42 U.S.C. 7545(k)(10)(D)..

APPENDIX

Table 1. HAP speciation factors for Stage I Gasoline – Tank Truck Unloading. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor
2501060051 2501060053	Gasoline Marketing Stage 1	71432	Benzene	0.0027
2501060053 2501060052	Gasoline Marketing Stage 1	540841	2,2,4-Trimethylpentane	0.0075
2501060053 2501060052	Gasoline Marketing Stage 1	98828	Cumene	0.00012
2501060053 2501060052	Gasoline Marketing Stage 1	100414	Ethyl Benzene	0.00053
2501060053 2501060052	Gasoline Marketing Stage 1	110543	n-Hexane	0.018
2501060053 2501060052	Gasoline Marketing Stage 1	91203	Naphthalene	0.0000027
2501060053 2501060052	Gasoline Marketing Stage 1	108883	Toluene	0.014
2501060053 2501060052	Gasoline Marketing Stage 1	1330207	Xylenes	0.0056

Table 2. Point-Nonpoint Crosswalk for Stage I Gasoline – Tank Truck Unloading

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40600305	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Unloading **	2501060053	Service Station Unloading, Balanced
40600306	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Balanced Submerged Filling	2501060053	Service Station Unloading, Balanced
40600399	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Other Not Elsewhere Classified	2501060053	Service Station Unloading, Balanced
40600706	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Balanced Submerged Filling	2501060053	Service Station Unloading, Balanced
40600302	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Submerged Filling w/o Controls	2501060051	Service Station Unloading, Submerged

40600702	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Submerged Filling w/o Controls	2501060051	Service Station Unloading, Submerged

GASOLINE MARKETING – UNDERGROUND STORAGE TANK BREATHING & EMPTYING

A. Source Category Description

Emissions from gasoline distribution occur as gasoline vapors are released into the atmosphere. Gasoline distribution emissions occur under a variety of conditions (including: 1) bulk terminals; 2) pipeline facilities; 3) bulk plants; 4) tank trucks; and 5) unloading at service stations). Emissions from underground storage tanks occurs when gasoline vapors evaporate from service station tanks and from the lines going to the pumps.

Table 1: 2023 NEI Stage I Gasoline – Underground Storage Tank Breathing and Emptying SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
250106201	Storage & Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Underground Tank: Breathing & Emptying

B. Overview of Calculations

Underground Storage Tank Breathing and Emptying Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using gasoline consumption and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated using speciation profiles from Hester et al. with the exception of benzene.[1] Speciation profiles for benzene emissions are based on county-specific emissions data from MOVES.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

The activity data for underground storage tank breathing and emptying is county-level total gasoline consumption. The Comptroller for the State of Maryland, Gasoline Tax Division, provides annual gallons of gasoline sold in the State.[2] The statewide total gallons of fuel sold is allocated to the county using the percentage of total registered vehicles in each county. Vehicle registration data is collected from the Maryland Department of Transportation, Motor Vehicle Administration and provided to Maryland Department of the Environment Mobile Sources Control Program. The 2023 NEI uses 2023 fuel consumption estimates, as shown in Table 2.

Table 2: 2022 County Level Fuel Consumption

County Name	State County FIPs	Total Gasoline Sold in MD (Gallons)	Registered Vehicles in MD	Registered Vehicles per County	Gasoline Consumption (thousand gallons)
Allegany	24001			56,350	29,683
Anne Arundel	24003			542,133	285,578
Baltimore	24005			648,563	341,642
Calvert	24009			84,308	44,411
Caroline	24011			39,419	20,765
Carroll	24013			167,900	88,444

Cecil	24015	2,547,654,857	4,836,394	88,029	46,371
Charles	24017			147,799	77,856
Dorchester	24019			29,505	15,542
Frederick	24021			248,648	130,980
Garrett	24023			28,430	14,976
Harford	24025			229,294	120,785
Howard	24027			270,743	142,619
Kent	24029			18,727	9,865
Montgomery	24031			785,671	413,866
Prince Georges	24033			692,524	364,799
Queen Annes	24035			52,009	27,397
Saint Mary's	24037			105,976	55,825
Somerset	24039			17,891	9,424
Talbot	24041			38,791	20,434
Washington	24043			130,568	68,779
Wicomico	24045			85,366	44,968
Worcester	24047			56,124	29,564
Baltimore City	24510			271,626	143,084

D. Emissions Factors

The VOC emissions factor for underground storage tank breathing and storing is 1 pound per 1,000 gallons throughput. The VOC emissions factor for underground storage tank breathing and storing is recommended by the Gasoline Distribution EIIP guidance document.[3] The VOC emission factor is then adjusted with county-specific monthly average temperature and true vapor pressure values.

VOC emission factors for all underground storage tank breathing and emptying are listed in table 3 below.

Table 3: 2023 NEI VOC emissions factors for Underground Storage Tank Breathing and Emptying

County Name	State County FIPs	Emission Factor	Unit
Allegany	24001	1.063013926923	lb/1,000 gal
Anne Arundel	24003	1.029615836351	lb/1,000 gal
Baltimore	24005	0.992235083964	lb/1,000 gal
Calvert	24009	1.071721729233	lb/1,000 gal
Caroline	24011	1.144085770409	lb/1,000 gal
Carroll	24013	0.968174495813	lb/1,000 gal
Cecil	24015	0.981400022563	lb/1,000 gal
Charles	24017	1.033836872179	lb/1,000 gal
Dorchester	24019	1.172841155658	lb/1,000 gal
Frederick	24021	0.975499120208	lb/1,000 gal
Garrett	24023	0.996147103465	lb/1,000 gal
Harford	24025	1.022740485120	lb/1,000 gal
Howard	24027	0.991724961384	lb/1,000 gal
Kent	24029	1.006021774288	lb/1,000 gal
Montgomery	24031	0.996821265039	lb/1,000 gal
Prince Georges	24033	1.016962807025	lb/1,000 gal

Queen Annes	24035	1.009825447399	lb/1,000 gal
Saint Mary's	24037	1.175945439400	lb/1,000 gal
Somerset	24039	1.185030716134	lb/1,000 gal
Talbot	24041	1.154473604082	lb/1,000 gal
Washington	24043	1.091471324738	lb/1,000 gal
Wicomico	24045	1.173060716272	lb/1,000 gal
Worcester	24047	1.175626525326	lb/1,000 gal
Baltimore City	24510	1.034533288688	lb/1,000 gal

E. Controls

Controls are reflected in the VOC emissions factor. Under the Clean Air Act, counties included in an ozone nonattainment area in Maryland are required to use reformulated gasoline or RFG. RFG is specially formulated to reduce emissions from automobiles. At a minimum, RFG must have an oxygen content of at least 2% by weight, must have a benzene content no greater than 1% by volume and not contain any heavy metals. Covered areas in Maryland are Baltimore City and the counties of Anne Arundel, Baltimore, Calvert, Carroll, Cecil, Charles, Frederick, Harford, Howard, Kent, Montgomery, Prince George's and Queen Anne's.[4]

F. Emissions

Total VOC emissions from underground storage tank breathing and emptying are calculated by multiplying county-level gasoline consumption by the VOC emission.

$$\boldsymbol{E_{VOC,c,ust} = EF_{VOC,ust} \times \frac{GC_{c,t}}{2,000\ pounds\ to\ tons\ conversion}}$$

Where:

$E_{VOC,c,ust}$ = Annual VOC emissions in county *c* from Underground Storage Tank breathing and emptying, in tons per year

$EF_{VOC,ust}$ = Emissions factor for VOC from Underground Storage Tank breathing and emptying, in pounds per 1,000 gallons (Table 3)

$GC_{c,t}$ = Gasoline consumption for county *c* for Underground Storage Tank breathing and emptying, in thousand gallons (Section C)

HAP emissions are estimated using the VOC emissions and HAP speciation factors (See Table 1 in Appendix).

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year

$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s*

G. Point Source Subtraction

Since emissions from underground storage tank breathing and emptying occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Maryland has no facilities that report underground storage tank breathing and emptying emissions as part of its point-source emissions. Point-source subtraction is unnecessary.

H. Sample Calculations

Sample calculations for VOC emissions from Stage I Gasoline Underground Storage Tank Breathing and Emptying in Anne Arundel County, Maryland are included in the table below.

Table 4: Sample Calculations of VOC emissions for Stage I Gasoline – Underground Storage Tank Breathing and Emptying in Anne Arundel County

Eq. #	Equation	Values for Anne Arundel County	Result
1	$E_{VOC,c,ust} = EF_{VOC,ust} \times \frac{GC_{c,t}}{2{,}000\ pounds\ to\ tons\ conversion}$	$1.029615836 \frac{lb}{1{,}000} gallons \times \frac{285{,}578\ thousand gallons\ consumed}{2{,}000\ pounds\ to\ tons\ conversion}$	147.0178 tons of VOC in 2023

I. References

[1] Hester, Charles, MACTEC, Inc. Memorandum from Charles Hester, MACTEC, Inc., to Stephen Shedd, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, "Review of Data on HAP Content in Gasoline," May 18, 2006. AND U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Chapter 7: Liquid Storage Tanks," Office of Air Quality Planning and Standards, Emission Inventory Group, September 1997.

[2] Comptroller of Maryland Revenue Administration Division Motor Fuel Tax Comparative Statement of Gallons Sold for Calendar Year 2022 and 2021. https://www.marylandtaxes.gov/reports/static-files/revenue/motorfuel/gallonssold/gallonsoldFY2021-2022.pdf.

[3] Eastern Research Group, Inc., "Volume III: Chapter 11, Gasoline Marketing (Stage I and Stage II), Revised Final," prepared for the Emission Inventory Improvement Program, January 2001.

[4] 42 U.S.C. 7545(k)(10)(D).

APPENDIX

Table 1. HAP speciation factors for Underground Storage Tank Breathing and Emptying. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor
250106201	Underground Tank: Breathing & Emptying	71432	Benzene	0.0027
250106201	Underground Tank: Breathing & Emptying	540841	2,2,4-Trimethylpentane	0.0075
250106201	Underground Tank: Breathing & Emptying	98828	Cumene	0.00012
250106201	Underground Tank: Breathing & Emptying	100414	Ethyl Benzene	0.00053
250106201	Underground Tank: Breathing & Emptying	110543	n-Hexane	0.018
250106201	Underground Tank: Breathing & Emptying	91203	Naphthalene	0.0000027
250106201	Underground Tank: Breathing & Emptying	108883	Toluene	0.014
250106201	Underground Tank: Breathing & Emptying	1330207	Xylenes	0.0056

Table 2. Point-Nonpoint Crosswalk for Stage I Gasoline – Underground Storage Tank Breathing and Emptying

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40600307	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Underground Tank Breathing and Emptying	2501060201	Storage and Transport; UST Breathing and Emptying; Gasoline
40600707	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Underground Tank Breathing and Emptying	2501060201	Storage and Transport; UST Breathing and Emptying; Gasoline

GRAPHIC ARTS

A. Source Category Description

Graphic arts include operations that are involved in the printing of newspapers, magazines, books and other printed materials. There are six basic operations used in graphic arts: lithography, gravure, letterpress, flexography, screen printing and metal decorating (plateless).

Table 1: 2023 NEI Solvent Utilization Graphic Arts

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types
2425010000	Solvent Utilization	Graphic Arts	Lithography	Total: All Solvent Types
2425020000	Solvent Utilization	Graphic Arts	Letterpress	Total: All Solvent Types
2425030000	Solvent Utilization	Graphic Arts	Rotogravure	Total: All Solvent Types
2425040000	Solvent Utilization	Graphic Arts	Flexography	Total: All Solvent Types

B. Overview of Calculations

Graphic Arts Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using population and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level population data from the U.S. Census Bureau.[2] Activity is further apportioned down to the SCC's using a percentage of Market Share from *Air Emissions Inventory Improvement Program Volume III; Chapter 7; Graphic Arts.*[3] The 2023 NEI uses print-type apportioned 2023 population estimates, as shown in Table 2.

Table 2: 2023 County Level Population

County Name	State County FIPs	Population for Inventory Year	Screen & Plateless (6%)	Offset Lithography (47%)	Letterpress (8%)	Rotogravure (18%)	Flexography (18%)
Allegany	24001	67,273	4,036	31,618	5,382	12,109	12,109
Anne Arundel	24003	594,582	35,675	279,454	47,567	107,025	107,025
Baltimore	24005	844,703	50,682	397,010	67,576	152,047	152,047
Calvert	24009	94,728	5,684	44,522	7,578	17,051	17,051
Caroline	24011	33,593	2,016	15,789	2,687	6,047	6,047

Carroll	24013	176,639	10,598	83,020	14,131	31,795	31,795
Cecil	24015	105,672	6,340	49,666	8,454	19,021	19,021
Charles	24017	171,973	10,318	80,827	13,758	30,955	30,955
Dorchester	24019	32,879	1,973	15,453	2,630	5,918	5,918
Frederick	24021	293,391	17,603	137,894	23,471	52,810	52,810
Garrett	24023	28,423	1,705	13,359	2,274	5,116	5,116
Harford	24025	264,644	15,879	124,383	21,172	47,636	47,636
Howard	24027	336,001	20,160	157,920	26,880	60,480	60,480
Kent	24029	19,303	1,158	9,072	1,544	3,475	3,475
Montgomery	24031	1,058,474	63,508	497,483	84,678	190,525	190,525
Prince Georges	24033	947,430	56,846	445,292	75,794	170,537	170,537
Queen Annes	24035	52,508	3,150	24,679	4,201	9,451	9,451
Saint Mary's	24037	115,281	6,917	54,182	9,222	20,751	20,751
Somerset	24039	24,910	1,495	11,708	1,993	4,484	4,484
Talbot	24041	37,823	2,269	17,777	3,026	6,808	6,808
Washington	24043	155,813	9,349	73,232	12,465	28,046	28,046
Wicomico	24045	104,800	6,288	49,256	8,384	18,864	18,864
Worcester	24047	54,171	3,250	25,460	4,334	9,751	9,751
Baltimore City	24510	565,239	33,914	265,662	45,219	101,743	101,743
Total		6,180,253	370,815	2,904,719	494,420	1,112,446	1,112,446

D. Emissions Factors

The recommended emission factor is 1.3 pounds of VOC per person per year, from *Air Emissions Inventory Improvement Program Volume III; Chapter 7; Graphic Arts.*[4] This represents the "uncontrolled" emission factor. MDE adjusts the uncontrolled emission factor through the implementation of three distinct rules aimed at reducing VOC emissions through product reformulation. Control programs are further discussed in Section E.

VOC emission factors for graphic arts SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Graphic Arts

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2425000000	Graphic Arts	VOC	1.3	lb/person	[5]
2425010000					
2425020000					
2425030000					
2425040000					

E. Controls

VOC emissions from cold clean degreasing are controlled through Code of Maryland Regulations (COMAR) 26.11.19: Volatile Organic Compounds from Specific Processes.[6] COMAR 26.11.19.10 addresses flexographic and rotogravure printing, and reduces emissions by, amongst other processes, requiring the use of low-VOC water-based paints. COMAR 26.11.19.11 addresses lithographic and letterpress printing and reduces emissions through, amongst other processes, prescribing the fountain

solution conditions and cleaning conditions. COMAR 26.11.19.18 addresses screen printing and reduces emissions by, amongst other processes, requiring the use of low-VOC ink.

The control efficiency for each regulation is based on data from each rulemakings technical support document. MDE assumes a 100% rule penetration and an 80% rule effectiveness. The final controlled reduction factor is outlined in Table 4 below.

Table 4. Control Factor for Graphic Arts

SCC	Type of Printing Operation	Control Efficiency	Rule Effectiveness	Rule Penetration	Reduction factor	SOURCE (COMAR)
2425000000	Screen & Plateless	0.350	0.800	1.000	0.2800	COMAR 26.11.19.18
2425010000	Lithographic	0.750	0.800	1.000	0.6000	COMAR 26.11.19.11
2425020000	Letterpress	0.000	0.800	1.000	0.0000	COMAR 26.11.19.11
2425030000	Rotogravure	0.630	0.800	1.000	0.5040	COMAR 26.11.19.10
2425040000	Flexographic	0.540	0.800	1.000	0.4320	COMAR 26.11.19.10

F. Emissions

Total VOC emissions from graphic arts are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = VOC emissions factor for source category s (Table 3)
RE = Rule Effectiveness with source category s
RP = Rule Penetration with source category s
CE = Control Efficiency with source category s

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

G. Point Source Subtraction

Since emissions from Graphic Arts occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Point source subtraction for this sector is completed at the county level through adjusting population. Facility level annual emissions from the mapped SCCs are divided by the *uncontrolled* emission factor, which yields the number of people in the county associated with the source category. The county population is then adjusted downward by the number of people. Nonpoint emissions are then estimated using the point source adjusted population. The resultant emissions represent emissions only associated with nonpoint activity.

The population adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{e,c} = Ep_{VOCc,s} \times 2000 \,/\, EF_{VOC,s}}$$

Where:

$NP_{s,c}$ = Nonpoint source population in county c for source category s, in tons per year
$Ep_{VOC,c,s}$ = Annual point VOC emissions for the mapped SCCs in county c for source category s, in tons per year
$EF_{VOC,s}$ = Uncontrolled VOC emissions factor for source category s

The point source population estimates for surface coating of Graphic Arts is outlined in Table 5 below.

Table 5: Point Source Population Adjustment for Graphic Arts

FIPS State and County Code	FIPS State Code	FIPS County Code	County Name	County Type	Postal State Code	Point Source Reduction VOC (tpy)	Total County Population for Point Source Subtraction
24001	24	001	Allegany	County	MD	0.00	0
24003	24	003	Anne Arundel	County	MD	0.00	0
24005	24	005	Baltimore	County	MD	14.16	21,785
24009	24	009	Calvert	County	MD	0.00	0
24011	24	011	Caroline	County	MD	12.64	19,445
24013	24	013	Carroll	County	MD	0.00	0
24015	24	015	Cecil	County	MD	0.00	0
24017	24	017	Charles	County	MD	2.60	4,004
24019	24	019	Dorchester	County	MD	0.00	0
24021	24	021	Frederick	County	MD	0.00	0
24023	24	023	Garrett	County	MD	0.00	0
24025	24	025	Harford	County	MD	10.26	15,785
24027	24	027	Howard	County	MD	0.00	0
24029	24	029	Kent	County	MD	0.00	0
24031	24	031	Montgomery	County	MD	0.00	0

24033	24	033	Prince George's	County	MD	0.00	0
24035	24	035	Queen Anne's	County	MD	21.08	32,430
24037	24	037	St. Mary's	County	MD	0.00	0
24039	24	039	Somerset	County	MD	0.00	0
24041	24	041	Talbot	County	MD	0.00	0
24043	24	043	Washington	County	MD	14.33	22,046
24045	24	045	Wicomico	County	MD	2.46	3,779
24047	24	047	Worcester	County	MD	0.00	0
24510	24	510	Baltimore	City	MD	43.03	66,200

H. Sample Calculations

Sample calculations for VOC emissions from Graphic Arts in Anne Arundel County, Maryland are included in the table below.

Table 6. Sample Calculations of VOC emissions for Screen & Plateless Graphic Arts in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$\left(35{,}675\ people\ \times 1.3 \frac{lb/person}{2000} \times [\mathbf{1} - \mathbf{0.35} \times \mathbf{0.8} \times \mathbf{1}\right)$	16.7 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] Eastern Research Group, Inc. Volume III: Chapter 7: Graphic Arts, November 1996. Retrieved December 27, 2024 from https://www.epa.gov/sites/default/files/2015-08/documents/iii07.pdf

[4] Eastern Research Group, Inc. Volume III: Chapter 7: Graphic Arts, November 1996. Retrieved December 27, 2024 from https://www.epa.gov/sites/default/files/2015-08/documents/iii07.pdf

[5] Eastern Research Group, Inc. Volume III: Chapter 7: Graphic Arts, November 1996. Retrieved December 27, 2024 from https://www.epa.gov/sites/default/files/2015-08/documents/iii07.pdf

[6] COMAR 26.11.19: Volatile Organic Compounds from Specific Processes. https://dsd.maryland.gov/regulations/Pages/26.11.19.00.aspx

APPENDIX

Table 1. HAP speciation factors for Graphic Arts For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2425000000	Graphic Arts	84742	Dibutyl phthalate	9.99E-02	1191
2425000000	Graphic Arts	171	Glycol Ethers	4.00E-04	1191
2425000000	Graphic Arts	584849	2,4-toluene diisocyanate	3.00E-04	1191

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Graphic Arts

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40500805	Chemical Evaporation	Printing/Publishing	Digital Printing	Dryer	2425000000	Graphic Arts
40500905	Chemical Evaporation	Printing/Publishing	Digital Printing	Dryer	2425000000	Graphic Arts
40500806	Chemical Evaporation	Printing/Publishing	Digital Printing	Other non-dryer printing	2425000000	Graphic Arts
40500906	Chemical Evaporation	Printing/Publishing	Digital Printing	Other non-dryer printing	2425000000	Graphic Arts
40500101	Chemical Evaporation	Printing/Publishing	Drying	Dryer	2425000000	Graphic Arts
40500308	Chemical Evaporation	Printing/Publishing	Flexographic	Dryer	2425000000	Graphic Arts
40500302	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Carbitol	2425000000	Graphic Arts
40500303	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Cellosolve	2425000000	Graphic Arts
40500304	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Ethyl Alcohol	2425000000	Graphic Arts
40500305	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Isopropyl Alcohol	2425000000	Graphic Arts
40500307	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Naphtha	2425000000	Graphic Arts
40500306	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, n-Propyl Alcohol	2425000000	Graphic Arts
40500309	Chemical Evaporation	Printing/Publishing	Flexographic	Other non-dryer printing	2425000000	Graphic Arts
40500301	Chemical Evaporation	Printing/Publishing	Flexographic	Printing	2425000000	Graphic Arts

40500315	Chemical Evaporation	Printing/Publishing	Flexographic	Steam: Water-based	2425000000	Graphic Arts
40500318	Chemical Evaporation	Printing/Publishing	Flexographic	Steam: Water-based in Ink	2425000000	Graphic Arts
40500319	Chemical Evaporation	Printing/Publishing	Flexographic	Steam: Water-based Ink Storage	2425000000	Graphic Arts
40588801	Chemical Evaporation	Printing/Publishing	Fugitive Emissions	General	2425000000	Graphic Arts
40500597	Chemical Evaporation	Printing/Publishing	General	Other Not Classified	2425000000	Graphic Arts
40500502	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Dimethylformamide	2425000000	Graphic Arts
40500503	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Ethyl Acetate	2425000000	Graphic Arts
40500506	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Methyl Ethyl Ketone	2425000000	Graphic Arts
40500507	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Methyl Isobutyl Ketone	2425000000	Graphic Arts
40500510	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Toluene	2425000000	Graphic Arts
40500511	Chemical Evaporation	Printing/Publishing	Gravure	Printing	2425000000	Graphic Arts
40500204	Chemical Evaporation	Printing/Publishing	Letterpress	Dryer	2425000000	Graphic Arts
40500202	Chemical Evaporation	Printing/Publishing	Letterpress	Ink Thinning Solvent, Kerosene	2425000000	Graphic Arts
40500203	Chemical Evaporation	Printing/Publishing	Letterpress	Ink Thinning Solvents, Mineral Solvents	2425000000	Graphic Arts
40500205	Chemical Evaporation	Printing/Publishing	Letterpress	Other non-dryer printing	2425000000	Graphic Arts
40500201	Chemical Evaporation	Printing/Publishing	Letterpress	Printing	2425000000	Graphic Arts
40500402	Chemical Evaporation	Printing/Publishing	Lithographic	Dryer	2425000000	Graphic Arts
40500403	Chemical Evaporation	Printing/Publishing	Lithographic	Other non-dryer printing	2425000000	Graphic Arts
40500401	Chemical Evaporation	Printing/Publishing	Lithographic	Printing	2425000000	Graphic Arts
40500415	Chemical Evaporation	Printing/Publishing	Offset Lithography	Dampening Solution with Alcohol Substitute	2425000000	Graphic Arts
40500416	Chemical Evaporation	Printing/Publishing	Offset Lithography	Dampening Solution with High Solvent Content	2425000000	Graphic Arts
40500418	Chemical Evaporation	Printing/Publishing	Offset Lithography	Dampening Solution with Isopropyl Alcohol	2425000000	Graphic Arts

40500421	Chemical Evaporation	Printing/Publishing	Offset Lithography	Heatset Ink Mixing	2425000000	Graphic Arts
40500422	Chemical Evaporation	Printing/Publishing	Offset Lithography	Heatset Solvent Storage	2425000000	Graphic Arts
40500431	Chemical Evaporation	Printing/Publishing	Offset Lithography	Nonheated Lithographic Inks	2425000000	Graphic Arts
40500601	Chemical Evaporation	Printing/Publishing	Printing	Ink Mixing	2425000000	Graphic Arts
40500599	Chemical Evaporation	Printing/Publishing	Printing	Ink Thinning Solvent	2425000000	Graphic Arts
40500515	Chemical Evaporation	Printing/Publishing	Rotogravure	Dryer	2425000000	Graphic Arts
40500516	Chemical Evaporation	Printing/Publishing	Rotogravure	Other non-dryer printing	2425000000	Graphic Arts
40500803	Chemical Evaporation	Printing/Publishing	Screen Printing	Dryer	2425000000	Graphic Arts
40500804	Chemical Evaporation	Printing/Publishing	Screen Printing	Other non-dryer printing	2425000000	Graphic Arts
40500801	Chemical Evaporation	Printing/Publishing	Screen Printing	Screen Printing	2425000000	Graphic Arts
40201103	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Mixing (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Graphic Arts
40201101	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Operation (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Graphic Arts
40201104	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Storage (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Graphic Arts
40201122	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Print:Dryer: Fuel-fired (Also See New Codes Under 4-02-040- XX)	2425000000	Graphic Arts
40201121	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Print:Dryer: Steam Coil (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40201116	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Flat Screen (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40201112	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Roller (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40201114	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Rotary Screen (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40201197	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Misc. Fugitives (Also New Codes 4-02-040-XX)	2425000000	Graphic Arts
40201199	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Other Not Classified (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40204021	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Application	2425000000	Graphic Arts
40204023	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Drying/Curing	2425000000	Graphic Arts

40204020	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Print Paste	2425000000	Graphic Arts
40204022	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Transfer	2425000000	Graphic Arts
40204002	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Application	2425000000	Graphic Arts
40204001	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Print Paste	2425000000	Graphic Arts
40204004	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Steam Cans/Drying	2425000000	Graphic Arts
40204003	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Transfer	2425000000	Graphic Arts
40204011	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Application	2425000000	Graphic Arts
40204013	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Drying/Curing	2425000000	Graphic Arts
40204010	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Print Paste	2425000000	Graphic Arts
40204012	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Transfer	2425000000	Graphic Arts
30503701	Industrial Processes	Mineral Products	Coated Abrasives Manufacturing	Printing of Backing	2425000000	Graphic Arts
36000102	Industrial Processes	Printing/Publishing	Scrap Processes	Flexographic: Scrap Substrate Collection System	2425000000	Graphic Arts
36000104	Industrial Processes	Printing/Publishing	Scrap Processes	Lithographic: Scrap Substrate Collection System	2425000000	Graphic Arts
36000103	Industrial Processes	Printing/Publishing	Scrap Processes	Rotogravure: Scrap Substrate Collection System	2425000000	Graphic Arts
33000102	Industrial Processes	Textile Products	Miscellaneous	Printing	2425000000	Graphic Arts
40500199	Petroleum and Solvent Evaporation	Printing/Publishing	Drying	Dryer	2425000000	Graphic Arts
40500311	Petroleum and Solvent Evaporation	Printing/Publishing	Flexographic	Printing: Flexographic	2425000000	Graphic Arts
40500312	Petroleum and Solvent Evaporation	Printing/Publishing	Flexographic	Printing: Flexographic	2425000000	Graphic Arts
40500316	Petroleum and Solvent Evaporation	Printing/Publishing	Flexographic	Steam: Water-based	2425000000	Graphic Arts
40500317	Petroleum and Solvent Evaporation	Printing/Publishing	Flexographic	Steam: Water-based	2425000000	Graphic Arts
40588802	Petroleum and Solvent Evaporation	Printing/Publishing	Fugitive Emissions	Specify in Comments Field	2425000000	Graphic Arts
40588803	Petroleum and Solvent Evaporation	Printing/Publishing	Fugitive Emissions	Specify in Comments Field	2425000000	Graphic Arts

40588804	Petroleum and Solvent Evaporation	Printing/Publishing	Fugitive Emissions	Specify in Comments Field	2425000000	Graphic Arts
40588805	Petroleum and Solvent Evaporation	Printing/Publishing	Fugitive Emissions	Specify in Comments Field	2425000000	Graphic Arts
40500598	Petroleum and Solvent Evaporation	Printing/Publishing	General	Ink Thinning Solvent: Other Not Specified	2425000000	Graphic Arts
40500501	Petroleum and Solvent Evaporation	Printing/Publishing	Gravure	Gravure: 2754	2425000000	Graphic Arts
40500512	Petroleum and Solvent Evaporation	Printing/Publishing	Gravure	Gravure: 2754	2425000000	Graphic Arts
40500513	Petroleum and Solvent Evaporation	Printing/Publishing	Gravure	Gravure: 2754	2425000000	Graphic Arts
40500211	Petroleum and Solvent Evaporation	Printing/Publishing	Letterpress	Letterpress: 2751	2425000000	Graphic Arts
40500212	Petroleum and Solvent Evaporation	Printing/Publishing	Letterpress	Printing: Letterpress	2425000000	Graphic Arts
40500411	Petroleum and Solvent Evaporation	Printing/Publishing	Lithographic	Lithographic: 2752	2425000000	Graphic Arts
40500412	Petroleum and Solvent Evaporation	Printing/Publishing	Lithographic	Lithographic: 2752	2425000000	Graphic Arts
40500432	Petroleum and Solvent Evaporation	Printing/Publishing	Offset Lithography	Nonheated Lithographic Inks	2425000000	Graphic Arts
40500433	Petroleum and Solvent Evaporation	Printing/Publishing	Offset Lithography	Nonheated Lithographic Inks	2425000000	Graphic Arts
40500811	Petroleum and Solvent Evaporation	Printing/Publishing	Screen Printing	Screen Printing	2425000000	Graphic Arts
40500812	Petroleum and Solvent Evaporation	Printing/Publishing	Screen Printing	Screen Printing	2425000000	Graphic Arts

INDUSTRIAL ADHESIVES

A. Source Category Description

Industrial adhesives are the application of a liquid or powder substance, such as solvent type paints, varnishes, and lacquers to a surface for decorative or protective purposes. The substances can be applied by brushing, rolling, spraying, dipping or flow coating. VOCs are released into the air as the substance dries. Powder coatings are applied to a hot surface and then melted; VOCs are released as the powder melts and dries.

Table 1: 2023 NEI Industrial Adhesive SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2440000000	Solvent Utilization	Miscellaneous Industrial	All Processes	Total: All Solvent Types

B. Overview of Calculations

Industrial Adhesives Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using population and a controlled emission factor.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific county-level population data from the U.S. Census Bureau.[1] The 2023 NEI uses 2023 population estimates, as shown in Table 2.

Table 2: 2023 County Level Population.

County Name	State County FIPs	Population for Inventory Year
Allegany	24001	67,273
Anne Arundel	24003	594,582
Baltimore	24005	844,703
Calvert	24009	94,728
Caroline	24011	33,593
Carroll	24013	176,639
Cecil	24015	105,672
Charles	24017	171,973
Dorchester	24019	32,879
Frederick	24021	293,391
Garrett	24023	28,423
Harford	24025	264,644
Howard	24027	336,001
Kent	24029	19,303
Montgomery	24031	1,058,474
Prince Georges	24033	947,430

Queen Annes	24035	52,508
Saint Mary's	24037	115,281
Somerset	24039	24,910
Talbot	24041	37,823
Washington	24043	155,813
Wicomico	24045	104,800
Worcester	24047	54,171
Baltimore City	24510	565,239
Total		6,180,253

D. Emissions Factors

MDE used a VOC emission factor of 1.10 lbs/capita/year developed by The California Air Resources Board (CARB) for adhesives and sealants. [2]

CARB's Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology (RACT/BART) estimated emission factor calculation for adhesives and sealants is estimated as:

> VOC = 45 tons/day estimated in 1994 * 365 days/year * 2000 lbs/ton / 29,760,021 capita where 45 tons/day is the estimated state-wide emissions for industrial adhesives in California, 2000 lbs/ton is a conversion factor, and 29,760,021 capita is the 1990 population of California. VOC Emf = 1.10 lbs/capita/year of industrial adhesives

E. Controls

VOC emissions from Industrial Adhesives are controlled through Code of Maryland Regulations (COMAR) 26.11.19.15: Paint, Resin, and Adhesive Manufacturing and Adhesive Application. The regulation achieves VOC reductions through two basic components: sale and manufacture restrictions that limit the VOC content of specified adhesives, sealants and primers sold in the state; and use restrictions that apply primarily to commercial/industrial applications. The regulation is similar to the one proposed by the Ozone Transport Commission (OTC).

CARB's Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology (RACT/BART) forms the basis of rule. In the years 1998-2001, the provisions of the CARB determination were adopted in regulatory form in various air pollution control districts in California including the Bay Area, Ventura County, Sacramento Metropolitan and San Joaquin Valley. CARB and OTC estimate a 64.4 percent reduction in emissions from the source category regulation that was fully implemented in Maryland in 2009.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Section C)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s*
RE = Rule Effectiveness with source category *s*
RP = Rule Penetration with source category *s*
CE = Control Efficiency with source category *s*

HAP emissions are estimated using the VOC emissions and HAP speciation factors (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year (Eqn. 1)
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for Industrial Adhesives; therefore, point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from Industrial Adhesives in Anne Arundel County, Maryland are included in the table below.

Table 3: Sample Calculations of VOC emissions for Industrial Adhesives (SCC 2440000000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$(1.10\ {}^{lb}/_{capita} \times 594{,}582\ people)/2000) \times 1 - 0.644$	116.42 tons of VOC in 2023

I. Reference

[1] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[2] Air Resources Board. Determination of Reasonably Available Control Technology and Best Available Retrofit Control technology for Adhesives and Sealants. December 1998.

APPENDIX

Table 1. HAP speciation factors for Industrial Adhesives. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2440000000	Industrial Adhesives	107211	Ethylene Glycol	0.034647	3.2
2440000000	Industrial Adhesives	110543	Hexane	0.012144	3.2
2440000000	Industrial Adhesives	108101	Methyl Isobutyl Ketone	0.008692	3.2
2440000000	Industrial Adhesives	108883	Toluene	0.110966	3.2
2440000000	Industrial Adhesives	79016	Trichloroethylene	0.006906	3.2
2440000000	Industrial Adhesives	1330207	Xylenes (Mixed Isomers)	0.0381	3.2
2440000000	Industrial Adhesives	107211	Ethylene Glycol	0.034647	3.2
2440000000	Industrial Adhesives	110543	Hexane	0.012144	3.2

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

INDUSTRIAL SURFACE COATING – FACTORY FINISHED WOOD

A. Source Category Description

Factory finished wood emissions result from applying a thin layer of coating (e.g. paint, lacquer, enamel, varnish, etc.) to the surface of a wood object for decorative or protective purposes. Emissions from this source category also result from the evaporation of the solvent used in the gluing and coating process. The coating products, which are solvent based, emit VOC emissions as the result of solvent evaporation during the drying or curing process.

Table 1: 2023 NEI Industrial Surface Coating – Factory Finished Wood SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401015000	Solvent Utilization	Surface Coating	Factory finished wood	Total: All Solvent Types

B. Overview of Calculations

Factory finished wood Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized is 321///. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany	24001		3,141 Employees from State Business Patterns. Withheld Employment = State Employment – County Employment = 188. Midpoints = 0	
Anne Arundel	24003	61		61
Baltimore	24005	110		110
Calvert	24009	138		138
Caroline	24011			
Carroll	24013	387		387
Cecil	24015	104		104
Charles	24017			

Dorchester	24019	31	Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	31
Frederick	24021	966		966
Garrett	24023	150		150
Harford	24025	29		29
Howard	24027	31		31
Kent	24029			
Montgomery	24031	53		53
Prince Georges	24033			
Queen Annes	24035	272		272
Saint Mary's	24037			
Somerset	24039			
Talbot	24041	193		193
Washington	24043	216		216
Wicomico	24045			
Worcester	24047			
Baltimore City	24510	212		212
Total		2,953		2,953

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has revised its emission factors to align with EPAs.

VOC emission factors for factory finished wood SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Industrial Surface Coating – Factory Finished Wood

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401015000	Factory finished wood	VOC	7.93	lb/employee	[4, 5 ,6]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from the surface coating of factory finished wood are calculated by multiplying the activity data for the source category by the emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

G. Point Source Subtraction

Since emissions from factory finished wood industrial coatings occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Maryland has no facilities that report the surface coating of factory finished wood as part of its point-source emissions. Point-source subtraction is unnecessary.

H. Sample Calculations

Sample calculations for VOC emissions from surface coating of factory finished wood in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Industrial Surface Coating – Factory Finished Wood in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}$	$\left(61\ employees \times 7.93 \frac{lb/employee}{2000}\right)$	0.24 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy..

[5] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

APPENDIX

Table 1. HAP speciation factors for Industrial Surface Coating – Factory finished Wood. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401015000	Factory Finished Wood	108883	Toluene	0.26600000	2405
2401015000	Factory Finished Wood	1330207	Xylenes	0.15100000	2405
2401015000	Factory Finished Wood	108101	Methyl isobutyl ketone	0.07350000	2405
2401015000	Factory Finished Wood	171	Glycol Ethers	0.00394000	2405
2401015000	Factory Finished Wood	107211	Ethylene glycol	0.00070800	2405

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Industrial Surace Coating - Factory finished wood (SCC 2401015000)

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202101	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Base Coat	2401015000	Surface Coating: Wood Products Manufacturing
40202103	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Coating Mixing	2401015000	Surface Coating: Wood Products Manufacturing
40202104	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Coating Storage	2401015000	Surface Coating: Wood Products Manufacturing
40202105	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Equipment Cleanup	2401015000	Surface Coating: Wood Products Manufacturing
40202106	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Topcoat	2401015000	Surface Coating: Wood Products Manufacturing
40202107	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Filler	2401015000	Surface Coating: Wood Products Manufacturing
40202108	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Sealer	2401015000	Surface Coating: Wood Products Manufacturing
40202109	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Inks	2401015000	Surface Coating: Wood Products Manufacturing
40202110	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Grove Coat Application	2401015000	Surface Coating: Wood Products Manufacturing
40202111	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Stain Application	2401015000	Surface Coating: Wood Products Manufacturing
40202117	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Filler Sander	2401015000	Surface Coating: Wood Products Manufacturing

40202118	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Sealer Sander	2401015000	Surface Coating: Wood Products Manufacturing
40202131	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Water-borne Coating	2401015000	Surface Coating: Wood Products Manufacturing
40202132	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Solvent-borne Coating	2401015000	Surface Coating: Wood Products Manufacturing
40202133	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Ultraviolet Coating	2401015000	Surface Coating: Wood Products Manufacturing
40202140	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Surface Preparation (Includes Tempering, Sanding, Brushing, Grove Cut)	2401015000	Surface Coating: Wood Products Manufacturing
40202199	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Other Not Elsewhere Classified	2401015000	Surface Coating: Wood Products Manufacturing

INDUSTRIAL SURFACE COATING – INDUSTRIAL MAINTENANCE

A. Source Category Description

Surface coating operations involve the application of a thin layer of coating (paint, lacquer, enamel, varnish, ink, etc.) to an object for decorative or protective purposes. The coating products, which are solvent-based, emit VOC emissions as the result of solvent evaporation during the drying or curing process.

Table 1: 2023 NEI Industrial Surface Coating – Industrial Maintenance SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401100000	Solvent Utilization	Surface Coating	Industrial Maintenance Coatings	Total: All Solvent Types

B. Overview of Calculations

Industrial Maintenance Coatings Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using population and an emission factor. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific county-level population data from the U.S. Census Bureau.[2] The 2023 NEI uses 2023 population estimates, as shown in Table 2.

Table 2: 2023 County Level Population.

County Name	State County FIPs	Population for Inventory Year
Allegany	24001	67,273
Anne Arundel	24003	594,582
Baltimore	24005	844,703
Calvert	24009	94,728
Caroline	24011	33,593
Carroll	24013	176,639
Cecil	24015	105,672
Charles	24017	171,973
Dorchester	24019	32,879
Frederick	24021	293,391
Garrett	24023	28,423
Harford	24025	264,644
Howard	24027	336,001
Kent	24029	19,303
Montgomery	24031	1,058,474
Prince Georges	24033	947,430

Queen Annes	24035	52,508
Saint Mary's	24037	115,281
Somerset	24039	24,910
Talbot	24041	37,823
Washington	24043	155,813
Wicomico	24045	104,800
Worcester	24047	54,171
Baltimore City	24510	565,239
Total		6,180,253

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

To align MDE's emission factor with EPA's values, MDE adjusted its uncontrolled emission factor, such that, when the state's credit for emissions control programs are applied, the final emission factor used to estimate emissions is equal to EPA's emission factor (which assumes controls within the factor). MDE's adjusted uncontrolled emission factor is 0.5978 lbs/employee, as is demonstrated in table 3 below. When controls are applied (as discussed in Section E), MDE's final emission factor will be 0.33 lbs/person, which is consistent with EPA's emission factor.

VOC emission factors for all industrial maintenance surface coatings are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factor for Industrial Maintenance Surface Coating

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401100000	Industrial Maintenance Coatings	VOC	0.8	lb/person	[4]
Adjustment to Align with EPA Emission Factor					
MDE Controlled Emission Factor (0.8 * [1- 31 control efficiency * 1 rule effectiveness * 1 rule penetration		VOC	0.4416	lb/person	
EPA Emission Factor		VOC	0.33	lb/person	[5], [6], [7]
Difference in Emission Factor: - 25.27%					
MDE Adjusted Uncontrolled Emission Factor 0.8* - 25.27%+0.8		VOC	0.5978	lb/person	

E. Controls

VOC emissions from cold clean degreasing are controlled through Code of Maryland Regulations (COMAR) 26.11.39: Architectural and Industrial Maintenance Coatings.[8] COMAR 26.11.39 established VOC content limits and standards for a variety of architectural and maintenance (AIM) coatings made available for sale and use in Maryland.

EPA's surface coating regulation allowed the state to take a 20% emissions reduction in 1999.[9] MDE then adopted The Ozone Transport Commission's (OTC) AIM rule Phase I[10] and II[11] in 2005 and 2017 respectively, allowing the state to take an additional 31% reduction in controls.

When accounting for the alignment of emission factors between MDE and EPA (as discussed in Section D), the final reduction from the uncontrolled emission factor of 0.8 lbs/person is 58.75%, yielding a final controlled emission factor of 0.33 lbs/person.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)
RE = Rule Effectiveness with source category *s*
RP = Rule Penetration with source category *s*
CE = Control Efficiency with source category *s*

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for Industrial Maintenance Coatings; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from industrial maintenance coatings in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Industrial Maintenance Coatings (SCC 2401100000) in Anne Arundel

County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$\left(594{,}582\ employees\ \times 0.8 \frac{lb/employee}{2000} \times [1 - 0.58749 \times 1 \times 1\right)$	98.11 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume 1, General Guidance for Stationary Sources, EPA-450/4-91-016, May 1991

[5] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[6] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[7] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019.

[8] COMAR 26.11.39: Architectural and Industrial Maintenance Coatings. https://mde.maryland.gov/programs/regulations/air/Documents/NPA_26-11-39_AIM_in_MD_Reg_01-22-2016.pdf

[9] EPA AIM Controls: 63 FR 48848, 1998: Federal Register, "National Volatile Organic Compound Emission Standards for Architectural Coatings, Final Rule, Volume 63, Number 176, September 11, 1998.

[10] COMAR 26.11.33: Architectural Coatings. [REPEALED & REPLACED WITH 26.11.39].

[11] COMAR 26.11.39: Architectural and Industrial Maintenance Coatings. https://mde.maryland.gov/programs/regulations/air/Documents/NPA_26-11-39_AIM_in_MD_Reg_01-22-2016.pdf

APPENDIX

Table 1. HAP speciation factors for Industrial Surface Coating – Industrial Maintenance. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401100000	Industrial Maintenance Coatings	108883	Toluene	0.05220000	3138
2401100000	Industrial Maintenance Coatings	1330207	Xylenes	0.04460000	3138
2401100000	Industrial Maintenance Coatings	75092	Dichloromethane	0.02010000	3138
2401100000	Industrial Maintenance Coatings	100414	Ethylbenzene	0.00611000	3138
2401100000	Industrial Maintenance Coatings	108054	Vinyl acetate	0.00235000	3138
2401100000	Industrial Maintenance Coatings	67561	Methanol	0.00172000	3138
2401100000	Industrial Maintenance Coatings	108101	Methyl isobutyl ketone	0.00125000	3138
2401100000	Industrial Maintenance Coatings	110543	N-hexane	0.00094000	3138
2401100000	Industrial Maintenance Coatings	171	Glycol Ethers	0.00062700	3138

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

INDUSTRIAL SURFACE COATING – MACHINERY AND EQUIPMENT

A. Source Category Description

Machinery and equipment Industrial surface coatings emissions are the result of evaporation of the solvent used in the coating process in manufacturing facilities for such as engines, turbines, farm and garden equipment, computers and office machinery.

Table 1: 2023 NEI Industrial Surface Coating – Machinery and Equipment SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment	Total: All Solvent Types

B. Overview of Calculations

Machinery and Equipment Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized is 333///. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany	24001	0	6,904 Employees from State Business Patterns. Withheld Employment = State Employment – County Employment = 378. Midpoints = 0 Adjustment Factor for County Employment =	0
Anne Arundel	24003	260		260
Baltimore	24005	1,670		1,670
Calvert	24009	19		19
Caroline	24011	0		0
Carroll	24013	719		719
Cecil	24015	130		130
Charles	24017	0		0
Dorchester	24019	0		0
Frederick	24021	970		970
Garrett	24023	0		0

Harford	24025	270	Withheld Employment / Midpoint = N/A	270
Howard	24027	96		96
Kent	24029	0		0
Montgomery	24031	34		34
Prince Georges	24033	121		121
Queen Annes	24035	0		0
Saint Mary's	24037	5		5
Somerset	24039	0		0
Talbot	24041	0		0
Washington	24043	1,884		1,884
Wicomico	24045	115		115
Worcester	24047	0		0
Baltimore City	24510	233		233
Total		6,526		6,526

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

VOC emission factors for machinery and equipment SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Industrial Surface Coating – Machinery & Equipment

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401055000	Machinery and Equipment	VOC	11.79	lb/employee	[4, 5, 6]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

Since emissions from machinery and equipment industrial coatings occur from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Point source subtraction for this sector is completed at the county level through adjusting employment. Facility level annual emissions from the mapped SCCs are divided by the *uncontrolled* emission factor, which yields the number of employees in the county associated with the source category. The county employment is then adjusted downward by the number of employees. Nonpoint emissions are then estimated using the point source adjusted employment. The resultant emissions represent emissions only associated with nonpoint activity.

The employment adjustment for point source subtraction is calculated as follows:

$$NP_{e,c} = Ep_{VOCc,s} \times 2000 \; / \; EF_{VOC,s}$$

Where:

$NP_{s,c}$ = Nonpoint source employment in county *c* for source category *s*, in tons per year
$Ep_{VOC,c,s}$= Annual point VOC emissions for the mapped SCCs in county *c* for source category *s*, in tons per year
$EF_{VOC,s}$ = Uncontrolled VOC emissions factor for source category *s*

The point source employment estimates for surface coating of machinery and equipment is outlined in Table 4 below.

Table 4: Point Source Employment Adjustment for Industrial Surface Coating – Machinery & Equipment

FIPS State and County Code	FIPS State Code	FIPS County Code	County Name	County Type	Postal State Code	Point Source Reduction VOC (tpy)	Total County Employment for Facilities
24001	24	001	Allegany	County	MD	0.00	0
24003	24	003	Anne Arundel	County	MD	0.00	0
24005	24	005	Baltimore	County	MD	0.00	0
24009	24	009	Calvert	County	MD	0.00	0
24011	24	011	Caroline	County	MD	0.00	0
24013	24	013	Carroll	County	MD	0.00	0
24015	24	015	Cecil	County	MD	2.81	477

24017	24	017	Charles	County	MD	0.00	0
24019	24	019	Dorchester	County	MD	0.00	0
24021	24	021	Frederick	County	MD	212.91	36,117
24023	24	023	Garrett	County	MD	0.00	0
24025	24	025	Harford	County	MD	0.42	72
24027	24	027	Howard	County	MD	0.22	38
24029	24	029	Kent	County	MD	0.00	0
24031	24	031	Montgomery	County	MD	1.62	274
24033	24	033	Prince George's	County	MD	0.00	0
24035	24	035	Queen Anne's	County	MD	0.00	0
24037	24	037	St. Mary's	County	MD	0.35	59
24039	24	039	Somerset	County	MD	0.00	0
24041	24	041	Talbot	County	MD	0.00	0
24043	24	043	Washington	County	MD	0.41	70
24045	24	045	Wicomico	County	MD	0.00	0
24047	24	047	Worcester	County	MD	0.00	0
24510	24	510	Baltimore	City	MD	0.00	0

H. Sample Calculations

Sample calculations for VOC emissions from machinery and equipment industrial surface coating in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Industrial Surface Coating Machinery and Equipment (SCC 2401055000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOC_{c,s}}} = \boldsymbol{A_{c,s}} \times \boldsymbol{EF_{VOC,s}}$	$\left(260\ employees\ \times 11.79 \frac{lb/employee}{2000}\right)$	1.53 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. County Business Patterns: 2021. U.S. Department of Commerce. Retrieved October 21, 2024 from https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy..

[5] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

APPENDIX

Table 1. HAP speciation factors for Industrial Surface Coating – Machinery and Equipment For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401055000	Machinery and Equipment	108883	Toluene	0.15800000	3149
2401055000	Machinery and Equipment	1330207	Xylenes	0.13800000	3149
2401055000	Machinery and Equipment	100414	Ethylbenzene	0.02150000	3149
2401055000	Machinery and Equipment	75092	Dichloromethane	0.00966000	3149
2401055000	Machinery and Equipment	108101	Methyl isobutyl ketone	0.00597000	3149
2401055000	Machinery and Equipment	110543	N-hexane	0.00455000	3149
2401055000	Machinery and Equipment	67561	Methanol	0.00042600	3149
2401055000	Machinery and Equipment	171	Glycol Ethers	0.00028400	3149
2401055000	Machinery and Equipment	91203	Naphthalene	0.00028400	3149
2401055000	Machinery and Equipment	107211	Ethylene glycol	0.00014200	3149
2401055000	Machinery and Equipment	98828	Cumene	0.00014200	3149
2401055000	Machinery and Equipment	108383	M-xylene	0.00014200	3149
2401055000	Machinery and Equipment	108054	Vinyl acetate	0.00014200	3149

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Industrial Surace Coating – Machinery and Equipment

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40200803	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Baked : 175F	2401055000	Machinery and Equipment
40200870	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Color Coat Oven	2401055000	Machinery and Equipment
40200802	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Dried < 175F	2401055000	Machinery and Equipment
40200872	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	EMI/RFI Shielding Coat Oven	2401055000	Machinery and Equipment
40200855	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Filler Oven	2401055000	Machinery and Equipment
40200801	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	General	2401055000	Machinery and Equipment
40200820	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Prime/Base Coat Oven	2401055000	Machinery and Equipment
40200856	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Sealer Oven	2401055000	Machinery and Equipment
40200861	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Single Coat Application: Oven	2401055000	Machinery and Equipment

40200845	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Curing Ovens (Includes Codes 46, 47, 48, and 49)	2401055000	Machinery and Equipment
40200849	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Interior Body Coat Oven	2401055000	Machinery and Equipment
40200847	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Base Coat (Exterior) Oven	2401055000	Machinery and Equipment
40200846	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Base Coat (Interior) Oven	2401055000	Machinery and Equipment
40200848	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Lithographic Coating Oven	2401055000	Machinery and Equipment
40200830	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Topcoat Oven	2401055000	Machinery and Equipment
40200871	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Topcoat/Texture Coat Oven	2401055000	Machinery and Equipment
40200841	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Base Coat Oven	2401055000	Machinery and Equipment
40200840	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Curing Ovens: General (Includes Codes 41, 42, and 43)	2401055000	Machinery and Equipment
40200843	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Interior Body Coat Oven	2401055000	Machinery and Equipment
40200842	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Over Varnish Oven	2401055000	Machinery and Equipment
40288821	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Basecoat	2401055000	Machinery and Equipment
40288823	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Cleartop Coat	2401055000	Machinery and Equipment
40288822	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Coating	2401055000	Machinery and Equipment
40288801	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	General	2401055000	Machinery and Equipment
40201807	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Coating Storage	2401055000	Machinery and Equipment
40201806	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Finish Coating	2401055000	Machinery and Equipment
40201899	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Other Not Classified	2401055000	Machinery and Equipment
40201801	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Prime Coating Application	2401055000	Machinery and Equipment
40201803	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Solvent Mixing	2401055000	Machinery and Equipment
40201804	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Solvent Storage (Use 4-07-004-01 thru 4-07-999-98 if possible)	2401055000	Machinery and Equipment
40202503	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Mixing	2401055000	Machinery and Equipment

40202501	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Operation	2401055000	Machinery and Equipment
40202504	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Storage	2401055000	Machinery and Equipment
40202532	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Dip	2401055000	Machinery and Equipment
40202531	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Flow	2401055000	Machinery and Equipment
40202533	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Spray	2401055000	Machinery and Equipment
40202535	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Dip and Spray	2401055000	Machinery and Equipment
40202534	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Flow and Spray	2401055000	Machinery and Equipment
40202536	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Spray	2401055000	Machinery and Equipment
40202537	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Manual Two Coat, Spray and Air Dry	2401055000	Machinery and Equipment
40202599	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Other Not Classified	2401055000	Machinery and Equipment
40202510	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application	2401055000	Machinery and Equipment
40202515	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Flashoff	2401055000	Machinery and Equipment
40202511	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Spray, High Solids	2401055000	Machinery and Equipment
40202512	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Spray, Water-borne	2401055000	Machinery and Equipment
40202544	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Dip	2401055000	Machinery and Equipment
40202546	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Flashoff	2401055000	Machinery and Equipment
40202545	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Flow Coat	2401055000	Machinery and Equipment
40202542	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Spray, High Solids	2401055000	Machinery and Equipment
40202543	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Spray, Water-borne	2401055000	Machinery and Equipment
40202520	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application	2401055000	Machinery and Equipment
40202523	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Dip	2401055000	Machinery and Equipment
40202525	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Flashoff	2401055000	Machinery and Equipment

40202524	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Flow Coat	2401055000	Machinery and Equipment
40202521	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Spray, High Solids	2401055000	Machinery and Equipment
40202522	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Spray, Water-borne	2401055000	Machinery and Equipment
40202603	Chemical Evaporation	Surface Coating Operations	Steel Drums	Coating Mixing	2401055000	Machinery and Equipment
40202601	Chemical Evaporation	Surface Coating Operations	Steel Drums	Coating Operation	2401055000	Machinery and Equipment
40202607	Chemical Evaporation	Surface Coating Operations	Steel Drums	Exterior Coating	2401055000	Machinery and Equipment
40202606	Chemical Evaporation	Surface Coating Operations	Steel Drums	Interior Coating	2401055000	Machinery and Equipment
40202699	Chemical Evaporation	Surface Coating Operations	Steel Drums	Other Not Classified	2401055000	Machinery and Equipment
40282001	Chemical Evaporation	Surface Coating Operations	Wastewater, Aggregate	Process Area Drains	2401055000	Machinery and Equipment
40282002	Chemical Evaporation	Surface Coating Operations	Wastewater, Aggregate	Process Equipment Drains	2401055000	Machinery and Equipment
40282599	Chemical Evaporation	Surface Coating Operations	Wastewater, Points of Generation	Other Not Classified	2401055000	Machinery and Equipment
40282501	Chemical Evaporation	Surface Coating Operations	Wastewater, Points of Generation	Printing Blanket, Rotary Screen	2401055000	Machinery and Equipment
40200810	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven - General	General	2401055000	Machinery and Equipment
40200898	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven - General	General	2401055000	Machinery and Equipment

INDUSTRIAL SURFACE COATING – MARINE

A. Source Category Description

Surface coating operations involve the application of a thin layer of coating (paint, lacquer, enamel, varnish, ink, etc.) to an object for decorative or protective purposes. The coating can be applied by brushing, rolling, spraying, flow coating or dipping the object. Emissions result as the thinner or solvent used to facilitate the application of the coatings evaporates.

Table 1: 2023 NEI Industrial Surface Coating – Marine SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401080000	Solvent Utilization	Surface Coating	Marine	Total: All Solvent Types

B. Overview of Calculations

Marine surface coating Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized is 3366//. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany	24001	0	424 Employees from State Business Patterns. Withheld Employment = State Employment – County Employment = 94. Midpoints = 0	0
Anne Arundel	24003	75		75
Baltimore	24005	0		0
Calvert	24009	0		0
Caroline	24011	29		29
Carroll	24013	0		0
Cecil	24015	0		0
Charles	24017	0		0
Dorchester	24019	0		0
Frederick	24021	0		0

Garrett	24023	24	Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	24
Harford	24025	0		0
Howard	24027	0		0
Kent	24029	0		0
Montgomery	24031	0		0
Prince Georges	24033	31		31
Queen Annes	24035	70		70
Saint Mary's	24037	0		0
Somerset	24039	0		0
Talbot	24041	0		0
Washington	24043	0		0
Wicomico	24045	0		0
Worcester	24047	31		31
Baltimore City	24510	70		70
Total		330		330

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has updated its emission factors to align with EPAs.

VOC emission factors for Marine surface coating SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Industrial Surface Coating - Marine

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401080000	Marine	VOC	242.10	lb/employee	[4, 5, 6]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used

for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

G. Point Source Subtraction

Since emissions for Marine industrial coatings occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Maryland has no facilities that report marine surface coating of as part of its point-source emissions. Point-source subtraction is unnecessary.

H. Sample Calculations

Sample calculations for VOC emissions from Marine industrial surface coating in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Industrial Surface Coating - Marine (SCC 2401080000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$\left(75\ employees\ \times 242.10 \frac{lb/employee}{2000}\right)$	9.079 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy..

[5] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

APPENDIX

Table 1. HAP speciation factors for Industrial Surface Coating – Marine . For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401080000	Marine	1330207	Xylenes	2.35E-01	2415
2401080000	Marine	108883	Toluene	1.36E-01	2415
2401080000	Marine	108101	Methyl isobutyl ketone	4.96E-02	2415
2401080000	Marine	171	Glycol Ethers	1.93E-02	2415
2401080000	Marine	107211	Ethylene glycol	3.50E-03	2415

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Industrial Surace Coating - Marine (SCC 2401080000)

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40202303	Chemical Evaporation	Surface Coating Operations	Large Ships	Coating Mixing	2401080000	Marine
40202304	Chemical Evaporation	Surface Coating Operations	Large Ships	Coating Storage	2401080000	Marine
40202399	Chemical Evaporation	Surface Coating Operations	Large Ships	Other Not Classified	2401080000	Marine
40202301	Chemical Evaporation	Surface Coating Operations	Large Ships	Prime Coating Operation	2401080000	Marine
40202306	Chemical Evaporation	Surface Coating Operations	Large Ships	Topcoat Operation	2401080000	Marine

INDUSTRIAL SURFACE COATING – METAL FURNITURE AND FIXTURES

A. Source Category Description

Metal furniture production is an assembly-line process in which components are cut, assembled, and coated. The common structural materials used in production are steel and aluminum; however, there has been a recent trend toward the use of plastics for certain components. Production of metal furniture involves coating operations that emit air pollutants through use of coatings with high solvent concentrations. Coatings and paints are applied to the metal surfaces to protect them from wear and corrosion. The coatings possess varying characteristics which make them suitable for different applications.

Table 1: 2023 NEI Industrial Surface Coating – Metal furniture SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401025000	Solvent Utilization	Surface Coating	Metal furniture	Total: All Solvent Types

B. Overview of Calculations

Metal furniture Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized is 337124, 336127, 337214, and 337215. Note that employment between 337127 and 337215 is split 50/50 between wood and metal furniture and fixtures. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany	24001	0	377 Employees from State Business Patterns. Withheld Employment = State Employment – County Employment =	0
Anne Arundel	24003	67		67
Baltimore	24005	0		0
Calvert	24009	0		0
Caroline	24011	0		0
Carroll	24013	0		0

Cecil	24015	0	296. Midpoints = 0 Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	0
Charles	24017	0		0
Dorchester	24019	0		0
Frederick	24021	0		0
Garrett	24023	0		0
Harford	24025	0		0
Howard	24027	0		0
Kent	24029	0		0
Montgomery	24031	0		0
Prince Georges	24033	0		0
Queen Annes	24035	0		0
Saint Mary's	24037	0		0
Somerset	24039	0		0
Talbot	24041	0		0
Washington	24043	0		0
Wicomico	24045	0		0
Worcester	24047	0		0
Baltimore City	24510	14		14
Total		81		81

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

VOC emission factors for metal furniture SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Metal furniture

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401025000	Metal furniture	VOC	429.11	lb/employee	[4,5,6]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year

$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

Since emissions from surface coatings for metal furniture occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Point source subtraction for this sector is completed at the county level through adjusting employment. Facility level annual emissions from the mapped SCCs are divided by the *uncontrolled* emission factor, which yields the number of employees in the county associated with the source category. The county employment is then adjusted downward by the number of employees. Nonpoint emissions are then estimated using the point source adjusted employment. The resultant emissions represent emissions only associated with nonpoint activity.

The employment adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{e,c} = Ep_{VOCc,s} \times 2000 \,/\, EF_{VOC,s}}$$

Where:

$NP_{s,c}$ = Nonpoint source employment in county *c* for source category *s*, in tons per year
$Ep_{VOC,c,s}$= Annual point VOC emissions for the mapped SCCs in county *c* for source category *s*, in tons per year
$EF_{VOC,s}$ = Uncontrolled VOC emissions factor for source category *s*

The point source employment estimates for surface coating of metal cans is outlined in Table 4 below.

Table 4: Point Source Employment Adjustment for Metal furniture (SCC 2401025000))

FIPS State and County Code	FIPS State Code	FIPS County Code	County Name	County Type	Postal State Code	Point Source Reduction VOC (tpy)	Total County Employment for Facilities
24001	24	001	Allegany	County	MD		0

24003	24	003	Anne Arundel	County	MD		67
24005	24	005	Baltimore	County	MD		0
24009	24	009	Calvert	County	MD		0
24011	24	011	Caroline	County	MD		0
24013	24	013	Carroll	County	MD		0
24015	24	015	Cecil	County	MD		0
24017	24	017	Charles	County	MD		0
24019	24	019	Dorchester	County	MD		0
24021	24	021	Frederick	County	MD		0
24023	24	023	Garrett	County	MD		0
24025	24	025	Harford	County	MD		0
24027	24	027	Howard	County	MD		0
24029	24	029	Kent	County	MD		0
24031	24	031	Montgomery	County	MD		0
24033	24	033	Prince George's	County	MD		0
24035	24	035	Queen Anne's	County	MD		0
24037	24	037	St. Mary's	County	MD		0
24039	24	039	Somerset	County	MD	0.26	0
24041	24	041	Talbot	County	MD		0
24043	24	043	Washington	County	MD		0
24045	24	045	Wicomico	County	MD		0
24047	24	047	Worcester	County	MD		0
24510	24	510	Baltimore	City	MD		14

H. Sample Calculations

Sample calculations for VOC emissions from surface coating of metal furniture in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Metal furniture (SCC 2401025000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$\left(67\ employees\ \times 429.11 \frac{lb/employee}{2000}\right)$	14.4 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy..

[5] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

APPENDIX

Table 1. HAP speciation factors for Industrial Surface Coating – Metal furniture . For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401025000	Metal Furniture	1330207	Xylenes	1.96E-01	2406
2401025000	Metal Furniture	108883	Toluene	9.88E-02	2406
2401025000	Metal Furniture	171	Glycol Ethers	2.60E-02	2406
2401025000	Metal Furniture	108101	Methyl isobutyl ketone	2.15E-02	2406
2401025000	Metal Furniture	107211	Ethylene glycol	9.31E-03	2406

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Industrial Surace Coating - Metal furniture (SCC 2401025000)

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40202003	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Mixing	2401025000	Metal Furniture
40202001	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Operation	2401025000	Metal Furniture
40202004	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Storage	2401025000	Metal Furniture
40202099	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Other Not Classified	2401025000	Metal Furniture
40202010	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application	2401025000	Metal Furniture
40202013	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Dip	2401025000	Metal Furniture
40202015	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Flashoff	2401025000	Metal Furniture
40202014	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Flow Coat	2401025000	Metal Furniture
40202011	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Spray, High Solids	2401025000	Metal Furniture
40202012	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Spray, Water-borne	2401025000	Metal Furniture
40202037	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Dip	2401025000	Metal Furniture
40202039	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Flashoff	2401025000	Metal Furniture
40202038	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Flow Coat	2401025000	Metal Furniture
40202035	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Spray, High Solids	2401025000	Metal Furniture
40202036	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Spray, Water-borne	2401025000	Metal Furniture
40202031	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Spray Line: General	2401025000	Metal Furniture
40202032	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray Dip Line: General (Use 4-02-020-37)	2401025000	Metal Furniture
40202033	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray High Solids Coating (Use 4-02-020-35)	2401025000	Metal Furniture
40202034	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray Water-borne Coating (Use 4-02-020-36)	2401025000	Metal Furniture
40202020	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application	2401025000	Metal Furniture
40202023	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Dip	2401025000	Metal Furniture
40202025	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Flashoff	2401025000	Metal Furniture
40202024	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Flow Coat	2401025000	Metal Furniture

40202021	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Spray, High Solids	2401025000	Metal Furniture
40202022	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Spray, Water-borne	2401025000	Metal Furniture

INDUSTRIAL SURFACE COATING – MISCELLANEOUS MANUFACTURING

A. Source Category Description

This source category includes small industrial surface coating establishments primarily engaged in manufacturing products not classified in any other group such as jewelry, silverware, musical instruments, dolls, toys, games, pens, pencils, buttons, brooms, and caskets. Operations involve applying a thin layer of coating, such as paint, lacquer, enamel and varnish, to an object for decorative purposes. The surface coating products are either water-based or solvent-based liquid carriers that mostly evaporate in the drying or curing process.

Table 1: 2023 NEI Industrial Surface Coating – Miscellaneous Manufacturing SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401090000	Solvent Utilization	Surface Coating	Misc. Manufacturing	Total: All Solvent Types

B. Overview of Calculations

Miscellaneous Manufacturing Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized is 339///. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany	24001	26	4,628 Employees from State Business Patterns.	26
Anne Arundel	24003	458		458
Baltimore	24005	394		394
Calvert	24009	0	Withheld Employment = State Employment – County Employment = 223.	0
Caroline	24011	33		33
Carroll	24013	109		109
Cecil	24015	1,148		1,148
Charles	24017	4	Midpoints = 0	0

Dorchester	24019	0	Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	0
Frederick	24021	127		127
Garrett	24023	0		0
Harford	24025	0		0
Howard	24027	83		83
Kent	24029	118		118
Montgomery	24031	245		245
Prince Georges	24033	259		259
Queen Annes	24035	507		507
Saint Mary's	24037	10		10
Somerset	24039	0		0
Talbot	24041	36		36
Washington	24043	42		42
Wicomico	24045	63		63
Worcester	24047	19		19
Baltimore City	24510	724		724
Total		4,405		4,405

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

VOC emission factors for industrial surface coating for miscellaneous manufacturing SCCs are listed in table 3 below.

Table 3: 2023 NEI VOC emissions factors for Miscellaneous Manufacturing

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401090000	Miscellaneous Manufacturing	VOC	49.01	lb/employee	[4], [5], [6]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)

$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

Since emissions for Miscellaneous Manufacturing occur from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Point source subtraction for this sector is completed at the county level through adjusting employment. Facility level annual emissions from the mapped SCCs are divided by the *uncontrolled* emission factor, which yields the number of employees in the county associated with the source category. The county employment is then adjusted downward by the number of employees. Nonpoint emissions are then estimated using the point source adjusted employment. The resultant emissions represent emissions only associated with nonpoint activity.

The employment adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{e,c} = Ep_{VOCc,s} \times 2000 \,/\, EF_{VOC,s}}$$

Where:

$NP_{s,c}$ = Nonpoint source employment in county *c* for source category *s*, in tons per year
$Ep_{VOC,c,s}$= Annual point VOC emissions for the mapped SCCs in county *c* for source category *s*, in tons per year
$EF_{VOC,s}$ = Uncontrolled VOC emissions factor for source category *s*

The point source employment estimates for miscellaneous manufacturing is outlined in Table 4 below.

Table 4: Point Source Employment Adjustment for Miscellaneous Manufacturing (SCC 2401090000)

FIPS State and County Code	FIPS State Code	FIPS County Code	County Name	County Type	Postal State Code	Point Source Reduction VOC (tpy)	Total County Employment for Facilities
24001	24	001	Allegany	County	MD		0
24003	24	003	Anne Arundel	County	MD	2.290000	93

24005	24	005	Baltimore	County	MD	0.161650	7
24009	24	009	Calvert	County	MD		0
24011	24	011	Caroline	County	MD		0
24013	24	013	Carroll	County	MD		0
24015	24	015	Cecil	County	MD	0.001722	0
24017	24	017	Charles	County	MD	14.313600	584
24019	24	019	Dorchester	County	MD		0
24021	24	021	Frederick	County	MD		0
24023	24	023	Garrett	County	MD		0
24025	24	025	Harford	County	MD	0.003650	0
24027	24	027	Howard	County	MD		0
24029	24	029	Kent	County	MD		0
24031	24	031	Montgomery	County	MD		0
24033	24	033	Prince George's	County	MD		0
24035	24	035	Queen Anne's	County	MD		0
24037	24	037	St. Mary's	County	MD		0
24039	24	039	Somerset	County	MD		0
24041	24	041	Talbot	County	MD		0
24043	24	043	Washington	County	MD		0
24045	24	045	Wicomico	County	MD		0
24047	24	047	Worcester	County	MD		0
24510	24	510	Baltimore	City	MD		0

H. Sample Calculations

Sample calculations for VOC emissions from miscellaneous manufacturing in Anne Arundel County, Maryland are included in the table below.

Table 5: Sample Calculations of VOC emissions for Miscellaneous Manufacturing (SCC 2401090000) in Anne Arundel County

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$\left(365\ employees\ \times 49.01 \frac{lb/employee}{2000}\right)$	8.9333tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. County Business Patterns: 2021. U.S. Department of Commerce. Retrieved October 21, 2024 from https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy..

[5] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

APPENDIX

Table 1. HAP speciation factors for Industrial Surface Coating – Miscellaneous Manufacturing (SCC 2401090000). For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401090000	Misc. Manufacturing	108883	Toluene	0.15800000	3149
2401090000	Misc. Manufacturing	1330207	Xylenes	0.13800000	3149
2401090000	Misc. Manufacturing	100414	Ethylbenzene	0.02150000	3149
2401090000	Misc. Manufacturing	75092	Dichloromethane	0.00966000	3149
2401090000	Misc. Manufacturing	108101	Methyl isobutyl ketone	0.00597000	3149
2401090000	Misc. Manufacturing	110543	N-hexane	0.00455000	3149
2401090000	Misc. Manufacturing	67561	Methanol	0.00042600	3149
2401090000	Misc. Manufacturing	171	Glycol Ethers	0.00028400	3149
2401090000	Misc. Manufacturing	91203	Naphthalene	0.00028400	3149
2401090000	Misc. Manufacturing	107211	Ethylene glycol	0.00014200	3149
2401090000	Misc. Manufacturing	98828	Cumene	0.00014200	3149
2401090000	Misc. Manufacturing	108383	M-xylene	0.00014200	3149
2401090000	Misc. Manufacturing	108054	Vinyl acetate	0.00014200	3149

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Industrial Surace Coating – Miscellaneous Manufacturing (SCC 2401090000)

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
49000503	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	1,1,1-Trichloroethane	2401090000	Misc. Manufacturing
49000504	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Chloroform	2401090000	Misc. Manufacturing
49000502	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Perchloroethylene	2401090000	Misc. Manufacturing
49000599	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Solvent	2401090000	Misc. Manufacturing
49000501	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Trichloroethylene	2401090000	Misc. Manufacturing
49000601	Chemical Evaporation	Organic Solvent Evaporation	Freon Recovery/Recycling Operations	CFC-12 Recovery - Auto Air Conditioning	2401090000	Misc. Manufacturing
40188898	Chemical Evaporation	Organic Solvent Evaporation	Fugitive Emissions	General	2401090000	Misc. Manufacturing

40100499	Chemical Evaporation	Organic Solvent Evaporation	Knit Fabric Scouring with Chlorinated Solvent	Other Not Classified	2401090000	Misc. Manufacturing
40100401	Chemical Evaporation	Organic Solvent Evaporation	Knit Fabric Scouring with Chlorinated Solvent	Perchloroethylene	2401090000	Misc. Manufacturing
49099998	Chemical Evaporation	Organic Solvent Evaporation	Miscellaneous Volatile Organic Compound Evaporation	Miscellaneous	2401090000	Misc. Manufacturing
49000104	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Furfural	2401090000	Misc. Manufacturing
49000102	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Methyl Ethyl Ketone	2401090000	Misc. Manufacturing
49000103	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Methyl Isobutyl Ketone	2401090000	Misc. Manufacturing
49000199	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Other Not Classified	2401090000	Misc. Manufacturing
49000101	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Petroleum Naphtha (Stoddard)	2401090000	Misc. Manufacturing
49000105	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Trichloroethylene	2401090000	Misc. Manufacturing
49000202	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Condenser Vent	2401090000	Misc. Manufacturing
49000208	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Decanting	2401090000	Misc. Manufacturing
49000207	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Distillation Vent	2401090000	Misc. Manufacturing
49000206	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Fugitive Leaks	2401090000	Misc. Manufacturing
49000203	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Incinerator Stack	2401090000	Misc. Manufacturing
49000299	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Other Not Classified	2401090000	Misc. Manufacturing
49000209	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Salting	2401090000	Misc. Manufacturing
40280001	Chemical Evaporation	Surface Coating Operations	Equipment Leaks	Equipment Leaks	2401090000	Misc. Manufacturing
40206030	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application	2401090000	Misc. Manufacturing
40206031	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Beam	2401090000	Misc. Manufacturing
40206032	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Beck	2401090000	Misc. Manufacturing
40206035	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Continuous	2401090000	Misc. Manufacturing
40206034	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Jet	2401090000	Misc. Manufacturing
40206033	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Jig	2401090000	Misc. Manufacturing
40206010	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Preparation	2401090000	Misc. Manufacturing

40206050	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Waste	2401090000	Misc. Manufacturing
40202701	Chemical Evaporation	Surface Coating Operations	Glass Mirrors	Mirror Backing: Coating Operation	2401090000	Misc. Manufacturing
40299998	Chemical Evaporation	Surface Coating Operations	Miscellaneous	Miscellaneous	2401090000	Misc. Manufacturing
40202206	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Baseline Coating Mix	2401090000	Misc. Manufacturing
40202209	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: High Solids Coating (25% Efficiency)	2401090000	Misc. Manufacturing
40202210	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: High Solids Solvent-borne Coating (40% Efficiency)	2401090000	Misc. Manufacturing
40202213	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Higher Solids Solvent-borne EMI/RFI Shielding Coating	2401090000	Misc. Manufacturing
40202207	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Low Solids Solvent-borne Coating	2401090000	Misc. Manufacturing
40202212	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Low Solids Solvent-borne EMI/RFI Shielding Coating	2401090000	Misc. Manufacturing
40202208	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Medium Solids Solvent-borne Coating	2401090000	Misc. Manufacturing
40202211	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Water-borne Coating	2401090000	Misc. Manufacturing
40202214	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Water-borne EMI/RFI Shielding Coating	2401090000	Misc. Manufacturing
40202215	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Zinc Arc Spray	2401090000	Misc. Manufacturing
40202203	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Mixing	2401090000	Misc. Manufacturing
40202201	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Operation	2401090000	Misc. Manufacturing
40202204	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Storage	2401090000	Misc. Manufacturing
40202230	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Color Coat Application	2401090000	Misc. Manufacturing
40202239	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Color Coat Flashoff	2401090000	Misc. Manufacturing
40202250	Chemical Evaporation	Surface Coating Operations	Plastic Parts	EMI/RFI Shielding Coat Application	2401090000	Misc. Manufacturing

40202259	Chemical Evaporation	Surface Coating Operations	Plastic Parts	EMI/RFI Shielding Coat Flashoff	2401090000	Misc. Manufacturing
40202280	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Maskant Application	2401090000	Misc. Manufacturing
40202299	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Other Not Classified	2401090000	Misc. Manufacturing
40202220	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Prime Coat Application	2401090000	Misc. Manufacturing
40202229	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Prime Coat Flashoff	2401090000	Misc. Manufacturing
40202270	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Sanding/Grit Blasting Prior to EMI/RFI Shielding Coat Application	2401090000	Misc. Manufacturing
40202240	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Topcoat/Texture Coat Application	2401090000	Misc. Manufacturing
40202249	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Topcoat/Texture Coat Flashoff	2401090000	Misc. Manufacturing
40200929	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	1,1,1-Trichloroethane (Methyl Chloroform)	2401090000	Misc. Manufacturing
40200902	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Acetone	2401090000	Misc. Manufacturing
40200925	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Benzene	2401090000	Misc. Manufacturing
40200903	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Butyl Acetate	2401090000	Misc. Manufacturing
40200904	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Butyl Alcohol	2401090000	Misc. Manufacturing
40200905	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Carbitol	2401090000	Misc. Manufacturing
40200906	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Cellosolve	2401090000	Misc. Manufacturing
40200907	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Cellosolve Acetate	2401090000	Misc. Manufacturing
40200908	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Dimethyl Formamide	2401090000	Misc. Manufacturing
40200909	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethyl Acetate	2401090000	Misc. Manufacturing
40200910	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethyl Alcohol	2401090000	Misc. Manufacturing
40200928	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethylene Oxide	2401090000	Misc. Manufacturing
40200911	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Gasoline	2401090000	Misc. Manufacturing
40200901	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	General	2401090000	Misc. Manufacturing
40200927	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Hexylene Glycol	2401090000	Misc. Manufacturing
40200913	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Isopropyl Acetate	2401090000	Misc. Manufacturing
40200912	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Isopropyl Alcohol	2401090000	Misc. Manufacturing
40200914	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Kerosene	2401090000	Misc. Manufacturing

40200915	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Lactol Spirits	2401090000	Misc. Manufacturing
40200916	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Acetate	2401090000	Misc. Manufacturing
40200917	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Alcohol	2401090000	Misc. Manufacturing
40200918	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Ethyl Ketone	2401090000	Misc. Manufacturing
40200919	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Isobutyl Ketone	2401090000	Misc. Manufacturing
40200930	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methylene Chloride	2401090000	Misc. Manufacturing
40200920	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Mineral Spirits	2401090000	Misc. Manufacturing
40200921	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Naphtha	2401090000	Misc. Manufacturing
40200931	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Perchloroethylene	2401090000	Misc. Manufacturing
40200922	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Toluene	2401090000	Misc. Manufacturing
40200926	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Turpentine	2401090000	Misc. Manufacturing
40200923	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Varsol	2401090000	Misc. Manufacturing
40200924	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Xylene	2401090000	Misc. Manufacturing

INDUSTRIAL SURFACE COATING – MOTOR VEHICLES

A. Source Category Description

Surface coating operations involve the application of a thin layer of coating (paint, lacquer, enamel, varnish, ink, etc.) to an object for decorative or protective purposes. The coating can be applied by brushing, rolling, spraying, flow coating or dipping the object. Emissions result as the thinner or solvent used to facilitate the application of the coatings evaporates.

Table 1: 2023 NEI Industrial Surface Coating – Motor Vehicles SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401070000	Solvent Utilization	Surface Coating	Motor Vehicles	Total: All Solvent Types

B. Overview of Calculations

Motor Vehicles Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized is 3361//, 3362//, 3363// and 3369//. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment

County Name	State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany	24001	0	804 Employees from State Business Patterns. Withheld Employment = State Employment – County Employment = 801. Midpoints = 0	0
Anne Arundel	24003	0		0
Baltimore	24005	3		3
Calvert	24009	0		0
Caroline	24011	0		0
Carroll	24013	0		0
Cecil	24015	0		0
Charles	24017	0		0
Dorchester	24019	0		0

Frederick	24021	0	Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	0
Garrett	24023	0		0
Harford	24025	0		0
Howard	24027	0		0
Kent	24029	0		0
Montgomery	24031	0		0
Prince Georges	24033	0		0
Queen Annes	24035	0		0
Saint Mary's	24037	0		0
Somerset	24039	0		0
Talbot	24041	0		0
Washington	24043	0		0
Wicomico	24045	0		0
Worcester	24047	0		0
Baltimore City	24510	0		0
Total		3		3

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

VOC emission factors for Motor Vehicles SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Motor Vehicles

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401070000	Motor Vehicles	VOC	29.03	lb/employee	[4], [5], [6]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in

Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

G. Point Source Subtraction

Since emissions from Motor Vehicles industrial coatings occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Maryland has no facilities that report the surface coating of Motor Vehicles as part of its point-source emissions. Point-source subtraction is unnecessary.

H. Sample Calculations

Sample calculations for VOC emissions from Motor Vehicles surface coating in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Motor Vehicles (SCC 2401070000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}$	$\left(3\ employees\ \times 29.03 \frac{lb/employee}{2000}\right)$	0.04 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. County Business Patterns: 2021. U.S. Department of Commerce. Retrieved October 21, 2024 from https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy..

[5] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

APPENDIX

Table 1. HAP speciation factors for Industrial Surface Coating – Motor Vehicles . For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401070000	Motor Vehicles	1330207	Xylenes	1.95E-01	3131
2401070000	Motor Vehicles	108883	Toluene	1.47E-01	3131
2401070000	Motor Vehicles	100414	Ethylbenzene	2.81E-02	3131
2401070000	Motor Vehicles	108101	Methyl isobutyl ketone	2.53E-03	3131

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Industrial Surace Coating - Motor Vehicles (SCC 2401070000)

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40201608	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Deadeners	2401070000	Motor Vehicles
40201623	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Solvent-borne - Automobiles	2401070000	Motor Vehicles
40201629	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Solvent-borne - Light Trucks	2401070000	Motor Vehicles
40201624	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Water-borne - Automobiles	2401070000	Motor Vehicles
40201630	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Water-borne - Light Trucks	2401070000	Motor Vehicles
40201699	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Other Not Classified	2401070000	Motor Vehicles
40201601	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Application/Electo-deposition/Dip/Spray	2401070000	Motor Vehicles
40201622	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Electro-deposition - Automobiles	2401070000	Motor Vehicles
40201628	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Electro-deposition - Light Trucks	2401070000	Motor Vehicles
40201621	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Solvent-borne - Automobiles	2401070000	Motor Vehicles
40201627	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Solvent-borne - Light Trucks	2401070000	Motor Vehicles
40201619	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Surfacing Operation	2401070000	Motor Vehicles
40201620	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Repair Topcoat Application Area	2401070000	Motor Vehicles
40201607	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Sealers	2401070000	Motor Vehicles

40201606	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat Operation	2401070000	Motor Vehicles
40201625	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Solvent-borne - Automobiles	2401070000	Motor Vehicles
40201631	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Solvent-borne - Light Trucks	2401070000	Motor Vehicles
40201626	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Water-borne - Automobiles	2401070000	Motor Vehicles
40201632	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Water-borne - Light Trucks	2401070000	Motor Vehicles

INDUSTRIAL SURFACE COATING – OTHER SPECIAL PURPOSE COATINGS

A. Source Category Description

Surface coating operations involve the application of a thin layer of coating (paint, lacquer, enamel, varnish, ink, etc.) to an object for decorative or protective purposes. The coating can be applied by brushing, rolling, spraying, flow coating or dipping the object. Emissions result as the thinner or solvent used to facilitate the application of the coatings evaporates.

Table 1: 2023 NEI Industrial Surface Coating – Other Special Purpose Coatings SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401200000	Solvent Utilization	Surface Coating	Other Special Purpose Coatings	Total: All Solvent Types

B. Overview of Calculations

Other Special Purpose Coatings Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using population and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific county-level population data from the U.S. Census Bureau.[2] The 2023 NEI uses 2023 population estimates, as shown in Table 2.

Table 2: 2023 County Level Population.

County Name	State County FIPs	Population for Inventory Year
Allegany	24001	67,273
Anne Arundel	24003	594,582
Baltimore	24005	844,703
Calvert	24009	94,728
Caroline	24011	33,593
Carroll	24013	176,639
Cecil	24015	105,672
Charles	24017	171,973
Dorchester	24019	32,879
Frederick	24021	293,391
Garrett	24023	28,423
Harford	24025	264,644
Howard	24027	336,001
Kent	24029	19,303
Montgomery	24031	1,058,474

Prince Georges	24033	947,430
Queen Annes	24035	52,508
Saint Mary's	24037	115,281
Somerset	24039	24,910
Talbot	24041	37,823
Washington	24043	155,813
Wicomico	24045	104,800
Worcester	24047	54,171
Baltimore City	24510	565,239
Total		6,180,253

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has updated its emission factor to align with EPAs.

To align MDE's emission factor with EPA's values, MDE adjusted its uncontrolled emission factor, such that, when the state's credit for emissions control programs are applied, the final emission factor used to estimate emissions is equal to EPA's emission factor (which assumes controls within the factor). MDE's adjusted uncontrolled emission factor is 0.3804 lbs/person, as is demonstrated in table 3 below. When controls are applied (as discussed in Section E), MDE's final emission factor will be 0.21 lbs/person, which is consistent with EPA's emission factor.

VOC emission factors for Other Special Purpose Coatings SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Other Special Purpose Coatings

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401100000	Industrial Maintenance Coatings	VOC	0.8	lb/person	[4]
Adjustment to Align with EPA Emission Factor					
MDE Controlled Emission Factor (0.8 * [1- 44.8% control efficiency * 1 rule effectiveness * 1 rule penetration		VOC	0.4416	lb/person	
EPA Emission Factor		VOC	0.21	lb/person	[5], [6], [7]
Difference in Emission Factor: - 52.45%					
MDE Adjusted Uncontrolled Emission Factor 0.8* - 52.45%+0.8		VOC	0.3804	lb/person	

E. Controls

EPA's surface coating regulation allowed the state to take a 20% emissions reduction in 1999.[8] MDE then adopted The Ozone Transport Commission's (OTC) AIM rule Phase I[9] and II[10] in 2005 and 2017 respectively, allowing the state to take an additional 31% reduction in controls.

When accounting for the alignment of emission factors between MDE and EPA (as discussed in Section D), the final reduction from the uncontrolled emission factor of 0.8 lbs/person is 73.75%, yielding a final controlled emission factor of 0.21 lbs/person.

F. Emissions

Total VOC emissions from other special purpose coatings are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)
RE = Rule Effectiveness with source category *s*
RP = Rule Penetration with source category *s*
CE = Control Efficiency with source category *s*

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

Since emissions from surface coating of other special purpose categories occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Point source subtraction for this sector is completed at the county level through adjusting population. Facility level annual emissions from the mapped SCCs are divided by the *uncontrolled* emission factor, which yields the number of people in the county associated with the source category. The county population is then adjusted downward by the number of employees. Nonpoint emissions are then estimated using the point source adjusted population. The resultant emissions represent emissions only associated with nonpoint activity.

The population adjustment for point source subtraction is calculated as follows:

$$\boldsymbol{NP_{p,c} = Ep_{VOCc,s} \times 2000 \,/\, EF_{VOC,s}}$$

Where:

$NP_{p,c}$ = Nonpoint source population in county *c* for source category *s*, in tons per year
$Ep_{VOC,c,s}$= Annual point VOC emissions for the mapped SCCs in county *c* for source category *s*, in tons per year

$EF_{VOC,s}$ = Uncontrolled VOC emissions factor for source category *s*

The point source population estimates for surface coating of other special purpose categories is outlined in Table 4 below.

Table 4: Point Source Population Adjustment for for Other Special Purpose Coatings (SCC 2401200000)

FIPS State and County Code	FIPS State Code	FIPS County Code	County Name	County Type	Postal State Code	Point Source Reduction VOC (tpy)	Total County Population Subtraction
24001	24	001	Allegany	County	MD		0
24003	24	003	Anne Arundel	County	MD		0
24005	24	005	Baltimore	County	MD		0
24009	24	009	Calvert	County	MD		0
24011	24	011	Caroline	County	MD		0
24013	24	013	Carroll	County	MD		0
24015	24	015	Cecil	County	MD		0
24017	24	017	Charles	County	MD		0
24019	24	019	Dorchester	County	MD		0
24021	24	021	Frederick	County	MD		0
24023	24	023	Garrett	County	MD		0
24025	24	025	Harford	County	MD		0
24027	24	027	Howard	County	MD		0
24029	24	029	Kent	County	MD		0
24031	24	031	Montgomery	County	MD		0
24033	24	033	Prince George's	County	MD		0
24035	24	035	Queen Anne's	County	MD		0
24037	24	037	St. Mary's	County	MD		0
24039	24	039	Somerset	County	MD		0
24041	24	041	Talbot	County	MD		0
24043	24	043	Washington	County	MD	8.57	21,148
24045	24	045	Wicomico	County	MD	0.12	293
24047	24	047	Worcester	County	MD		0
24510	24	510	Baltimore	City	MD		0

H. Sample Calculations

Sample calculations for VOC emissions from Other Special Purpose Coatings in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Other Special Purpose Coatings (SCC 2401200000) in Anne Arundel

County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$	$\left(594{,}582\ people \times .8 \frac{lb/employee}{2000} \times [\mathbf{1} - \mathbf{0.7375} \times \mathbf{1} \times \mathbf{1}\right)$	62.42 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume 1, General Guidance for Stationary Sources*, EPA-450/4-91-016, May 1991

[5] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[6] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[7] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[8] EPA AIM Controls: 63 FR 48848, 1998: Federal Register, "National Volatile Organic Compound Emission Standards for Architectural Coatings, Final Rule, Volume 63, Number 176, September 11, 1998.

[9] COMAR 26.11.33: Architectural Coatings. [REPEALED & REPLACED WITH 26.11.39].

[10] COMAR 26.11.39: Architectural and Industrial Maintenance Coatings. https://mde.maryland.gov/programs/regulations/air/Documents/NPA_26-11-39_AIM_in_MD_Reg_01-22-2016.pdf

APPENDIX

Table 1. HAP speciation factors for Industrial Surface Coating – Other Special Purpose Coatings . For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401200000	Other Special Purpose Coatings	108883	Toluene	3.55E-02	2552
2401200000	Other Special Purpose Coatings	71432	Benzene	2.60E-02	2552
2401200000	Other Special Purpose Coatings	108383	M-xylene	1.42E-02	2552
2401200000	Other Special Purpose Coatings	95476	O-xylene	1.37E-02	2552
2401200000	Other Special Purpose Coatings	98828	Cumene	1.02E-02	2552
2401200000	Other Special Purpose Coatings	110543	N-hexane	1.02E-02	2552
2401200000	Other Special Purpose Coatings	100414	Ethylbenzene	9.60E-03	2552
2401200000	Other Special Purpose Coatings	106423	P-xylene	5.60E-03	2552

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Industrial Surace Coating - Other Special Purpose Coatings (SCC 2401200000)

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40204735	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Coagulation Baths and Solvent Separation	2401200000	Other Special Purpose Coatings
40204730	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204750	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Drying	2401200000	Other Special Purpose Coatings
40204721	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204740	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Solvent Recovery	2401200000	Other Special Purpose Coatings
40204770	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste	2401200000	Other Special Purpose Coatings
40204772	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204755	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Winding	2401200000	Other Special Purpose Coatings
40204330	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204340	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Drying/Curing	2401200000	Other Special Purpose Coatings

40204321	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204360	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste	2401200000	Other Special Purpose Coatings
40204362	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204530	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204532	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application: Coating Die	2401200000	Other Special Purpose Coatings
40204531	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application: Extruder	2401200000	Other Special Purpose Coatings
40204550	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cooling Cylinder	2401200000	Other Special Purpose Coatings
40204521	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204570	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste	2401200000	Other Special Purpose Coatings
40204572	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204555	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Winding	2401200000	Other Special Purpose Coatings
40204130	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204140	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Drying/Curing	2401200000	Other Special Purpose Coatings
40204121	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204160	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste	2401200000	Other Special Purpose Coatings
40204162	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204630	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204631	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application: Calendar Rolls	2401200000	Other Special Purpose Coatings
40204632	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application: Pick Up Roll	2401200000	Other Special Purpose Coatings
40204650	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cooling Rolls	2401200000	Other Special Purpose Coatings
40204621	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204670	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste	2401200000	Other Special Purpose Coatings

40204672	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204655	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Winding	2401200000	Other Special Purpose Coatings
40204230	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204240	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Drying/Curing	2401200000	Other Special Purpose Coatings
40204221	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204260	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste	2401200000	Other Special Purpose Coatings
40204262	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204430	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204431	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application: First Roll Applicator	2401200000	Other Special Purpose Coatings
40204432	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application: Second Roll Applicator	2401200000	Other Special Purpose Coatings
40204450	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cooler	2401200000	Other Special Purpose Coatings
40204440	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing	2401200000	Other Special Purpose Coatings
40204441	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: First Predrier	2401200000	Other Special Purpose Coatings
40204443	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: Main Drying Tunnel	2401200000	Other Special Purpose Coatings
40204442	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: Second Predrier	2401200000	Other Special Purpose Coatings
40204435	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Lamination: Laminating Device	2401200000	Other Special Purpose Coatings
40204421	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204470	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste	2401200000	Other Special Purpose Coatings
40204472	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204455	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Winding	2401200000	Other Special Purpose Coatings
40201201	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: General (Also See New Codes Under 4-02-060-XX)	2401200000	Other Special Purpose Coatings

INDUSTRIAL SURFACE COATING – WOOD FURNITURE AND FIXTURES

A. Source Category Description

Emissions from the industrial surface coating of wood furniture and fixtures results form applying a thin layer of coating (e.g. paint, lacquer, enamel, varnish, etc.) to the surface of an object of wood furniture for decorative or protective purposes. The coating products, which are solvent based, emit emissions as the result of solvent evaporation during the drying or curing process.

Table 1: 2023 NEI Industrial Surface Coating – Wood Furniture and Fixtures SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401020000	Solvent Utilization	Surface Coating	Wood Furniture	Total: All Solvent Types

B. Overview of Calculations

Wood Furniture and Fixture Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using employment and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state and county-level employment data from the U.S. Census Bureau.[2] County Business Pattern NAICS Codes utilized are 337110, 337121, 337122, 337127, 337129, 337211, 337212, 337215, and 339111. Employment for NAICS 337127 and 337215 are divided in half to represent an even split between wood and metal furniture. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized and a true-up between County and State Business Patterns is utilized to fill the employment gaps. The 2023 NEI uses 2021 employment estimates, as shown in Table 2.

Table 2: 2021 County Level Employment.

County Name		State County FIPs	2021 County Employment	2021 State Employment and Adjustment Factor	Adjusted County Employment (If Midpoint = 0, County Business Patterns, otherwise = Midpoint X Adjustment Factor
Allegany		24001	584	2,177 Employees from State Business Patterns. Withheld Employment = State Employment – County Employment	584
Anne Arundel		24003	22		22
Baltimore		24005	254		254
Calvert		24009	0		0
Caroline		24011	0		0
Carroll		24013	46		46
Cecil		24015	0		0

Charles		24017	0	= 845.	0
Dorchester		24019	0	Midpoints = 0	0
Frederick		24021	119		119
Garrett		24023	0	Adjustment Factor for County Employment = Withheld Employment / Midpoint = N/A	0
Harford		24025	0		0
Howard		24027	0		0
Kent		24029	0		0
Montgomery		24031	87		87
Prince Georges		24033	191		191
Queen Annes		24035	0		0
Saint Mary's		24037	27		27
Somerset		24039	0		0
Talbot		24041	0		0
Washington		24043	65		65
Wicomico		24045	0		0
Worcester		24047	0		0
Baltimore City		24510	81		81
Total			1,476		1,476

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

VOC emission factors for the industrial surface coating of wood furniture and fixtures are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Industrial Surface Coating – Wood Furniture and Fixtures

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401020000	Wood Furniture	VOC	135.62	lb/employee	[4], [5], [6]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Section C)

$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)

HAP emissions are estimated using the VOC emissions and HAP speciation factors (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year (Eqn. 1)
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

Since emissions from the surface coating of wood furniture and fixtures occurs from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Maryland has no facilities that report the surface coating of wood furniture and fixtures as part of its point-source emissions. Point-source subtraction is unnecessary.

H. Sample Calculations

Sample calculations for VOC emissions from wood furniture and fixtures in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for Wood Furniture and Fixtures (SCC 2401020000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$\left(22\ employees\ \times 135.62 \frac{lb/employee}{2000}\right)$	1.49 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. County Business Patterns: 2021. U.S. Department of Commerce. Retrieved October 21, 2024 from https://www.census.gov/data/datasets/2021/econ/cbp/2021-cbp.html.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy..

[5] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

APPENDIX

Table 1. HAP speciation factors for the solvent utilization sector. For estimating HAPs, EPA will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401020000	Wood Furniture	108883	Toluene	0.26600000	2405
2401020000	Wood Furniture	1330207	Xylenes	0.15100000	2405
2401020000	Wood Furniture	108101	Methyl isobutyl ketone	0.07350000	2405
2401020000	Wood Furniture	171	Glycol Ethers	0.00394000	2405
2401020000	Wood Furniture	107211	Ethylene glycol	0.00070800	2405

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Industrial Surace Coating – Wood Furniture and Fixtures (SCC 2401020000)

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
40201903	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Mixing	2401020000	Wood Furniture
40201901	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Operation	2401020000	Wood Furniture
40201904	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Storage	2401020000	Wood Furniture
40201999	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Other Not Classified	2401020000	Wood Furniture

MUNICIPAL SOLID WASTE LANDFILLS

A. Source Category Description

Municipal solid waste landfills receive household and commercial trash. VOC emissions are produced from volatilization, chemical reaction and biological decomposition of waste. Methane and Carbon dioxide are the primary constituents of landfill gas, and are produced during anaerobic decomposition of cellulose and proteins in the landfill waste. 98.7 percent of landfill emissions are methane and carbon dioxide. [1] In addition to methane and carbon dioxide, non-methane organic carbons (NMOCs) are produced as a small fraction of the landfill gas emissions (less than 1%). NMOCs include hazardous air pollutants and reactive Volatile Organic Compounds (VOC).

Table 1: 2023 NEI Landfill SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2620030000	Waste Disposal, Treatment, and Recovery	Landfills	Municipal	Total

B. Overview of Calculations

Landfill Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using the Landfill Gas Emissions Model (LandGEM) Version 3.03. [2]

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), and point source subtraction (Section G).

C. Activity Data

LandGEM model inputs are collected from Maryland Department of the Environment's (MDE) Solid Waste Program and from the landfill facilities directly. LandGEM inputs include landfill characteristics and model parameters. Landfill characteristics covers open and closure years, waste design capacity, and waste acceptance rates. Model parameters cover methane generation rate, methane generation capacity non-methane organic compound concentration, and methane content by volume.

D. Emissions Factors

Emission factors are included in the LandGEM model; users can either accept default emission factors or provide emission factors.

E. Controls

Controls are included in the LandGEM model.

F. Emissions

To estimate emissions for the various compounds present in landfill gas, total landfill gas emissions must first be estimated. MDE equates NMOC to VOC emissions. LandGEM uses the following first-order

decomposition rate equation to estimate annual emissions over a user specified time period:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where:

QCH4 = annual methane generation in the year of the calculation (m3 /year)
i = 1 year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1 year time increment
k = methane generation rate (year-1)
Lo = potential methane generation capacity (m3 /Mg)
Mi = mass of waste accepted in the ith year (Mg)
tij = age of the jth section of waste mass Mi accepted in the ith year (decimal years, e.g., 3.2 years)

G. Point Source Subtraction

Some municipal solid waste landfills in Maryland are considered to be point sources. LandGEM model runs for these landfills were not done for these sources to ensure emissions from this sector are not double-counted.

H. Reference

[1] U.S. Environmental Protection Agency. Volatile Organic Compounds Species Data Manual. 1978. Retrieved November 4, 2024 from https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=91010XSI.TXT.

[2] U.S. Environmental Protection Agency. Landfill Gas Emissions Model (LandGEM) Version 3.03. Retrieved November 4, 2024 from https://www.epa.gov/land-research/landfill-gas-emissions-model-landgem.

LEAKING UNDERGROUND STORAGE TANKS

A. Source Category Description

Many underground storage tanks (USTs) are over 15 years old and are constructed of steel, which may rust over time. The underground piping connected to these tanks also has the potential to leak. Leaking USTs (leaking underground storage tank sites or LUST sites) are of concern because they may result in the contamination of drinking water, subsurface soils, and ground and surface water, and may emit toxic and/or explosive vapors.

Table 1: 2023 NEI Leaking Underground Storage Site SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2660000000	Waste Disposal, Treatment, and Recovery	Leaking Underground Storage Tanks	Leaking Underground Storage Tanks	Total: All Storage Types

B. Overview of Calculations

Leaking underground storage tanks Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using the number of LUST sites and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and county-level LUST sites Maryland Department of the Environment's Oil Control Program.[2] The number of LUST sites is multiplied by an assumed 30-day remediation period during which it is assumed that emissions are released. The 2023 NEI uses 2023 LUST remediation events, as shown in Table 2.

Table 2: 2023 LUST Remediation Events

County Name	State County FIPs	2021 Count of LUST Sites	Remediation Event Time (Days)	Lust Remediation Events
Allegany	24001	7	30	210
Anne Arundel	24003	79		2370
Baltimore	24005	31		930
Calvert	24009	4		120
Caroline	24011	6		180
Carroll	24013	7		210
Cecil	24015	13		390
Charles	24017	15		450
Dorchester	24019	5		150
Frederick	24021	17		510

Garrett	24023	2		60
Harford	24025	14		420
Howard	24027	9		270
Kent	24029	2		60
Montgomery	24031	29		870
Prince Georges	24033	36		1080
Queen Annes	24035	8		240
Saint Mary's	24037	0		0
Somerset	24039	2		60
Talbot	24041	5		150
Washington	24043	10		300
Wicomico	24045	11		330
Worcester	24047	6		180
Baltimore City	24510	20		600

D. Emissions Factors

The emission factor used to estimate emissions from LUST sites is derived from the *Emissions Inventory Improvement Project Volume III: Area Source Category Method Abstract – Remediation of Leaking Underground Storage Tanks*.[3]

VOC emission factors for LUST site SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for LUST Sites

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2660000000	Leaking Underground Storage Tanks	VOC	28	lb/day	[4]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from LUST sites are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = VOC emissions factor for source category s

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for LUST sites; therefore, point source subtraction is not performed for this category

H. Sample Calculations

Sample calculations for VOC emissions from LUST sites in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for LUST Sites (SCC 2660000000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}$	$\left(2{,}370\ days\ \times 28 \frac{lb/day}{2000}\right)$	33.18 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] Maryland Department of the Environment Oil Control Program. https://mde.maryland.gov/programs/land/OilControl/Pages/index.aspx.

[3] U.S. Environmental Protection Agency: *Emissions Inventory Improvement Project Volume III: Area Source Category Method Abstract – Remediation of Leaking Underground Storage Tanks*, https://www.epa.gov/sites/default/files/2015-08/documents/ust2_dec2000.pdf

[4] U.S. Environmental Protection Agency: *Emissions Inventory Improvement Project Volume III: Area Source Category Method Abstract – Remediation of Leaking Underground Storage Tanks*, https://www.epa.gov/sites/default/files/2015-08/documents/ust2_dec2000.pdf

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APPENDIX

Table 1. HAP speciation factors for LUST Sites. For estimating HAPs, MDE will multiply the VOC emissions by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor
2660000000	Leaking Underground Storage Tanks	91203	Naphthalene	0.000002700
2660000000	Leaking Underground Storage Tanks	98828	Cumene	0.000120000
2660000000	Leaking Underground Storage Tanks	100414	Ethyl Benzene	0.000530000
2660000000	Leaking Underground Storage Tanks	108883	Toluene	0.014000000
2660000000	Leaking Underground Storage Tanks	110543	n-Hexane	0.018000000
2660000000	Leaking Underground Storage Tanks	540841	2,2,4-Trimethylpentane	0.007500000
2660000000	Leaking Underground Storage Tanks	1330207	Xylenes	0.005600000

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

LIGHTER FLIUD, FIRE STARTER, & OTHER FUELS

A. Source Category Description

Volatile Organic Compounds (VOC) are emitted when lighter fluids or fire starters are used. Evaporative emissions occur from leakage and combustion emissions occur from combustion.

Table 1: 2023 NEI Lighter Fluid, Fire Starter & Other Fuels SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2460030999	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	Lighter Fluid, Fire Starter, Other Fuels	Total: All Volatile Chemical Product Types

B. Overview of Calculations

Lighter Fluid, Fire Starter & Other Fuels Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using population and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using U.S. EPA's SPECIATE database[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific county-level population data from the U.S. Census Bureau.[2] The 2023 NEI uses 2023 population estimates, as shown in Table 2.

Table 2: 2023 County Level Population.

County Name	State County FIPs	Population for Inventory Year
Allegany	24001	67,273
Anne Arundel	24003	594,582
Baltimore	24005	844,703
Calvert	24009	94,728
Caroline	24011	33,593
Carroll	24013	176,639
Cecil	24015	105,672
Charles	24017	171,973
Dorchester	24019	32,879
Frederick	24021	293,391
Garrett	24023	28,423
Harford	24025	264,644
Howard	24027	336,001
Kent	24029	19,303
Montgomery	24031	1,058,474
Prince Georges	24033	947,430
Queen Annes	24035	52,508

Saint Mary's	24037	115,281
Somerset	24039	24,910
Talbot	24041	37,823
Washington	24043	155,813
Wicomico	24045	104,800
Worcester	24047	54,171
Baltimore City	24510	565,239
Total		6,180,253

D. Emissions Factors

For the 2020 National Emissions Inventory (NEI), Environmental Protection Agency's (EPA) adopted emission factors generated using a new framework[3] for solvents. MDE has reviewed EPA's updated methodology and finds it to be a reasonable update and has aligned its emission factors to align with EPAs.

VOC emission factors for Lighter Fluid, Fire Starter & Other Fuels SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Lighter Fluid, Fire Starter & Other Fuels

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2460030999	Lighter Fluid, Fire Starter, Other Fuels	VOC	0.04	lb/capita	[4], [5], [6]

E. Controls

There are two methods for controlling organic emissions from the nonpoint solvent utilization sector: product reformulation and post-use controls (add-on controls, manufacturing modifications, and disposal). Per EPA's *2020 Solvent's Nonpoint Emissions Methodology and Operator* (NEMO) document, emissions for lighter fluid, fire starter, and other fuels are assumed to feature 90% destruction via in-use combustion.[7]

F. Emissions

Total VOC emissions from lighter fluid, fire starter and other fuels are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)
RE = Rule Effectiveness with source category *s*
RP = Rule Penetration with source category *s*
CE = Control Efficiency with source category *s*

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown (see Table 1 in Appendix). It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used

for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP p county c for source category s, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$SF_{p,s}$ = Speciation factor for HAP p for source category s (Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for Lighter Fluid, Fire Starter & Other Fuels; therefore, point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from Lighter Fluid, Fire Starter & Other Fuels in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Lighter Fluid, Fire Starter & Other Fuels (SCC 2401030000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times [1 - RE \times RP \times CE]$	$\left(594{,}580\ people \times 0.04 \frac{lb/capita}{2000}\right) \times [1 - 0.9 \times 1 \times 1]$	1.189 tons of VOC in 2023

I. References

[1] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019. https://www.epa.gov/air-emissions-modeling/speciate-50-final-report-and-addenda-speciate-51-53. Note: This is the final report for the SPECIATE database. There is an addendum for Version 5.2 at the same location.

[2] U.S. Census Bureau. Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2023 (CO-EST2023-POP) U.S. Department of Commerce. Retrieved April 8, 2024 from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html#v2023.

[3] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[4] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[5] California Air Resources Board (CARB): Final 2015 Consumer & Commercial Product Survey Data Summaries, 2019.

[6] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019.

[7] U.S. Environmental Protection Agency: *2020 Solvent's Nonpoint Emissions Methodology and Operator* (NEMO). https://usepa.sharepoint.com/:w:/r/sites/NEI/Shared%20Documents/General/NEI%20Resource%20Library/NEMOs/Solvents%20NEMO.docx?d=wbca30e5277fd4c09848b14f34a59f15f&csf=1&web=1&e=0aGrxQ

APPENDIX

Table 1. HAP speciation factors for Lighter Fluid, Fire Starter & Other Fuels. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2460030999	Lighter Fluid, Fire Starter, Other Fuels	108883	Toluene	1.17E-03	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	N590	Polycyclic Organic Matter	7.79E-04	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	67561	Methanol	7.42E-04	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	108383	M-xylene	3.13E-04	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	75092	Dichloromethane	1.56E-04	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	110543	N-hexane	4.64E-05	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	91203	Naphthalene	1.70E-05	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	108101	Methyl isobutyl ketone	1.56E-05	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	71432	Benzene	5.95E-06	95820

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

PETROLEUM VESSEL UNLOADING LOSSES

A. Source Category Description

Petroleum liquids are transported via ships and barges, and on-land transportation. This category does not include emissions from fuel consumed by vessels while in transit or in port. Loading losses occur as organic vapors in "empty" cargo tanks are displaced to the atmosphere by the liquid being loaded into the tanks. These vapors are a composite of vapors formed in three ways: vapors which are formed in the "empty" tank by evaporation of residual product from previous loads; vapors transferred to the tank from a vapor balance system that was used when the previous load was being unloaded; and vapors generated in the tank as the new product is being loaded. Evaporative VOC emissions from ocean going ships and barges carrying petroleum liquids result from loading losses, ballasting losses and transit losses. Petroleum liquids are classified into groups which are represented by crude oil, gasoline, jet naphtha, distillate oil/kerosene, or residual oil. Loading and ballasting losses do not occur with pipeline transport of petroleum products.

Table 1: 2023 NEI Petroleum Vessel Unloading Loss SCCs.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2505020030	Storage and Transport	Petroleum and Petroleum Product Transport	Marine Vessel	Crude Oil
2505020060	Storage and Transport	Petroleum and Petroleum Product Transport	Marine Vessel	Residual Oil
2505020090	Storage and Transport	Petroleum and Petroleum Product Transport	Marine Vessel	Distillate Oil
2505020120	Storage and Transport	Petroleum and Petroleum Product Transport	Marine Vessel	Gasoline
2505020150	Storage and Transport	Petroleum and Petroleum Product Transport	Marine Vessel	Jet Naphtha
2505020180	Storage and Transport	Petroleum and Petroleum Product Transport	Marine Vessel	Kerosene

B. Overview of Calculations

Petroleum Vessel Unloading Loss Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using the weight of cargo moved and emission factors. Hazardous Air Pollutant (HAP) emissions are estimated based on the composition of products and profiles using Pechan & ERTAC[1].

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific and port-specific cargo data from the U.S. Army Corps of Engineers' Institute for Water Resources *Waterborne Cargo and Trips Data*.[2] The USACE waterborne commerce data supplies tonnage and types of petroleum products delivered to the various ports in Maryland in 2022. Petroleum products moved is further subdivided into four types of loading losses: ship loading, barge loading, ballasting and transit. Tonnages of petroleum delivered were converted into Kgals (1000 gallons) using densities from AP-42 Appendix A - Table 7.1-2. [3] The 2023 NEI uses petroleum

products estimates, as shown in Table 2.

Table 2: 2022 County Level Waterborne Commerce of Petroleum Products.

	Crude Oil Kgals SCC = 2505020030	Distillate Oil Kgals SCC = 2505020090	Gasoline Kgals SCC = 2505020120	Jet Naphtha Kgals SCC = 2505020150	Residual Oil Kgals SCC = 2505020060	Kerosene Kgals SCC = 2505020180
Allegany (24001) – N/A – No Port						
Anne Arundel (24003)						
Vessel Loading	0	0	0	0	0	0
Barge Loading	0	0	0	0	0	0
Ballasting	0	0	0	0	0	0
Transit	0	0	0	0	0	0
Baltimore (24005) – N/A – No Port						
Calvert (24009)						
Vessel Loading	0	0	0	0	0	0
Barge Loading	0	0	0	0	0	0
Ballasting	0	0	0	0	0	0
Transit	0	0	0	0	0	0
Caroline (24011) – N/A – No Port						
Carroll (24013) – N/A – No Port						
Cecil (24015) – N/A – No Port						
Charles (24017) – N/A – No Port						
Dorchester (24019)						
Vessel Loading	0	0	0	0	0	0
Barge Loading	0	0	0	0	0	0
Ballasting	0	0	0	0	0	0
Transit	0	0	0	0	646.58	0
Frederick (24021) – N/A – No Port						
Garrett (24023) – N/A – No Port						
Harford (24025) – N/A – No Port						
Howard (24027) – N/A – No Port						
Kent (24029) – N/A – No Port						
Montgomery (24031) – N/A – No Port						
Prince Georges (24033) – N/A – No Port						
Queen Annes (24035) – N/A – No Port						
Saint Mary's (24037)						
Vessel Loading	0	0	0	0	0	0
Barge Loading	0	0	0	0	0	0
Ballasting	0	0	0	0	0	0
Transit	0	0	0	0	0	9,816.00
Somerset (24039)						
Vessel Loading	0	0	0	0	0	0
Barge Loading	0	0	0	0	0	0
Ballasting	0	0	0	0	0	0
Transit	0	0	0	0	0	0
Talbot (24041) – N/A – No Port						
Washington (24043) – N/A – No Port						

Wicomico (24045)						
Vessel Loading	0	0	0	0	0	0
Barge Loading	0	0	0	0	0	0
Ballasting	0	0	0	0	0	0
Transit	0	43,239.72	152,910.36	0	1,042.53	0
Worcester (24047) – N/A – No Port						
Baltimore City (24510)						
Vessel Loading	0	0	0	0	0	0
Barge Loading	0	0	0	0	0	0
Ballasting	0	0	0	0	0	0
Transit	5.92	64,420.28	117,041.07	5.94	190,970.89	83,359.14

D. Emissions Factors

Emissions from petroleum vessel unloading losses were calculated using emission factors from the *Emissions Inventory Improvement Project: Volume III: Chapter 12: Marine Vessel Loading, Ballasting and Transit*.[4]

VOC emission factors for petroleum vessel unloading loss SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Petroleum Vessel Unloading Loss in Lbs. VOC per 1,000 gallons Transferred

	Crude Oil Kgals SCC = 2505020030	Distillate Oil Kgals SCC = 2505020090	Gasoline Kgals SCC = 2505020120	Jet Naphtha Kgals SCC = 2505020150	Residual Oil Kgals SCC = 2505020060	Kerosene Kgals SCC = 2505020180	Source
Vessel Loading	0.61	0.005	1.8	0.5	0.00004	0.005	[5]
Barge Loading	1	0.012	3.4	1.2	0.00009	0.012	
Ballasting	1.1	N/A	0.8	N/A	N/A	N/A	
Transit	1.3	0.005	2.7	0.7	0.00003	0.005	

E. Controls

For vessel loading operations, 90 percent of the total throughput was loaded at terminals with a control system of 95 percent efficiency.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category. In addition to the general equation shown below, vessel loading applies a control factor, ballasting applies a 20% capacity ballasted factor, and transit applies a 6 hour per week transit time factor.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)

$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 3)

HAP emissions are estimated using a county-wide VOC emission factor associated with all four unloading types. The county-wide emission factor is then multiplied by a HAP speciation factor. The VOC emission factor and HAP speciation factors are shown in Tables 1 and 2 of the Appendix.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Appendix Table 1)

G. Point Source Subtraction

There are no point source-specific SCCs for petroleum vessel unloading losses; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from petroleum vessel unloading loss in Baltimore City, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Petroleum Vessel Unloading Losses in Baltimore City.

Eq. #	Equation	Values for Baltimore City	Result
Vessel Loading – No Product – Sample for Crude Oil			
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times (0.1 + \left(0.9 * \left(1 - \frac{95}{100}\right)\right))}$	$\left(0\ kgal \times 0.61 \frac{lb/kgal}{2000} \times (\mathbf{0.1} + \left(\mathbf{0.9} * \left(\mathbf{1} - \frac{\mathbf{95}}{\mathbf{100}}\right)\right)\right)$	0 tons of VOC in 2023
Barge Loading – No Product – Sample for Crude Oil			
2	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$\left(0\ kgal \times 1 \frac{lb/kgal}{2000}\right)$	0 tons of VOC in 2023
Ballasting – No Product – Sample for Crude Oil			
3	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times Capacity\ Ballasted}$	$\left(0\ kgal \times 1.1 \frac{lb/kgal}{2000} \times 0.2\right)$	0 tons of VOC in 2023
Transit - Crude Oil			
4	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times Transit\ Time}$	$\left(5.92\ kgal \times 1.3 \frac{lb/kgal}{2000} \times 0.035714\right)$	0.0001 tons of VOC in 2023
Transit - Distillate Oil			

5	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times Transit\ Time}$	$\left(64{,}420.28\ kgal \times 0.005 \frac{lb/kgal}{2000} \times 0.035714\right)$	0.0058 tons of VOC in 2023
Transit - Gasoline			
6	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times Transit\ Time}$	$\left(117{,}041.07\ kgal \times 2.7 \frac{lb/kgal}{2000} \times 0.035714\right)$	5.6431 tons of VOC in 2023
Transit – Jet Naphtha			
7	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times Transit\ Time}$	$\left(5.94\ kgal \times 0.7 \frac{lb/kgal}{2000} \times 0.035714\right)$	0.0001 tons of VOC in 2023
Transit – Residual Oil			
8	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times Transit\ Time}$	$\left(190{,}970.89\ kgal \times 0.00003 \frac{lb/kgal}{2000} \times 0.035714\right)$	0.0001 tons of VOC in 2023
Transit – Kerosene			
9	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times Transit\ Time}$	$\left(83{,}359.14\ kgal \times 0.005 \frac{lb/kgal}{2000} \times 0.035714\right)$	0.0074 tons of VOC in 2023
Total			
			5.6565 tons of VOC in 2023

I. References

[1] Pechan/ERTAC 2007.

[2] U.S. Army Corps of Engineers Institute for Water Resources. *Waterborne Cargo and Trips Data*: Carto_2022_Atlantic. Retrieved April December 6, 2024 from https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll2/id/14579%3Cbr%20/%3E.

[3] U.S. EPA. *AP-42 5TH Edition: Volume 1: Chapter 7: Liquid Storage Tanks*. Retrieved December 6, 2024. https://www3.epa.gov/ttnchie1/ap42/ch07/final/ch07s01.pdf

[4] U.S. EPA. *Emissions Inventory Improvement Project: Volume III: Chapter 12: Marine Vessel Loading, Ballasting and Transit*. https://www.epa.gov/sites/default/files/2015-08/documents/iii12_apr2001.pdf

[5] U.S. EPA. *Emissions Inventory Improvement Project: Volume III: Chapter 12: Marine Vessel Loading, Ballasting and Transit*. https://www.epa.gov/sites/default/files/2015-08/documents/iii12_apr2001.pdf

APPENDIX

Table 1. HAP speciation factors for Petroleum Vessel Unloading Losses. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

Pollutant Code	Speciation Factor
100414	0.00053
1330207	0.0056
108883	0.014
91203	0.0000027
98828	0.00012
110543	0.018
540841	0.0075
71432	0.005584

Table 2. County-Wide VOC Emission Factors for Petroleum Vessel Unloading Losses. For estimating HAPs, MDE will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in Table1.

FIPS State and County Code	County Name	SCC (AMS)	Description	Pollutant Code	County VOC Emissions (Ton)	County Throughput (E3GAL)	County VOC Emission Factor	Unit
24510	Baltimore City	2505020030	Crude Oil	VOC	0.000137	5.915493	0.046429	lb/Kgal
24019	Dorchester	2505020060		VOC	3.46E-07	646.5823	1.07E-06	lb/Kgal
24045	Wicomico	2505020060		VOC	5.58E-07	1042.532	1.07E-06	lb/Kgal
24510	Baltimore City	2505020060	Residual Oil	VOC	0.000102	190970.9	1.07E-06	lb/Kgal
24045	Wicomico	2505020090		VOC	0.003861	43239.72	0.000179	lb/Kgal
24510	Baltimore City	2505020090	Distillate Oil	VOC	0.005752	64420.28	0.000179	lb/Kgal
24045	Wicomico	2505020120		VOC	7.372464	152910.4	0.096429	lb/Kgal
24510	Baltimore City	2505020120	Gasoline	VOC	5.643052	117041.1	0.096429	lb/Kgal
24510	Baltimore City	2505020150	Jet Naptha	VOC	7.42E-05	5.9375	0.025	lb/Kgal
24037	St. Mary's	2505020180		VOC	0.000876	9816	0.000179	lb/Kgal
24510	Baltimore City	2505020180	Kerosene	VOC	0.007443	83359.14	0.000179	lb/Kgal

OIL SPILLS

A. Source Category Description

Oil spills involve oil tanker accidents, tanker truck accidents, and spills and blowouts from oil rigs or pipelines in coastal and inland areas. Because a wide range of fuel types may be spilled, the nature and quantity of emissions can vary. Emissions are also influenced by the clean-up procedure and by dispersion and weathering processes.

Table 1: 2023 Oil Spill SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2830000000	Miscellaneous Area Sources	Catastrophic/Accidental Releases	All Catastrophic/Accidential Releases	Total

B. Overview of Calculations

Oil spill Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using county gallons of oil spilled and an emission factor.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific and county-level gallons from oil spills collected from Maryland Department of the Environment's Oil Control's Emergency Response Program. The 2023 NEI uses 2017 gallons of oil spilled, as shown in Table 2.

Table 2: 2017 County Level Oil Spills.

County Name	State County FIPs	2017 Gallons of Oil Spilled
Allegany	24001	339
Anne Arundel	24003	5,344
Baltimore	24005	6,351
Calvert	24009	210
Caroline	24011	179
Carroll	24013	1,266
Cecil	24015	1,622
Charles	24017	1,703
Dorchester	24019	385
Frederick	24021	1,244
Garrett	24023	588
Harford	24025	12,556
Howard	24027	1,034
Kent	24029	27
Montgomery	24031	2,572
Prince Georges	24033	17,238

Queen Annes	24035	319
Saint Mary's	24037	1,160
Somerset	24039	269
Talbot	24041	409
Washington	24043	4,977
Wicomico	24045	428
Worcester	24047	204
Baltimore City	24510	7,560
Total		67,985

D. Emissions Factors

The emission factor used to estimate oil spill emissions are from E.H. Pechan and Associates, Inc, the contractor used by the Metropolitan Washington Council of Governments for the 1990 base year inventory. The emission factor is based on a California Air Resources Board (CARB) study of air emissions from large oil spills.

VOC emission factors for oil spill SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for Oil Spills

SCC	Description	Pollutant Code	Emission Factor	Unit
2830000000	Oil Spill	VOC	0.0000925	ton/gallon

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from oil spills are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category s (Table 3)

G. Point Source Subtraction

There are no point source specific SCCs for oil spills; therefore point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from oil spills in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Oil Spill (SCC 2830000000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$\left(5{,}345\ gallons\ \times 0.0000925\ {}^{ton}/_{gallon}\right)$	0.4944 tons of VOC in 2023

OPEN BURNING – LAND CLEARING DEBRIS

A. Source Category Description

Open burning of land clearing debris is the purposeful burning of debris, such as trees, shrubs, and brush, from the clearing of land for the construction of new buildings and highways. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates from open burning of land clearing debris are a function of the amount of material or fuel subject to burning per year. In 2014, open burning from land clearing debris resulted in approximately 87,277 tons of PM25-PRI emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610000500	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)

B. Overview of Calculations

The emissions from open burning from land clearing debris are estimated based on the number of acres disturbed from non-residential, residential, and road construction. The number of acres disturbed is multiplied by a fuel loading factor to determine the amount of land clearing debris burned in each county. This number is multiplied by emissions factors to determine emissions of CAPs and HAPs. Sources of activity data and calculations are discussed in section C. The process of allocating non-residential construction activity data to the county level, allocating building permit data to the county level, and allocating road construction activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from open burning from land clearing debris is discussed in section G.

C. Activity Data

The amount of material burned is estimated using the county-level total number of acres disturbed by residential, non-residential, and road construction. County-level weighted loading factors are applied to the total number of construction acres to convert acres to tons of available fuel.

Acres Disturbed from Non-Residential Construction

The activity data for this non-residential construction is the acreage disturbed from non-residential construction, which is estimated using data from the U.S. Census Bureau's *Annual Value of Construction Put in Place in the U.S.*[1] and a conversion factor from MRI's *Estimating Particulate Matter Emissions from Construction Operations, Final Report*.[2] The national-level non-residential construction spending data are allocated to the county-level based on the proportion of non-residential construction employees in each county. Employment data are taken from the U.S. Census Bureau's 2016 County Business Patterns (CBP), and gaps in employment data are filled using a process described in detail in section D.

$$EmpFr_c = \frac{Emp_c}{Emp_{US}} \quad (1)$$

$$CS_c = EmpFr_c \times CS_{US} \quad (2)$$

Where:

$EmpFr_c$ = The fraction of non-residential construction employees in county c
Emp_c = The number of non-residential construction employees in county c
Emp_{US} = The number of non-residential construction employees in the US
CS_c = Non-residential construction spending in county c
CS_{US} = Non-residential construction spending in the US

Non-residential construction spending is converted to acres disturbed using a conversion factor from MRI's report. For the average acres disturbed per million dollars of non-residential construction, MRI reported a conversion factor of 2 acres/$1 million (in 1992 constant dollars). The 1992 conversion factor is adjusted to 2017 using the *Price Deflator (Fisher) Index of New Single-Family Houses under Construction*.[3] In 2017 the conversion factor was 1.009 acres per million dollars spent on non-residential construction activities.

$$Apd_{2017} = \frac{2\ acres}{\$1\ million} \times \frac{PD_{1992}}{PD_{2017}} \quad (3)$$

Where:

Apd_{2017} = Acres disturbed per million dollars in 2017
PD_{1992} = Price Deflator (Fisher) Index value in 1992
PD_{2017} = Price Deflator (Fisher) Index value in 2017

County-level non-residential construction spending (from equation 2) is then multiplied by this conversion factor to estimate county-level acreage disturbed from non-residential construction activities.

$$ANR_c = CS_c \times Apd_{2017} \quad (4)$$

Where:

ANR_c = Acres disturbed from non-residential construction in county *c*
CS_c = Non-residential construction spending in county *c*, in million dollars
Apd_{2017} = Acres disturbed per million dollars in 2017

Acres Disturbed from Residential Construction

The US Census Bureau has 2017 data for *Housing Starts - New Privately Owned Housing Units Started*,[4,5] which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. Regional-level results are also provided for quarterly totals and 1 unit structures (Table 1). The 2-to-4 unit category is broken down using a ratio calculated from the 2000 US Census Bureau *National Housing Starts* data for 2 and 3-4 units,[6] for each quarter in 2017. Note that 2000 is the last full year when Census housing starts data were available separately for 2-unit and 3-4 unit homes. Table 2 shows a breakdown of the 2 units and 3-4 unit structures based on the following calculation.

$$S_{Q,n} = \left(\frac{U_n}{U_t}\right) \times S_{Q,2-4} \quad (5)$$

Where:

$S_{Q,n}$ = Housing starts, by quarter, *Q*, and number of units, *n* (2 units or 3-4 units), in thousand units
U_n = Number of housing starts by number of units, *n*, from the 2000 *National Housing Starts* data, in thousand housing starts
U_t = Total number of housing starts for both 2 units and 3-4 units from the 2000 *National Housing Starts* data, in thousand housing starts
$S_{Q,2\text{-}4}$ = Number of 2-4 units by quarter, *Q*, from the 2017 *New Privately Owned Housing Units Started by Purpose and Design* data, in thousand units

Table 1. Housing Start Data for 2017

Quarter	Total	Structure			Region				Regional Starts of Structures with 1 unit			
		1 unit	2 to 4 units	5 units or more	NE	MW	S	W	NE	MW	S	W
Q1-14	267.0	181.0	2.0	84.0	24.0	29.0	150.0	64.0	12.0	21.0	107.0	41.0
Q2-14	327.0	238.0	3.0	86.0	31.0	56.0	152.0	89.0	16.0	41.0	122.0	58.0
Q3-14	319.0	230.0	3.0	86.0	31.0	50.0	155.0	84.0	20.0	35.0	119.0	56.0
Q4-14	290.0	200.0	3.0	87.0	28.0	45.0	141.0	76.0	15.0	33.0	104.0	48.0

Source: Reference 5

Table 2. Breakdown of 2 to 4 unit structures in 2017

Quarter	Structure		
	2 to 4 units	2 units	3-4 units
Q1-14	2.0	0.74	1.26
Q2-14	3.0	1.11	1.89
Q3-14	3.0	1.11	1.89
Q4-14	3.0	1.11	1.89

Ratios of the number of 2, 3 and 4, and 5 unit structures are then used to estimate the number of structures of each type in each region. The ratios are calculated by dividing the housing starts by quarter for each unit type by the total housing starts for buildings with more than 2 units.

$$r_{Q,n} = \frac{S_{Q,n}}{S_{Q.t}} \tag{6}$$

Where:

$r_{Q,n}$ = Ratio of structures with number of units, n, to total number of units by quarter, Q
$S_{Q,n}$ = Housing starts, by quarter, Q, and number of units, n, from distributed calculation in Step 1 for the 2-unit or 3-4 unit categories or directly from the 2017 *New Privately Owned Housing Units Started by Purpose and Design* data for the 5 units or more category, in thousand housing starts
$S_{Q,t}$ = Housing starts, by quarter, Q, for total number of units greater than 2 units, t (excludes 1-unit category), in thousand housing starts

The ratio is then used to distribute the 2017 *New Privately Owned Housing Units Started by Purpose and Design*[5] regional data for all unit types to the 2, 3-4, or 5 or more unit categories within each Census region – Northeast, Midwest, South, and West.

$$A_{Q,n,rgn} = r_{Q,n} \times (RS_{t,rgn} - RS_{1,rgn}) \tag{7}$$

Where:

$A_{Q,n,rgn}$ = Number of housing units started in quarter Q, by number of units, n, and region of the country, rgn, in thousand units
$r_{Q,n}$ = Ratio of structures with number of units, n, to total number of units by quarter, Q
$RS_{t,rgn}$ = Total regional starts from the 2017 *New Privately Owned Housing Units Started by Purpose and Design* data, in thousand housing starts
$RS_{1,rgn}$ = Regional starts of structures with 1 unit from the 2017 *New Privately Owned Housing Units Started by Purpose and Design* data, in thousand housing starts

Data from the Census report *New Privately Owned Housing Units Authorized Unadjusted Units*[7] is used to calculate a conversion factor to determine the ratio of structures to units in the 5 or more unit category. The conversion factor is calculated by dividing the total number of units in structures with 5 or more units by region[6] by the total number of buildings with 5 or more units by region.[7]

$$CF_5 = \frac{U_{5,rgn}}{B_{5,rgn}} \tag{8}$$

Where:

$CF_{5,rgn}$ = Ratio of 5 units or more to the number of buildings with 5 units or more by region, *rgn*
$U_{5,rgn}$ = Total number of 5 or more units by region, *rgn*
$B_{5,rgn}$ = Total number of buildings with 5 or more units by region, *rgn*

Structures started by category are then calculated at a regional level by summing the number of housing unit starts across all four quarters and dividing the by number of units in each building type. For the 3-4 unit type, the number of units per building is 3.5. The value is multiplied by 1,000 because the Census data are in units of thousand building starts.

For buildings with 1, 2, or 3-4 units:

$$B_{n,rgn} = \frac{(\sum_{Q1}^{Q4} A_{Q.n.rgn}) \times 1{,}000}{n} \tag{9}$$

Where:

$B_{n,rgn}$ = Number of building starts by the unit number category, *n*, and by region, *rgn*
$A_{Q,n,rgn}$ = Number of housing units started in quarter *Q,* by number of units*, n*, and region of the country*, rgn*, in thousand units
n = Number of units per building

For buildings with 5 or more units:

$$B_{n,rgn} = \frac{(\sum_{Q1}^{Q4} A_{Q.n.rgn}) \times 1{,}000}{CF_5} \tag{10}$$

Where:

$B_{n,rgn}$ = Number of building starts by the unit number category, *n*, and by region, *rgn*
$A_{Q,n,rgn}$ = Number of housing units started in quarter *Q,* by number of units*, n*, and region of the country*, rgn*, in thousand units
CF_5 = Ratio of 5 units or more to the number of buildings with 5 units or more

Annual county building permit data were purchased from the US Census Bureau for 2017.[8] The 2017 County Level Residential Building Permit dataset has 2017 data to allocate regional housing starts to the county level. This results in county level housing starts by number of units.

The number of building permits for each unit number category by region is calculated by summing the county-level Census data to the region level.

$$BP_{n,rgn} = \sum BP_{n,c} \tag{11}$$

Where:

$BP_{n,rgn}$ = Number of building permits by the unit number category, *n*, and by region, *rgn*
$BP_{n,c}$ = Number of building permits by the unit number category, *n*, and by county, *c*

The ratio of the number of building permits by county to the total number of building permits by region in which the county is located, for each unit number category, is then calculated.

$$R_{BP,c} = \frac{BP_{n,c}}{BP_{n,rgn}} \tag{12}$$

Where:

$R_{BP,c}$ = Ratio building permits, *BP*, to total regional building permits in county *c*
$BP_{n,c}$ = Number of building permits by the unit number category, *n*, and by county, *c*
$BP_{n,rgn}$ = Number of building permits by the unit number category, *n*, and by region, *rgn*

The final number of building starts for each unit type category is then calculated at the county-level by multiplying the number of structures started at the regional level and the building permit ratio.

$$B_{n,c} = B_{n,rgn} \times R_{BP,c} \tag{13}$$

Where:

$B_{n,c}$ = Number of building starts by the unit number category, *n*, and by county, *c*
$B_{n,rgn}$ = Number of building starts by the unit number category, *n*, and by region, *rgn*
$R_{BP,c}$ = Ratio building permits, *BP*, to total regional building permits in county, *c*

The number of acres of surface area disturbed by the construction of residential buildings is calculated for apartment buildings, buildings with 2 units, and buildings with 1 unit. Table 3 shows the assumptions used for the surface area disturbed for each unit type. Buildings with unit types of 3-4 and 5 or more are grouped together as apartments in this step.

Table 3. Surface Soil removed per unit type

Structure	Acres disturbed
1-Unit	1/4 acre/structure
2-Unit	1/3 acre/structure
Apartment	1/2 acre/structure

The acres of soil disturbed by the construction of residential buildings are calculated for apartment buildings, buildings with 2 units, and buildings with 1 unit.

$$AR_{n,c} = B_{n.c} \times a_n \tag{14}$$

Where:

$AR_{n,c}$ = Surface soil disturbed by building construction by county, *c*, and unit type category, *n*, in acres
$B_{n,c}$ = Number of building starts by the unit number category, *n*, and by county, *c*
a_n = Acres of surface soil disturbed by each unity type category, *n*. See Table 3.

Acres Disturbed by Road Construction

The activity data for this source category is the acreage disturbed from new road construction, which is estimated using data from FHWA's *Highway Statistics, State Highway Agency Capital Outlay 2014, Table SF-12A* [9] and FLDOT's *Generic Cost per Mile Models*.[10] From the FHWA table, the following columns are used: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening. These columns are also differentiated according to the following six classifications:

1. Interstate, urban
2. Interstate, rural
3. Other arterial, urban

4. Other arterial, rural
5. Collectors, urban
6. Collectors, rural

Construction spending for each road type is summed across all construction types to determine the total annual highway spending for each road type.

$$HS_{s,r} = \sum_{ct} S_{s,r} \tag{15}$$

Where:

$HS_{s,r}$ = Annual highway spending for road type *r* in state *s*, in dollars
ct = Construction type
$S_{s,r}$ = Annual spending per construction type for road type *r* in state *s*, in dollars

State expenditure data are converted to miles of new road and acres disturbed per mile of new road based on conversions obtained from FLDOT. The conversions are shown in

Table 4, and the acres disturbed per mile conversions are calculated by multiplying the total affected roadway width (including all lanes, shoulders, and areas affected beyond the road width) by one mile and converting the resulting land area to acres.

$$RC_{m,s,r} = \frac{HS_{s,r}}{TDM} \tag{16}$$

$$RC_{a,s,r} = RC_{m,s,r} \times ADM \tag{17}$$

Where:

$RC_{m,s,r}$ = Miles of FHWA road type *r* constructed in state *s*
$RC_{a,s,r}$ = Acres of land disturbed for construction of FHWA road type *r* in state *s*
$HS_{s,r}$ = Annual highway spending for road type *r* in state *s*
TDM = Conversion of dollars spent to road miles constructed, in thousand dollars per mile
ADM = Conversion of road miles constructed to acres disturbed, in acres per mile

Table 4. Spending per Mile and Acres Disturbed per Mile by Highway Type

Road Type	Thousand Dollars per mile	Total Affected Roadway Width (ft)*	Acres Disturbed per mile
Urban Areas, Interstate	6,895	94	11.4
Rural Areas, Interstate	3,810	89	10.8
Urban Areas, Other Arterials	4,112	63	7.6
Rural Areas, Other Arterials	2,076	55	6.6
Urban Areas, Collectors	4,112	63	7.6
Rural Areas, Collectors	2,076	55	6.6
*Total Affected Roadway Width = (lane width (12 ft) * number of lanes) + (shoulder width * number of shoulders) + area affected beyond road width (25 ft)			

Source: Reference 10.

The acres of land disturbed by road type can then be summed across all road types in a state to calculate the total state-level acreage disturbed due to new road construction.

$$ARC_s = \sum_r RC_{a,s} \quad (18)$$

Where:

ARC_s = Acres of land disturbed for all road construction in state *s*
$RC_{a,s}$ = Acres of land disturbed for construction of FHWA road type *r* in state *s*

Similar to residential construction, county-level building permits data from the U.S. Census Bureau are used to allocate the state-level acres disturbed by road construction to the county.[11] Specifically, the ratio of the county-to state-level number of building starts is calculated and multiplied by the state-level acreage disturbed (from equation 18) to estimate the county-level acreage disturbed by road construction.

$$BFrac_c = \frac{Build_c}{Build_s} \quad (19)$$

$$ARC_c = ARC_s \times BFrac_c \quad (20)$$

Where:

$BFrac_c$ = The fraction of building starts in county *c*
$Build_c$ = The number of building starts in county *c*
$Build_s$ = The number of building starts in state *s*
ARC_c = Acres of land disturbed for road construction in county *c*
ARC_s = Acres of land disturbed for all road construction in state *s*

Converting Acres Disturbed to Tons of Land Clearing Debris Burned

The total acres disturbed by all construction types is calculated by summing the acres disturbed from residential, non-residential, and road construction.

$$TAD_c = ANR_c + (\sum AR_{n.c}) + ARC_c \quad (21)$$

Where:

TAD_c = Total acres disturbed in from nonresidential, residential, and road construction in county *c*
ANR_c = Acres disturbed from non-residential construction in county *c*
$AR_{n,c}$ = Acres of surface soil disturbed from residential construction in county *c* and unit type category *n* (summed to one value for residential construction for the county)
ARC_c = Acres of land disturbed for road construction in county *c*

Version 2 of the Biogenic Emissions Land cover Database (BELD2) within EPA's Biogenic Emission Inventory System (BEIS) is used to identify the acres of hardwoods, softwoods, and grasses in each county.

Because BELD2 does not contain data on Alaska and Hawaii, the acres of hardwoods, softwoods, and grasses in each county is estimated by using the state-level land cover statistics from the USGS National Land Cover Database on the percent land cover under each vegetation type.[12] These percentages are multiplied by the county area (acres), from the U.S. Census Bureau.[13]

$$A_{AK/HI,c,f} = LA_{AK/HI,c} \times LC_{AK/HI,\%,f} \quad (22)$$

Where:

$A_{AK/HI,c,f}$ = Total acres of each fuel type, *f*, for each county, *c*, in Alaska or Hawaii
$LA_{AK/HI,c,}$ = County acres from the U.S. Census Bureau of each fuel type, *f*, for each county, *c*, in Alaska or Hawaii
$LC_{AK/HI,\%,f}$ = Land cover percentages for each fuel type (hardwood, softwood, grass) in Alaska or Hawaii

Table 5 presents the average fuel loading factors by vegetation type. The average loading factors for slash hardwood and slash softwood are adjusted by a factor of 1.5 to account for the mass of tree that is below the soil surface that would be subject to burning once the land is cleared.[14] Weighted average county-level loading factors are calculated by multiplying the average loading factors by the percent contribution of each type of vegetation class to the total land area for each county.

$$WFLF_{c,f} = \frac{A_{c,f}}{A_{c,total}} \times LF_f \quad (23)$$

Where:

$WFLF_{c,f}$ = Weighted average fuel loading factor by for fuel type *f* in county *c*
$A_{c,f}$ = Acres of land cover in county *c*, by fuel type *f* (from BELD2 for continental U.S.; from equation 22 for Alaska and Hawaii)
$A_{c,total}$ = Total acres of land cover of all fuel types in county *c*
LF_f = Fuel loading factor by fuel type, *f*, in tons/acre, from Table 5

Table 5. Fuel Loading Factors by Vegetation Type

Vegetation Type	Unadjusted Average Fuel Loading Factor (Ton/acre)	Adjusted Average Fuel Loading Factor (Ton/acre)
Hardwood	66	99
Softwood	38	57
Grass	4.5	Not Applicable

Source: Reference 14, averages of data on page III-19

The weighted average county-level loading factors for each fuel type are then summed across fuel types to calculate a single weighted average loading factor for each county.

$$WFLF_c = \sum_f WFLF_{c,f} \quad (24)$$

Where:

$WFLF_c$ = Weighted average fuel loading factors for county *c*
$WFLF_{c,f}$ = Weighted average fuel loading factor by for fuel type *f* in county *c*

The county-level total acres disturbed are then multiplied by the weighted average loading factor to derive tons of land clearing debris.

$$LCD_c = TAD_c \times WFLF_c \quad (25)$$

Where:

$LCDc$ = Land clearing debris in county *c*, in tons
TAD_c = Total acres disturbed in county *c*
$WFLF_c$ = Weighted average fuel loading factors for county *c*

The total land clearing debris burned per county is calculated by multiplying acres of land clearing debris by county by a control factor, based on the percent of urban land from the 2010 U.S. Census data.[13] See Section F for more information on the control factor.

$$BLCD_c = LCD_c \times CF_c \quad (26)$$

Where:

$BLCD_c$ = Land clearing debris burned in county *c*, in tons
$LCDc$ = Land clearing debris in county *c*, in tons
CF_c = Control factor. The control factor is 1 for counties with less than 80% urban population and 0 for Colorado or in counties with an urban population of 0.8% or more based on the 2010 U.S. Census data[13] as no burning occurs in these counties. See Section F for more information on the control factor.

D. Allocation Procedure

Acres disturbed by Non-residential Construction – County business patterns allocation

Employment data are obtained from the U.S. Census Bureau's 2016 County Business Patterns (CBP).[15] Due to concerns with releasing confidential business information, the *CBP* does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of employment flags is used. To estimate employment in counties and states with withheld data, the following procedure is used for NAICS code 2362 (non-residential construction).

To gap-fill withheld state-level employment data:

1. State-level data for states with known employment are summed to the national level.
2. State-level known employment is subtracted from the national total reported in the national-level CBP.
3. Each of the withheld states is assigned the midpoint of the employment flag. Table 6 lists the employment flags and midpoints.
4. The midpoints for the states with withheld data are summed to the national-level.
5. An adjustment factor is created by dividing the number of withheld employees (calculated in step 2 of this section) by the sum of the midpoints (step 4)
6. For the states with withheld employment data, the midpoint of the range for that state (step 3) is multiplied by the adjustment factor (step 5) to calculate the adjusted state-level employment for non-residential construction.

These same steps are then followed to fill in withheld data in the county-level business patterns.

1. County-level data for counties with known employment are summed by state.
2. County-level known employment is subtracted from the state total reported in state-level CBP (or, if the state-level data are withheld, from the state total estimated using the procedure discussed above).
3. Each of the withheld counties is assigned the midpoint of the employment flag (Table 6).
4. The midpoints for the counties with withheld data are summed to the state level.
5. An adjustment factor is created by dividing the number of withheld employees (step 2) by the sum of the midpoints (step 4).
6. For counties with withheld employment data, the midpoints (step 3) are multiplied by the adjustment factor (step 5) to calculate the adjusted county-level employment for non-residential construction.

Note that step 5 adjusts all counties within each state with withheld employment data by the same state-based proportion. It is unlikely that actual employment corresponds exactly with this smoothed adjustment method, but this method is the best option given the availability of the data.

Table 6. Ranges and Midpoints for Data Withheld from State And County Business Patterns

Employment Flag	Employment Range	Midpoint
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750

Employment Flag	Employment Range	Midpoint
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000
M	100,000+	

For example, take the 2016 CBP data for NAICS 2362 (nonresidential construction) in Arizona provided in Table 7.

Table 7. 2016 CBP for NAICS 2361 in Arizona

State FIPS	County FIPS	NAICS	Employment Flag	Employment
04	001	2362	B	withheld
04	003	2362		125
04	005	2362		166
04	007	2362		24
04	011	2362	B	withheld
04	012	2362	A	withheld
04	013	2362		8,580
04	015	2362		64
04	017	2362		53
04	019	2362		2,085
04	021	2362		115
04	023	2362		16
04	025	2362		260
04	027	2362		233

1. The total of employees not including withheld counties is 11,831.
2. The state-level CBP reports 11,721 employees for NAICS 2362. The difference is 110.
3. Withheld counties are given the midpoint of the employment range. County 001 is given a midpoint of 60 (since employment flag A is 20 – 99) and County 012 is given a midpoint of 10 (since employment flag H is 0 – 19).
4. State total for these all withheld counties is 130.
5. 110/130 = 0.846.
6. The adjusted employment for county 001 is 60 × 0.846 = 51.36 employees. County 012 has an adjusted employment of 10 × 0.846 = 8.46 employees.

The county-level employment data are used to allocate the national-level non-residential construction spending data to the county-level (see equation 1).

Acres disturbed by Residential Construction – Building permits allocation

Annual county building permit data were purchased from the U.S. Census Bureau for 2017[8] and used to allocate regional housing starts to the county level. This results in county level housing starts by number of units. See equations 11-13 in section C.

Acres Disturbed by Road Construction – Building permits allocation

State-level estimates of acres disturbed by road construction is distributed to the counties based on county-level data on residential building starts from the U.S. Census Bureau.[11] See equations 19 and 20 in section C.

E. Emissions Factors

Emissions factors are reported in Table 8 below. Emissions factors for CAPs and HAPs are from the AP-42 and U.S. EPA Emissions Inventory Improvement Program.[16, 17] The PM25 to PM10 emissions factor ratio for brush burning (0.7709) is multiplied by the PM10 emissions factors for land clearing debris burning to develop PM25 emissions factors. Emission factors for NH3 were derived from the 2002 NEI crop residue emission estimates using the ratio of NH3/NOx for pasture grass from Pouliot et al. (2017)[18] and the NOx emission factor from AP-42. Emissions factors for HAPs are from an EPA Control Technology Center report.[19]

Table 8. Emissions Factors for Open Burning of Land Clearing Debris (SCC 2610000500)

Pollutant	Pollutant Code	Emissions Factor (lb/ton)	Emission Factor Reference
VOC	VOC	11.3	Reference 16, Table 2.5-5, a
NOX	NOX	4.0	Reference 16, Table 2.5-5, b
CO	CO	164.8	Reference 17, Table 16.4-2, c
PM10-FIL	PM10-FIL	20.4	Reference 17, Table 16.4-2, c
PM25-FIL	PM25-FIL	18.6	Reference 17, Table 16.4-2, c
PM10-PRI	PM10-PRI	20.4	Reference 17, Table 16.4-2, c
PM25-PRI	PM25-PRI	18.6	Reference 17, Table 16.4-2, c
Cumene	98828	0.012	Reference 16, Table 16.4-3, d
Ethyl Benzene	100414	0.048	Reference 16, Table 16.4-3, d
Phenol	108952	0.115	Reference 16, Table 16.4-3, d
Styrene	100425	0.102	Reference 16, Table 16.4-3, d
Ammonia	NH3	11.62	Reference 16, Reference 18

a. Average of factors for forest residues.
b. Emissions factor is from footnote to Table 2.5-5
c. Average of factors from Table 16.4-2 except for last two rows (test burn with blower)
d. Average of factors from Table 16.4-3 except for last two columns (test burn with blower)

F. Controls

Controls for land clearing debris burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that are more than 80% urban by land area determined by the 2010 U.S. Census data,[13] are assumed not to practice any open burning of land clearing debris. Therefore, CAP and HAP emissions from open burning of land clearing debris are zero in these counties.

Additionally, it is assumed that even in counties that are less than 80% urban by land area, open burning will only be practiced in areas that are rural. Therefore, the total land clearing debris burned per county (from equation 26) will be scaled based on the fraction of rural land area in each county from the 2010 Census.

$$BLCD_{r,c} = BLCD_c \times \frac{RLand_c}{TLand_c} \quad (27)$$

Where:

$BLCD_{r,c}$ = Land clearing debris burned in rural areas by county, c, in tons
$BLCD_c$ = Land clearing debris burned by county, c, in tons
$RLand_c$ = Amount of rural land by land area in county c
$TLand_c$ = Total amount of land in county c

Further controls on burning (i.e., burn bans in rural areas) are represented by multiplying the land clearing debris

burned in rural counties by a burn ban's effectiveness; effectiveness is a value between 0 and 1.

$$BLCD_{r,c} = BLCD_{r,c} \times BE_c \quad (28)$$

Where:

$BLCD_{r,c}$ = Land clearing debris burned in rural areas by county, c, in tons
BE_c = Burn ban effectiveness in county c

In this methodology, burn ban effectiveness is represented by a single value between 0 and 1 that is multiplied by the amount of land clearing debris burned in the rural areas of each county. In practice, the burn ban effectiveness is a function of both a rule's penetration and effectiveness. Rule penetration refers to the extent to which a regulation covers emissions for a specified controlled area, and effectiveness concerns the ability of the regulatory program to achieve emissions reductions compared to full compliance. By default the burn ban effectiveness for each county is 1 (i.e. the methodology assumes no burn bans in each county), although this may be updated by state, local, or tribal agencies.

G. Emissions

County-level criteria pollutant and HAP emissions are calculated by multiplying the mass of land clearing debris burned in rural areas per year (from equation 28) by an emissions factor from Table 8.

$$E_{c,p} = BLCD_{r,c} \times EF_p \times \frac{1\ ton}{2000\ lb} \quad (29)$$

Where:

$E_{c,p}$ = Emissions by county, c, and pollutant, p, in tons
$BLCD_{r,c}$ = Land clearing debris burned in rural areas by county, c, in tons
EF_p = Emissions factor by pollutant, p, in pounds/ton

H. Point Source Subtraction

There are no point source-specific SCCs for open burning of land clearing debris; therefore point source subtraction is not performed for this category.

I. Sample Calculations

Table 9 shows sample calculations for PM25-PRI emissions from open burning of land clearing debris in McLean County, Illinois. Equations 5 through 7 use the first quarter (Q1) of 2017 for 2-unit structures as an example. However these calculations would need to be repeated to calculate values for all 4 quarters for all 3 unit sizes. Note that structures with 5 or more units and structures with 1 unit with or without a basement have additional steps not shown in the sample calculations here. Equations 15 through 20 use urban roads as an example for acres of land disturbed from road construction. For full calculations of acres of land disturbed from road construction the calculations for rural roads would also need to be incorporated.

Table 9. Sample calculations for PM25-PRI emissions from open burning of land clearing debris in McLean County, IL

Eq. #	Equation	Values for McLean County, IL	Result
1	$EmpFr_c = \frac{Emp_c}{Emp_{US}}$	$\frac{140\ nonres\ construction\ employees}{581{,}963\ nonres\ construction\ employees}$	0.000241 fraction on non-residential construction employees in McLean County, IL
2	$CS_c = EmpFr_c \times CS_{US}$	$0.000241 fraction\ of\ employees \times \$\ 347{,}666\ million\ in\ nonres\ construction\ spending\ in\ the\ US$	$83.79 million in non-residential construction spending in McLean County, IL
3	$Apd_{2017} = \frac{2\ acres}{\$1\ million} \times \frac{PD_{1992}}{PD_{2017}}$	$\frac{2\ acres\ disturbed}{\$1\ million} \times \frac{57\ in\ 1992}{113\ in\ 2017}$	1.009 acres disturbed per million dollars spent on non-residential construction spending, nationally
4	$ANR_c = CS_c \times Apd_y$	$\$83.79\ million \times 1.009 \frac{acres\ disturbed}{million\ \$}$	84.4 acres disturbed from non-residential construction in McLean County, IL
5	$S_{Q,n} = \left(\frac{U_n}{U_t}\right) \times S_{Q,2-4}$	$\left(\frac{14\ two\ unit\ housing\ starts\ in\ 2002}{38\ total\ housing\ starts\ in\ 2002}\right) \times 2\ two\ to\ four\ unit\ housing\ starts\ in\ Q1\ 2017$	0.74 thousand housing starts for 2-unit structures in Q1 2017, nationally
6	$r_{Q,n} = \frac{S_{Q,n}}{S_{Q.t}}$	$\frac{0.74\ two\ unit\ housing\ starts}{72\ two\ or\ more\ unit\ housing\ starts}$	0.01 ratio of buildings with 2 units to all units greater than 2 for Q1 2017, nationally
7	$A_{Q,n,rgn} = r_{Q,n} \times (RS_t - RS_1)$	$0.01 \times (21\ total\ Q1\ housing\ starts\ in\ Midwest - 14\ one\ unit\ housing\ starts\ in\ Midwest\ )$	0.07 thousand housing starts for 2-unit structures for Q1 2017 in the Midwest
8	$CF_5 = \frac{U_{5,rgn}}{B_{5,r}}$	N/A	Equation is for 5 or more unit buildings; example is for 2-unit buildings
9	$B_{n,rgn} = \frac{(\sum A_{Q.n.rgn}) \times 1{,}000}{n}$	$\frac{0.775\ two\ unit\ structures\ \times 1{,}000}{2\ units\ per\ building}$	388 2-unit structures constructed in the Midwest

Eq. #	Equation	Values for McLean County, IL	Result
10	$B_{n,rgn} = \frac{(\sum A_{Q.n.rgn}) \times 1{,}000}{CF_5}$	N/A	Equation is for 5 or more unit buildings; example is for 2-unit buildings
11	$BP_{n,rgn} = \sum BP_{n,c}$	$\sum Midwest\ two\ unit\ building\ permits$	1,571 2-unit structure building permits in the Midwest
12	$R_{BP,c} = \frac{BP_{n,c}}{BP_{n,rgn}}$	$\frac{1\ McLean\ County\ building\ permits}{1{,}571\ Midwest\ building\ permits}$	0.000637 ratio of county-level building permits to regional-level building permits in McLean County, IL
13	$B_{n,c} = B_{n,rgn} \times R_{BP,c}$	$388\ two\ unit\ building\ starts\ in\ the\ Midwest \times 0.000637$	0.25 total 2-unit structure building starts for McLean County, IL
14	$AR_{n,c} = B_{n.c} \times a_n$	$0.25\ two\ unit\ structures \times 0.33\ acres\ per\ structure$	0.08 acres surface soil disturbed by 2-unit structures in McLean County, IL
15	$HS_{s,r} = \sum_{ct} S_{s,r}$	$\$20{,}399{,}000 + \$33{,}029{,}000 + \$93{,}892{,}000$	$147,320,000 spent on urban interstate construction in IL
		$\$58{,}519{,}000 + \$2{,}626{,}000 + \$35{,}1367{,}000 + \$206{,}057{,}000 + \$17{,}193{,}000$	$319,532,000 spent on urban other arterial construction in IL
		$\$16{,}093{,}000 + \$338{,}000 + \$355{,}000$	$16,786,000 spend on urban collector construction in IL
16	$RC_{m,s,r} = \frac{HS_{s,r}}{TDM}$	$\frac{\$147{,}320{,}000}{6{,}895{,}000\ \$\ per\ mile}$	21.4 miles of urban interstate constructed in IL
		$\frac{\$319{,}532{,}000}{4{,}112{,}000\ \$\ per\ mile}$	77.7 miles of urban other arterial constructed in IL
		$\frac{\$16{,}786{,}000}{4{,}112{,}000\ \$\ per\ mile}$	4.1 miles of urban collector constructed in IL

Eq. #	Equation	Values for McLean County, IL	Result
17	$RC_{a,s,r} = RC_{m,s,r} \times ADM$	$21.4\ miles \times 11.4\ acres\ per\ mile$	242.9 acres disturbed from urban interstate construction in IL
		$77.7\ miles \times 7.6\ acres\ per\ mile$	589.6 acres disturbed from urban other arterial construction in IL
		$4.1\ miles \times 7.6\ acres\ per\ mile$	31 acres disturbed from urban collector construction in IL
18	$ARC_s = \sum_r RC_{a,s}$	$242.9\ acres + 589.6\ acres + 31\ acres$	863.5 acres disturbed from urban road construction in IL
19	$BFrac_c = \frac{Build_c}{Build_s}$	$\frac{246\ building\ starts\ in\ McLean\ County}{20{,}578\ building\ starts\ in\ IL}$	0.012 fraction of building starts in McLean County, IL
20	$ARC_c = ARC_s \times BFrac_c$	$863.5\ acres \times 0.012$	10.4 acres disturbed from urban road construction in McLean County, IL
21	$TAD_c = ANR_c + (\sum S_{n.c}) + ARC_c$	$84.4\ acres + 62.02^{*}\ acres + 13.95^{**}\ acres$ * note that the value for residential construction is for all unit types, not just 2-unit buildings as shown in example above ** note the value for road construction is for all road types, not just urban roads as shown in the example above	160.4 total acres disturbed in McLean County, IL
22	$A_{AK/HI,c,f} = LA_{AK/HI,c} \times LC_{AK/HI,\%,f}$	N/A	Equation is for Alaska or Hawaii
23	$WFLF_{c,f} = \frac{A_{c,f}}{A_{total}} \times LF_f$	$\frac{17{,}516\ acres}{758{,}793\ acres} \times 99\ tons\ per\ acre$	2.3 tons/ acre weighted factor for hardwood fuel in McLean County, IL
		$\frac{0\ acres}{758{,}793\ acres} \times 57\ tons\ per\ acre$	0.0 tons/ acre weighted factor for softwood fuel in McLean County, IL

Eq. #	Equation	Values for McLean County, IL	Result
		$\frac{741{,}276\ acres}{758{,}793\ acres} \times 4.5\ tons\ per\ acre$	4.4 tons/ acre weighted factor for grass fuel in McLean County, IL
24	$WFLF_c = \sum WFLF_{c,f}$	$2.3\frac{tons}{acre} + 0.0\frac{tons}{acre} + 4.4\frac{tons}{acre}$	6.7 tons/acre weighted factor for all fuels in McLean County, IL
25	$LCD_c = TAD_c \times WFLF_c$	$160.4\ acres \times 6.7\frac{tons}{acre}$	1,071 tons of land clearing debris in McLean County, IL
26	$BLCD_c = LCD_c \times CF_c$	$1{,}071\ tons \times 1\ control\ factor$	1,071 tons of land clearing debris burned in McLean County, IL
27	$BLCD_{r,c} = BLCD_c \times \frac{RLand_c}{TLand_c}$	$1{,}071\ tons \times \frac{2{,}923{,}414{,}473\ m^2\ rural\ land}{3{,}064{,}933{,}852\ m^2\ total\ land}$	1,022 tons of land clearing debris burned in rural areas in McLean County, IL
28	$E_{c,p} = BLCD_{r,c} \times EF_p \times \frac{1\ ton}{2000\ lb}$	$1{,}022\ tons \times 13.1053\frac{lb}{ton} \times \frac{1\ ton}{2000\ lb}$	6.7 tons PM25-PRI emissions in McLean County, IL

J. Changes from 2014 Methodology

There main change to this methodology from the methodology used to calculate the 2014 v2 NEI is that the estimated amount of land clearing debris in each county is multiplied by the fraction of rural land area in each county. This step was not done in the methodology used for the 2014 v2 NEI.

K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exist to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

L. References

[1] U.S. Census Bureau. 2017. *Value of Construction Put in Place*, from http://www.census.gov/construction/c30/c30index.html.

[2] Midwest Research Institute. 1999. *Estimating Particulate Matter Emissions from Construction Operations, Final Report* (prepared for the Emission Factor and Inventory Group, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency).

[3] U.S. Census Bureau. *Price Deflator (Fisher) Index of New Single-Family Houses Under Construction*. https://www.census.gov/construction/nrs/pdf/price_uc.pdf.

[4] U.S. Census Bureau. 2018. "New Privately Owned Housing Units Started, Annual Data," https://www.census.gov/construction/nrc/pdf/startsan.pdf

[5] U.S. Census Bureau. 2018. "New Privately Owned Housing Units by Purpose and Design," https://www.census.gov/construction/nrc/pdf/quarterly_starts_completions.pdf

[6] U.S. Census Bureau. 2001. Housing Starts. Table 1. https://www.census.gov/prod/2001pubs/c20-0103.pdf.

[7] U.S. Census Bureau, New Privately Owned Housing Units Authorized - Unadjusted Units for Regions, Divisions, and States, Annual 2017, Table 2au. https://www.census.gov/construction/bps/txt/tb2u2017.txt..

[8] U.S. Census Bureau, Annual Housing Units Authorized by Building Permits CO2017A, https://www2.census.gov/econ/bps/County/.

[9] Federal Highway Administration. 2014 Highway Spending, http://www.fhwa.dot.gov/policyinformation/statistics/2014/sf12a.cfm.

[10] Florida Department of Transportation. Cost Per Mile Models. https://www.fdot.gov/programmanagement/estimates/lre/costpermilemodels/cpmsummary.shtm.

[11] 2017 Building Permits data from US Census "BPS01", http://www.census.gov/construction/bps/

[12] U.S. Geological Survey (USGS). 2015. National Land Cover Database (NLCD). http://www.mrlc.gov/nlcd2011.php

[13] U.S. Census Bureau, Decennial Censuses. 2010. Census: Summary File 1, http://www2.census.gov/census_2010/04-Summary_File_1/.

[14] D.V. Sandberg, D.E. Ward, R.D. Ottmar, C.C. Hardy, T.E. Reinhardt, and J.N. Hall. 1989. Mitigation of Prescribed Fire Atmospheric Pollution through Increased Utilization of Hardwoods, Piled Residues, and Long-Needled Conifers. Final Report. USDA Forest Service, Pacific Northwest Research Station, Fire and Air Resource Management.

[15] U.S Census Bureau, County Business Patterns. 2016. *Complete County File [15.6mb zip],* from https://www.census.gov/data/datasets/2016/econ/cbp/2016-cbp.html.

[16] U.S. Environmental Protection Agency. 1992. AP-42, Fifth Edition, Volume 1, Chapter 2: Solid Waste Disposal. https://www3.epa.gov/ttn/chief/ap42/ch02/index.html

[17] U.S. Environmental Protection Agency. 2001. Emission Inventory Improvement Program, Volume III, Chapter 16, Open Burning, https://www.epa.gov/sites/production/files/2015-08/documents/iii16_apr2001.pdf

[18] G. Pouliot, V. Rao, J.L. McCarty, and A. Soja. 2017. Development of the crop residue and rangeland burning in the 2014 National Emissions Inventory using information from multiple sources. Journal of the Air & Waste Management Association, 67(5), 613-622. https://doi.org/10.1080/10962247.2016.1268982.

[19] U.S. Environmental Protection Agency. 1997. Evaluation of Emissions from the Open Burning of Household Waste in Barrels, EPA-600/R-97-134a.

OPEN BURNING – RESIDENTIAL HOUSEHOLD WASTE

A. Source Category Description

Open burning of residential household waste (RHW) is the purposeful burning of RHW in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for RHW burning are a function of the amount of waste burned per year. In 2014, open burning of RHW in the U.S., Puerto Rico, and U.S. Virgin Islands resulted in approximately 18,614 tons of VOC emissions, 292,400 tons of CO emissions, 87,300 tons of primary PM25 emissions, and 95,327 tons of primary PM10 emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610030000	Waste Disposal, Treatment, and Recovery	Open Burning	Residential	Household Waste (use 26-10-000-xxx for Yard Wastes)

Burning of yard waste is included in SCC 2610000100 and SCC 2610000400; therefore, it is not part of residential household waste.

B. Overview of Calculations

The calculations for estimating the emissions from the burning of RHW involve first estimating the amount of combustible waste generated in each county. The amount of waste generated in the U.S. is available from the EPA report, *Advancing Sustainable Materials Management: 2015 Fact Sheet*.[1] The amount of county-level RHW burned is estimated by calculating the per capita amount of RHW generated using the national data from EPA, and multiplying that by the number of people likely to burn waste in each county. The number of people likely to burn waste is based on the rural population in each county from the 2010 census. To estimate emissions from RHW burning, pollutant emissions factors are multiplied by the amount of combustible waste burned. Emissions factors for PM , VOC, and HAPs are from the literature, whereas emissions factors for CO, NOX, and SO2 are adjusted based on the ratio of total waste to combustible waste. Sources of data and calculations for the amount of waste generated are discussed in section C. Emissions factors are discussed in section E. The estimation of emissions from open burning of RHW is discussed in section G.

C. Activity Data

The activity data for this source category is the amount of RHW burned in each county, which is estimated using data the EPA report *Advancing Sustainable Materials Management: 2015 Fact Sheet*.[1] The report presents the total mass of waste generated from the residential and commercial sectors in the United States by type of waste for the calendar year 2015.

Table 1 shows the total national-level waste generated by type and the corresponding per capita values. Per capita values of RHW subject to burning were developed based on EPA's total amount of waste generated in 2015. According to the 2010 version of the same EPA report, residential waste generation accounts for 55-65% of the total waste from the residential and commercial sectors;[2] for the per capita calculation, the median value of 60% of total waste generated is assumed. This number is multiplied by the sums of the total and combustible waste, respectively. Each number is then divided by the U.S. population in 2017 (329 million people)[3] to determine separate per capita values for total and combustible waste. Note that yard waste is not included in either per capita value as emissions from the burning of yard waste are calculated in separate SCCs.

$$PC_{cwaste} = \frac{\sum_{Com} W \times 0.60}{P_{y,US}} \quad (1)$$

$$PC_{twaste} = \frac{\sum_{T} W \times 0.60}{P_{US}} \quad (2)$$

Where:

PC_{cwaste} = Per capita value of combustible waste in the U.S., in tons per person
PC_{twaste} = Per capita value of total waste in the U.S., in tons per person
Com = Types of combustible waste (not including yard waste)
T = All types of waste (not including yard waste)
W = Annual weight of waste, in million tons
$P_{y,US}$ = Population of the U.S. for year of inventory, in million people

The per capita value of combustible household waste is estimated to be 0.354 tons generated per person in 2015, and the per capita value of total waste is 0.420 tons generated per person.

Table 1. Annual Waste Generated in the U.S. in 2015

		Tons Generated per Person	
Material	**Weight Generated (million tons)**	**Total RHW**	**Combustible RHW**
Paper	68.61	0.129	0.129
Glass	11.48	0.022	0
Metals			
Steel	17.69	0.033	0. 0
Aluminum	3.53	0.007	0.0
Other nonferrous	2.04	0.004	0.0
Total Metals	*23.26*	*0.044*	*0.0*
Plastics	32.25	0.061	0.061
Rubber/leather	8.21	0.015	0.015
Textiles	16.22	0.031	0.031
Wood	16.12	0.030	0.030
Other	4.44	0.008	0.008
Total Materials	*180.59*	*0.340*	*0.274*
Other wastes			
Food	38.40	0.072	0.072
Yard	34.50	0.0	0.0
Miscellaneous inorganic	3.97	0.007	0.007
Total Other	*76.87*	*0.080*	*0.080*
TOTAL RHW	**257.46**	**0.420**	**0.354**

Source: Reference 1, Table 1

As open burning of RHW is generally not practiced in urban areas, only the rural population in each county is assumed to practice open burning. The rural and urban populations are taken from 2010 U.S. Census data for each county.[4] It is assumed that 24% of the rural population burns RHW.[5]

$$PBurn_c = RPop_c \times 0.24 \quad (3)$$

Where:

$RPop_{,c}$ = Rural population in county c in 2010
$PBurn_c$ = Population likely to burn RHW in county c

The number of people likely to burn waste in each county (from equation 3) is then used with the values of per capita household waste subject to burning (from equations 1 and 2) to determine the amount of household RHW burned.

$$CWst_c = PBurn_c \times PC_{cwaste} \quad (4)$$

Where:

$CWst_c$ = Annual combustible RHW burned in county c, in tons
$PBurn_c$ = Population likely to burn in county *c*
PC_{cwaste} = Per capita value of combustible waste in the U.S., in tons per person

D. Allocation Procedure

National values for the amount of waste generated are distributed to the counties based on rural population, as described in Section C.

E. Emissions Factors

Emissions factors for open burning of RHW are reported in Table 3. The emissions factors for CO, NOX, PM, SO2, and VOC and some HAPs are from AP-42[6] and the EPA report *Evaluation of Emissions from the Open Burning of Household Waste in Barrels*.[7] Emissions factors for HAPs are from an EPA Office of Research and Development report[8] and a Minnesota Pollution Control Agency Report.[9] For HAP emissions factors from the EPA Control Technology Center report,[7] the emissions factors are based on an average of emissions factors for non-recyclers. This assumes that a person burning RHW in their yard is more likely to be a non-recycler than an avid recycler.

The emissions factors for PM, VOC, and HAPs were developed based on the amount of combustible waste burned. Emissions factors for CO, NOX, and SO2 were developed based on the amount of total waste burned; therefore, these factors need to be adjusted to be used with the values of combustible waste burned. This is accomplished by multiplying the emissions factors by a ratio of the total per capita waste to combustible per capita waste in 2015.

$$EF_{p,Com} = EF_{p,T} \times \frac{PC_{twaste}}{PC_{cwaste}} \quad (5)$$

Where:

EF_p = Emission factor for pollutant *p,* in lbs. of pollution per ton of waste burned
Com = Types of combustible waste (not including yard waste)
T = All types of waste (not including yard waste)
PC_{cwaste} = Per capita value of combustible waste in the US, in tons per person
PC_{twaste} = Per capita value of total waste in the US, in tons per person

F. Controls

Controls for residential household waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. However, literature suggests that burn bans are not 100% effective. It is therefore assumed that approximately 25% of the residents that may burn trash in the yard would burn waste even if a ban is in place. For counties that have burn bans, the assumption is applied by multiplying 0.25 by the annual waste burned. Currently no counties are assumed to have burn bans in place.

$$\begin{gathered} If\ county\ c\ has\ a\ burn\ ban \\ Then\ CWst_c = CWst_c \times 0.25 \end{gathered} \quad (6)$$

Where:

$CWst_c$ = Annual combustible RHW burned in county c, in tons

G. Emissions

The annual amount of combustible RHW burned in each county is multiplied by the emissions factors listed in Table 3 to estimate emissions.

$$E_{p,c} = CWst_c \times EF_{p,Com} \quad (7)$$

Where:

$E_{p,c}$ = Annual emissions of pollutant p in county c
$EF_{p,Com}$ = Emission factor for pollutant p, in lbs. of pollution per ton of combustible waste burned
$CWst_c$ = Annual combustible RHW burned in county c, in tons

H. Point Source Subtraction

There are no point source-specific SCCs for open burning of RHW; therefore point source subtraction is not performed for this category.

I. Sample Calculations

Table 2 lists sample calculations to determine the CO and VOC emissions from open burning in Autauga County, Alabama.

Table 2. Sample calculations for CO and VOC emissions from open burning in Autauga County, Al.

Eq. #	Equation	Values for Autauga County, AL	Result
1	$PC_{cwaste} = \frac{\sum_{Com} W \times 0.60}{P_{y,US}}$	$\frac{188.22\ million\ tons\ of\ waste \times 0.60}{318.85\ million\ people}$	0.354 tons combustible waste per person per year
2	$PR_{twaste} = \frac{\sum_{NC} W \times 0.60}{P_{US}}$	$\frac{222.96\ million\ tons\ of\ waste \times 0.60}{318.85\ million\ people}$	0.420 tons total waste per person per year
3	$PBurn_c = RPop_c \times 0.24$	$22{,}921\ people \times 0.24$	5,501 people likely to burn in Autauga County, AL
4	$CWst_c = PBurn_c \times PC_{cwaste}$	$5{,}501\ people \times 0.354\ tons\ combustible$ waste $per\ person$	1,947.4 tons of combustible waste burned in Autauga County, AL
5	$EF_{p,Com} = EF_{p,T} \times \frac{PC_{twaste}}{PC_{cwaste}}$	$85\ lbs.per\ ton \times \frac{0.42\ tons\ per\ person}{0.354\ tons\ per\ person}$	100.8 lbs. of CO per ton of combustible waste burned
6	$If\ county\ c\ has\ a\ burn\ ban$ $Then\ CWst_c = CWst_c \times 0.25$	N/A	Autauga County, AL does not have a burn ban
7	$E_{p,c} = CWst_c \times EF_{p,Com}$	$1{,}947.4\ tons \times 100.8\ lbs.per\ ton$	98.14 tons CO emissions from burning of RHW in Autauga County, AL
		$1{,}947.4\ tons \times 8.46\ lbs.per\ ton$	8.23 tons VOC emissions from burning of RHW in Autauga County, AL

J. Changes from 2014 Methodology

The 2017 emissions inventory methodology for RHW burning includes changes to the method for determining population likely to burn, and changes to the emissions factors for CO, NOX, and SO2. The 2014 v2 NEI methodology determined the population likely to burn by identifying the rural and "like rural" population in each county in 2010 and using the fraction of 2010 rural and like rural population to total population in order to determine the rural population in 2014. The 2017 methodology only uses the 2010 rural population to determine the population likely to burn.

Additionally the 2014 v2 NEI methodology used emissions factors for CO, NOX, and SO2 that corresponded to the amount of combustible plus non-combustible waste burned. The 2017 methodology uses a ratio of combustible to total waste burned in order to adjust the CO, NOX, and SO2 emissions factors to be used with the amount of combustible waste burned.

K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are calculated using 2010 population data, since 2017 Census Data does not exist for the U.S. Virgin Islands.

L. References

[1] U.S. Environmental Protection Agency. 2018. *Advancing Sustainable Materials: 2015 Fact Sheet*, "Table 1. Generation, Recovery and Discards of Materials in MSW, 2015 (in millions of tons and percent of generation of each material)". https://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures-report

[2] U.S. Environmental Protection Agency. 2011. *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010—Fact Sheet*," p. 4. https://archive.epa.gov/epawaste/nonhaz/municipal/web/pdf/msw_2010_factsheet.pdf

[3] U.S. Census Bureau. *Total Population, American Community Survey,* https://data.census.gov/cedsci/table?hidePreview=false&tid=ACSDT1Y2017.B01003&vintage=2018

[4] U.S. Census Bureau, Decennial Censuses, 2010 Census: Summary File 1. http://www2.census.gov/census_2010/04-Summary_File_1/.

[5] Environment Canada. 2001. "Household Garbage Disposal and Burning." Prepared by Environics Research Group.

[6] U.S. Environmental Protection Agency. 1995. *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.5 Open Burning.* Research Triangle Park, NC.

[7] U.S. Environmental Protection Agency. 1997. "Evaluation of Emissions from the Open Burning of Household Waste in Barrels." EPA-600/R-97-134a. https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryID=115129

[8] U.S. Environmental Protection Agency. 2002. "Emissions of organic air toxics from open burning: a comprehensive review." EPA-600/R-02-076. https://nepis.epa.gov/Exe/ZyNET.exe/P1001G31.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2000+Thru+2005&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C00thru05%5CTxt%5C00000016%5CP1001G31.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL

[9] Babineau, I., Wu, C.Y., Jackson, A., Minnesota Pollution Control Agency. 2016. "Emission Factor Development for Mercury Emitted From Municipal Solid Waste during Processing and Handling." In proceedings of the 109th Annual Meeting of the A&WMA, New Orleans, LA.

Table 3. Emissions Factors for Open Burning of RHW

Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
Carbon Monoxide	CO	85	lbs./ton	100.61	lbs./ton	Reference 6, Table 2.5-1; original factor based on total waste; converted factor based on combustible waste
Nitrogen Oxides	NOX	6	lbs./ton	7.10	lbs./ton	Reference 6, Table 2.5-1; original factor based on total waste; converted factor based on combustible waste
PM10-FIL	PM10-FIL	18.76	g/kg	38	lbs./ton	Reference 7 (average of non-recyclers)
PM10-PRI	PM10-PRI	18.76	g/kg	38	lbs./ton	Reference 7 (average of non-recyclers)
PM25-FIL	PM25-FIL	17.44	g/kg	34.8	lbs./ton	Reference 7 (average of non-recyclers)
PM25-PRI	PM25-PRI	17.44	g/kg	34.8	lbs./ton	Reference 7 (average of non-recyclers)
Sulfur Oxides	SO2	1	lbs./ton	1.184	lbs./ton	Reference 6, Table 2.5-1; original factor based on total waste; converted factor based on combustible waste
VOC	VOC	-	mg/kg	7.409	lbs./ton	Reference 8, Table 3-6 (sum of HAP VOC emissions factors)
1,2,4-trichlorobenzene	120821	0.1	mg/kg	2.00E-04	lbs./ton	Reference 8, Table 3-6
1,4-dichlorobenzene	106467	0.03	mg/kg	6.00E-05	lbs./ton	Reference 8, Table 3-6
2,4,6-Trichlorophenol	88062	0.19	mg/kg	3.80E-04	lbs./ton	Reference 8, Table 3-6
2-Methylnapthalene	91576	8.53	mg/kg	1.70E-02	lbs./ton	Reference 8, Table 3-6
Acenaphthene	83329	0.64	mg/kg	1.28E-03	lbs./ton	Reference 8, Table 3-6
Acenaphthylene	208968	7.34	mg/kg	1.47E-02	lbs./ton	Reference 8, Table 3-6
Acetalaldehyde	75070	428.4	mg/kg	8.55E-01	lbs./ton	Reference 8, Table 3-6
Acetophenone	98862	4.69	mg/kg	9.36E-03	lbs./ton	Reference 8, Table 3-6
Acrolein	107028	26.65	mg/kg	5.32E-02	lbs./ton	Reference 8, Table 3-6
Anthracene	120127	1.3	mg/kg	2.59E-03	lbs./ton	Reference 8, Table 3-6
Benz[a]anthracene	56553	1.51	mg/kg	3.01E-03	lbs./ton	Reference 8, Table 3-6
Benzene	71432	979.75	mg/kg	1.96E+00	lbs./ton	Reference 8, Table 3-6
Benzo[a]pyrene	50328	1.4	mg/kg	2.79E-03	lbs./ton	Reference 8, Table 3-6
1,3-Butadiene	106990	141.25	mg/kg	2.82E-01	lbs./ton	Reference 8, Table 3-6
Benzo[b]fluoranthene	205992	1.86	mg/kg	3.71E-03	lbs./ton	Reference 8, Table 3-6
Benzo[g,h,i,]Perylene	191242	1.3	mg/kg	2.59E-03	lbs./ton	Reference 8, Table 3-6
Benzo[k]fluoranthene	207089	0.67	mg/kg	1.34E-03	lbs./ton	Reference 8, Table 3-6
Bis (2-Ethylhexyl) Phthalate	117817	23.79	mg/kg	4.75E-02	lbs./ton	Reference 8, Table 3-6
Chloromethane	74873	163.25	mg/kg	3.26E-01	lbs./ton	Reference 8, Table 3-6
Chrysene	218019	1.8	mg/kg	3.59E-03	lbs./ton	Reference 8, Table 3-6
Cresol/Cresylic Acid (Mixed Isomers)	1319773	68.77	Mg/kg	1.37E-01	lbs./ton	Reference 8, table 3-6
Dibenzo[a,h]anthracene	53703	0.27	mg/kg	5.40E-04	lbs./ton	Reference 8, Table 3-6
Dibutyl Phthalate	84742	3.45	mg/kg	6.89E-03	lbs./ton	Reference 8, Table 3-6
Ethyl Benzene	100414	181.75	mg/kg	3.63E-01	lbs./ton	Reference 8, Table 3-6
Fluoranthene	206440	2.77	mg/kg	5.53E-03	lbs./ton	Reference 8, Table 3-6
Fluorene	86737	2.99	mg/kg	5.97E-03	lbs./ton	Reference 8, Table 3-6
Formaldehyde	50000	443.65	mg/kg	8.85E-01	lbs./ton	Reference 8, Table 3-6
Dibenzofuran	132649	3.64	mg/kg	7.26E-03	lbs./ton	Reference 8, Table 3-6
Hexachlorobenzene	118741	0.04	mg/kg	8.00E-05	lbs./ton	Reference 8, Table 3-6

Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
Indeno[1,2,3-c,d]pyrene	193395	1.27	mg/kg	2.53E-03	lbs./ton	Reference 8, Table 3-6
Isophorone	78591	9.25	mg/kg	1.85E-02	lbs./ton	Reference 8, Table 3-6
Methylene Chloride	75092	17	mg/kg	3.39E-02	lbs./ton	Reference 8, Table 3-6
Mercury	7439976	8.74E-04	lbs./ton	-	-	Reference 9
Naphthalene	91203	11.36	mg/kg	2.27E-02	lbs./ton	Reference 8, Table 3-6
Pentachloronitrobenzene	82688	0.01	mg/kg	2.00E-05	lbs./ton	Reference 8, Table 3-6
Phenanthrene	85018	5.33	mg/kg	1.06E-02	lbs./ton	Reference 8, Table 3-6
Phenol	108952	112.66	mg/kg	2.25E-01	lbs./ton	Reference 8, Table 3-6
Polychlorinated Biphenyls (PCBs)	1336363	0.126	mg/kg	2.51E-04	lbs./ton	Reference 8, Table 3-6
Propionaldehyde	123386	112.6	mg/kg	2.25E-01	lbs./ton	Reference 8, Table 3-6
Pyrene	129000	3.18	mg/kg	6.35E-03	lbs./ton	Reference 8, Table 3-6
Styrene	100425	527.5	mg/kg	1.05E+00	lbs./ton	Reference 8, Table 3-6
Toluene	108883	372	mg/kg	7.42E-01	lbs./ton	Reference 8, Table 3-6
Xylenes (Mixed Isomers)	1330207	38	mg/kg	7.58E-02	lbs./ton	Reference 8, Table 3-6

a. Emissions factor for 1,4-Dichlorobenzene is reported as <1 mg/kg. The factor used for this methodology assumes that the actual value is 0.333 mg/kg.
b. Emissions factor for Pentachlorophenol is reported as <0.0025 and <0.0018 g/kg. The factor used for this methodology assumes that the actual value is 5.3E-05 g/kg.

OPEN BURNING – YARD WASTE-LEAF AND BRUSH SPECIES

A. Source Category Description

Open burning of yard waste is the purposeful burning of leaf and brush species in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for leaf and brush waste burning are a function of the amount of waste burned per year. In 2014, open burning of yard waste in the U.S., Puerto Rico, and U.S. Virgin Islands resulted in approximately 5,035 tons of VOC emissions, 4,470 tons of primary PM10 emissions, and 3,446 tons of primary PM25 emissions.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste – Leaf Species Unspecified
2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste – Brush Species Unspecified

B. Overview of Calculations

The calculations for estimating the emissions from the burning of yard waste involve first estimating the amount of leaf and brush waste generated in each county. The amount of waste generated in the U.S. is available from the EPA report *Advancing Sustainable Materials Management: 2015 Fact Sheet*.[1] The amount of county-level yard waste burned is estimated by calculating the per capita amount of leaf and brush waste generated using the national data from the EPA report, and multiplying that by the number of people likely to burn waste in each county. The number of people likely to burn waste is based on the rural population in each county from the 2010 census. The total amount of yard waste burned is multiplied by emissions factors for criteria air pollutants (CAPs) and hazardous air pollutants (HAPs) to estimate emissions of these pollutants from yard waste burning. Sources of data and calculations for the amount of waste generated are discussed in section C. Emissions factors are discussed in section E. The estimation of emissions from open burning of yard waste is discussed in section G.

C. Activity Data

The activity data for this source category is the amount of leaf and brush waste generated, which is estimated using data the EPA report *Advancing Sustainable Materials Management: 2015 Fact Sheet*.[1] The report presents the total mass of waste generated from the residential and commercial sectors in the United States by type of waste for the calendar year 2015.

Table 1 shows the national-level yard waste generated and the corresponding per capita values. The per capita value of yard waste subject to burning was developed based on EPA's total amount of waste generated. According to the 2010 version of the same EPA report, residential waste generation accounts for 55-65% of the total waste from the residential and commercial sectors;[2] for the per capita calculation, the median value of 60% of total waste generated is assumed. This number is multiplied by the amount of yard waste generated and divided by the U.S. population in 2015 (319 million people)[3] to determine the per capita amount of yard waste generated in the United States.

$$PC_{yw} = \frac{YW \times 0.60}{P_{y,US}} \quad (1)$$

Where:

PC_{yw} = Per capita value of yard waste in the US, in tons per person
YW = Annual yard waste generated, in million tons
$P_{y,US}$ = Population of the US for year of inventory, in million people

The per capita value of yard waste is estimated to be 0.065 tons per person in 2015.

Table 1. Annual Waste Generated in the US in 2015

Material	Weight Generated (million tons)	Tons per person
Yard	34.50	0.065

Source: Reference 1, Table 1

As open burning is generally not practiced in urbanized areas, only the rural population in each county is assumed to practice open burning. The rural and urban populations are taken from 2010 U.S. Census data.[4] It is assumed that 24% of the rural population burns yard waste.[5]

$$PBurn_c = RPop_c \times 0.24 \quad (2)$$

Where:

$PBurn_c$ = Population likely to burn in county c
$RPop_c$ = Rural population in county c in 2010

The number of people likely to burn waste in each county (from equation 2) is then used with the value of per capita yard waste generated (from equation 1) and two assumptions to determine the amount of leaf and brush waste burned. The first assumption concerns the composition of yard waste; of the total amount of yard waste generated, yard waste composition is assumed to be 25 percent leaves, 25 percent brush, and 50 percent grass by weight.[6] However, open burning of grass clippings is not typically practiced by homeowners, and as such only estimates for leaf burning and brush burning are developed.

The second assumption adjusts for variations in vegetation; the percentage of forested acres (including rural forest and urban forest) is determined using Version 2 of the Biogenic Emission Landuse Database (BELD2) within the Biogenic Emissions Inventory System (BEIS). Based on this percentage, county-level yard waste values are adjusted according to the values in Table 2. To better account for the native vegetation that likely occurs in residential yards of farming states, agricultural land acreage is subtracted before calculating the percentage of forested acres. All municipios in Puerto Rico and counties in the U.S. Virgin Islands, Hawaii, and Alaska were assumed to have greater than 50 percent forested acres.

$$LW_c = PBurn_c \times PC_{yw} \times YWFr_t \times AF_{fa,c} \quad (3)$$

$$BW_c = PBurn_c \times PC_{yw} \times YWFr_t \times AF_{fa,c} \quad (4)$$

Where:

LW_c = Annual leaf waste burned in county c, in tons
BW_c = Annual brush waste burned in county c, in tons
$PBurn_c$ = Population likely to burn in county c, from equation 2
PC_{yw} = Per capita value of yard waste in the US, in tons per person, from equation 1
$YWFr_t$ = Fraction of total yard waste for waste type t (leaf or brush)
$AF_{fa,c}$ = Adjustment factor based on percent of forested acres in county c, from Table 2

Table 2. Adjustment for Percentage of Forested Acres

Percent Forested Acres per County	Adjustment for Yard Waste Generated
< 10%	0% generated
≥ 10% & < 50%	50% generated
≥ 50%	100% generated

D. Allocation Procedure

National values for the amount of waste generated are distributed to the counties based on rural population, as described in Section C.

E. Emissions Factors

Emissions factors for open burning of yard are reported in Table 4 and Table 5. The emissions factors for CAPs are from AP-42[7] and the emissions inventory improvement program.[8] For burning of leaves, emissions factors for PM25 are calculated by multiplying the PM10 emissions factor by a ratio of 0.7709, the PM25 to PM10 emissions factor ratio for brush burning. Emission factors for NH3 were derived from the 2002 NEI crop residue emission estimates using the ratio of NH3/NOx for pasture grass from Pouliot et al. (2017)[9] and the NOx emission factor from AP-42. Emissions factors for HAPs are from an EPA Control Technology Center report.[10]

F. Controls

Controls for residential yard waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. However, literature suggests that burn bans are not 100% effective. It is therefore assumed that approximately 25% of the residents that may burn yard waste would burn do so even if a ban is in place. For counties that have burn bans, the assumption is applied by multiplying 0.25 by the annual waste burned. Currently no counties are assumed to have burn bans in place.

$$\begin{matrix} If\ county\ c\ has\ a\ burn\ ban \\ Then\ LW_c = LW_c \times 0.25 \end{matrix} \quad (5)$$

$$\begin{matrix} If\ county\ c\ has\ a\ burn\ ban \\ Then\ BW_c = BW_c \times 0.25 \end{matrix} \quad (6)$$

Where:

LW_c = Annual leaf waste burned in county *c,* in tons
BW_c = Annual brush waste burned in county *c,* in tons

G. Emissions

The annual amount of leaf and brush waste burned in each county is multiplied by the emissions factors listed in Table 4 and Table 5 to estimate emissions. Emissions for leaves and residential brush are calculated separately, since emission factors vary by yard waste type.

$$E_{p,c} = LW_c \times EF_p \quad (7)$$

$$E_{p,c} = BW_c \times EF_p \quad (8)$$

Where:

$E_{p,c}$ = Annual emissions of pollutant p in county c
LW_c = Annual leaf waste burned in county *c,* in tons
BW_c = Annual brush waste burned in county *c,* in tons
EF_p = Emission factor for pollutant *p,* in lbs. of pollution per ton of waste burned

H. Point Source Subtraction

There are no point source-specific SCCs for open burning of yard waste; therefore point source subtraction is not performed for this category.

I. Sample Calculations

Table 3 lists sample calculations to determine the CO emissions from open burning of yard waste in Autauga County, Alabama.

Table 3. Sample calculations for CO emissions from open burning in Autauga County, Al.

Eq. #	Equation	Values for Autauga County, AL	Result
1	$PC_{yw} = \frac{YW \times 0.60}{P_{y,US}}$	$\frac{34.5\ million\ tons \times 0.60}{318.85\ million\ people}$	0.065 tons yard waste per person per year
2	$PBurn_c = RPop_c \times 0.24$	$22{,}921\ people \times 0.24$	5,501 people likely to burn in Autauga County, AL
3	$LW_c = PBurn_c \times PC_{yw} \times YWFr_t \times AF_{fa,c}$	$5{,}501\ people \times 0.065\ tons \times 0.25 \times 1$	89.39 tons of leaf waste burned in Autauga County, AL
4	$BW_c = PBurn_c \times PC_{yw} \times YWFr_t \times AF_{fa,c}$	$5{,}501\ people \times 0.065\ tons \times 0.25 \times 1$	89.39 tons of brush waste burned in Autauga County, AL
5	$If\ county\ c\ has\ a\ burn\ ban$ $Then\ LW_c = LW_c \times 0.25$	N/A	Autauga County, AL does not have a burn ban
6	$If\ county\ c\ has\ a\ burn\ ban$ $Then\ BW_c = BW_c \times 0.25$	N/A	Autauga County, AL does not have a burn ban
7	$E_{p,c} = LW_c \times EF_p$	$89.39\ tons\ of\ leaf\ waste \times 112\ lbs.per\ ton$	5.01 tons CO emissions from burning of leaf waste in Autauga County, AL
8	$E_{p,c} = BW_c \times EF_p$	$89.39\ tons\ of\ brush\ waste \times 140\ lbs.per\ ton$	6.26 tons CO emissions from burning of brush waste in Autauga County, AL

J. Changes from 2014 Methodology

The 2017 emissions inventory methodology for yard waste burning includes a change to the method for determining population likely to burn. The 2014 v2 NEI methodology determined the population likely to burn by identifying the rural and "like rural" population in each county in 2010 and using the fraction of 2010 rural and like rural population to total population in order to determine the rural population in 2014. The 2017 methodology only uses the 2010 rural population to determine the population likely to burn.

K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are calculated using 2010 population data, since 2017 Census Data does not exist for the U.S. Virgin Islands.

L. References

[1] U.S. Environmental Protection Agency. 2018. *Advancing Sustainable Materials: 2015 Fact Sheet*, "Table 1. Generation, Recovery and Discards of Materials in MSW, 2015 (in millions of tons and percent of generation of each material)". https://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures-report

[2] U.S. Environmental Protection Agency. 2011. *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010—Fact Sheet*," p. 4. https://archive.epa.gov/epawaste/nonhaz/municipal/web/pdf/msw_2010_factsheet.pdf

[3] U.S. Census Bureau. *Total Population, American Community Survey,* https://data.census.gov/cedsci/table?hidePreview=false&tid=ACSDT1Y2017.B01003&vintage=2018

[4] U.S. Census Bureau, Decennial Censuses, 2010 Census: Summary File 1. http://www2.census.gov/census_2010/04-Summary_File_1/.

[5] Environment Canada. 2001. "Household Garbage Disposal and Burning." Prepared by Environics Research Group.

[6] Two Rivers Regional Council of Public Officials and Patrick Engineering, Inc. 1994. "Emission Characteristics of Burn Barrels," prepared for the U.S. Environmental Protection Agency, Region V.

[7] U.S. Environmental Protection Agency. 1992. AP-42, Fifth Edition, Volume 1, Chapter 2: Solid Waste Disposal. Section 2.5: Open Burning.

[8] Eastern Research Group, Inc. Emissions Inventory Improvement Program. Volume III: Chapter 16, Open Burning. 2001. https://www.epa.gov/sites/production/files/2015-08/documents/iii16_apr2001.pdf

[9] G. Pouliot, V. Rao, J.L. McCarty, and A. Soja. 2017. Development of the crop residue and rangeland burning in the 2014 National Emissions Inventory using information from multiple sources. Journal of the Air & Waste Management Association, 67(5), 613-622. https://doi.org/10.1080/10962247.2016.1268982.

[10] U.S. Environmental Protection Agency, Control Technology Center. 1997. "Evaluation of Emissions from the Open Burning of Household Waste in Barrels." EPA-600/R-97-134a. https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryID=115129

Table 4. Emissions Factors for Open Burning of Leaf Species

Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
CO	CO	112	lbs./ton	--	--	Reference 7, Table 2.5-6
Nitrogen Oxides	NOX	6.2	lbs./ton	--	--	Reference 7, Reference 8
PM10-FIL	PM10-FIL	38	lbs./ton	--	--	Reference 7, Table 2.5-6
PM10-PRI	PM10-PRI	38	lbs./ton	--	--	Reference 7, Table 2.5-6
PM25-FIL	PM25-FIL	29.3	lbs./ton	--	--	0.7709 * PM10
PM25-PRI	PM25-PRI	29.3	lbs./ton	--	--	0.7709 * PM10
Sulfur Dioxide	SO2	0.76	lbs./ton	--	--	Reference 7, Reference 8
VOC	VOC	28	lbs./ton	--	--	Reference 7, Table 2.5-6
Cumene	98828			0.01325	lbs./ton	Reference 10
Ethyl Benzene	100414			0.048	lbs./ton	Reference 10
Phenol	108952			0.115	lbs./ton	Reference 10
Styrene	100425			0.1015	lbs./ton	Reference 10
Ammonia	NH3	18.01	lbs./ton	--	--	Reference 7, Reference 9

Table 5. Emissions Factors for Open Burning of Brush Species

Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
CO	CO	140	lbs./ton	--	--	Reference 7, Table 2.5-5
Nitrogen Oxides	NOX	5	lbs./ton	--	--	Reference 7, Reference 8
PM10-PRI	PM10-PRI	17	lbs./ton	--	--	Reference 8
PM10-FIL	PM10-FIL	17	lbs./ton	--	--	Reference 8
PM25-PRI	PM25-PRI	13.1	lbs./ton	--	--	0.7709 * PM10
PM25-FIL	PM25-FIL	13.1	lbs./ton	--	--	0.7709 * PM10
Sulfur Dioxide	SO2	1.66	lbs./ton	--	--	Reference 7, Reference 8
VOC	VOC	19	lbs./ton	--	--	Reference 7, Table 2.5-5
Cumene	98828			0.01325	lbs./ton	Reference 10
Ethyl Benzene	100414			0.048	lbs./ton	Reference 10
Phenol	108952			0.115	lbs./ton	Reference 10
Styrene	100425			0.1015	lbs./ton	Reference 10
Ammonia	NH3	14.52	lbs./ton	--	--	Reference 7, Reference 9

PESTICIDE APPLICATION

A. Source Category Description

Pesticides are substances or mixtures used to control plant and animal life for the purposes of: agricultural production, public health from pest-borne disease, reducing property damage due to pests, and improving the aesthetic quality of outdoor and indoor surroundings. Agriculture, homeowners, industry, and government agencies use pesticides. The largest usage of pesticides by weight is in agriculture. Agricultural pesticides control weeds, insects, mites, fungi, nematodes, and other threats to the yield, quality, or safety of food production. There are several methods used to apply pesticides. For our calculations we used surface or soil application.

Emissions arise from pesticide use because of the volatile nature of many ingredients, solvents, or other additives used in the formulations. Many pesticide formulations use solvents as carriers for more active organic or inorganic ingredients. In pesticide formulations, the organic or inorganic solute is the "active ingredient" (AI), while the solvent carrier is the "inert carrier." Thus, the terms "active" and "inert" in pesticide formulations refer to toxicological action, and are not indicators of photochemical activity. Both the active and inert ingredients in these formulations evaporate and contribute to VOC emissions.

Table 1: 2023 NEI Pesticides SCCs.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2461800001	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Pesticide Application: All Processes	Surface Application
2461800002	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Pesticide Application: All Processes	Soil Incorporation

B. Overview of Calculations

Pesticide Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using the amount of active ingredient and the ingredients emission factor. Total pesticide emissions are disaggregated to application type using harvested acres.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emission factors (Section D), accounting for control programs (Section E), Emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific county-level pesticide usage from the U.S. Department of Agriculture National Agricultural Statistics Service (USDA NAAS). USDA NAAS'S *2022 Maryland Pesticide Survey Statistics* lists county-level top-10 publishable pesticide usage by pounds of active ingredient.[1] The data reports annual county-level pesticide use for herbicides, insecticides and fungicides applied to agricultural crops ground in Maryland for 2022. (see Table 1 in Appendix).

D. Emissions Factors

The VOC emission factors are obtained from the U.S. Environmental Protection Agency's *2017*

Agricultural Pesticides Nonpoint Emissions Methodology and Operator Instructions (NEMO). [Error! Bookmark not defined.] (See Table 2 in Appendix). Per EPA, the VOC emissions factors are derived for each active ingredient based on the pesticide profiles database maintained by the CA DPR.3[Error! Bookmark not defined.] This database contains the chemical formulation for pesticide products registered in the State of California and provides key inputs for the development of VOC emissions factors, including the mass fraction of the active ingredient and the emission potential (EP) of registered pesticide products.

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions from pesticide application are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Section C)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Section D)

Pesticide application emissions are then split between application process using harvest acres using the USDA's *USDA 2022 - 2023 Agricultural Statistics Annual Bulletin Maryland.* [4] The USDA reports the types of crops and the amount of each harvest in each county. In Maryland, pesticides for soybean and corn are normally applied to soil and wheat and barley are applied to the surface. A percentage based on the portion of each crop type was used to divide total county pesticide emissions into the application processes described by the SCCs. (See Table 3 in Appendix)

$$\boldsymbol{E_{c,s,t} = E_{VOC,c,s} \times Application_{s,t}}$$

Where:

$E_{c,s,t}$ = Annual VOC emissions in county *c* for source category *s*, for application type *t,* in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year
$Application_{s,t}$ = Application share factor for application type *t* (Appendix Table 3)

G. Point Source Subtraction

There are no point source-specific SCCs for pesticide application, therefore, point source subtraction is not performed for this category

H. Sample Calculations

Sample calculations for VOC emissions from pesticide application in Anne Arundel County, Maryland are included in the table below.

Table 2. Sample Calculations of VOC emissions for Pesticide Application in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
Emissions by Pesticide			
1- Glycophosphate	$A_{c,s} \times EF_{VOC,s}$	$(14{,}279\ lbs \times 0.159\ lb/lb)/2000$	1.13 tons of VOC in 2023
2 - Lambda-cyhalothrin	$A_{c,s} \times EF_{VOC,s}$	$(4{,}597\ lbs \times 0.034\ lb/lb)/2000$	0.078 tons of VOC in 2023
3 - Mineral oil	$A_{c,s} \times EF_{VOC,s}$	$(2{,}388\ lbs \times 0.534\ lb/lb)/2000$	0.637 tons of VOC in 2023
4 - 2,4-D	$A_{c,s} \times EF_{VOC,s}$	$(1{,}868\ lbs \times 0.827\ lb/lb)/2000$	0.772 tons of VOC in 2023
5 - Chlorothalonil	$A_{c,s} \times EF_{VOC,s}$	$(890\ lbs \times 0.113\ lb/lb)/2000$	0.050 tons of VOC in 2023
6 - Pendimethalin	$A_{c,s} \times EF_{VOC,s}$	$(724\ lbs \times 0.559\ lb/lb)/2000$	0.202 tons of VOC in 2023
7 - Dicamba	$A_{c,s} \times EF_{VOC,s}$	$(367\ lbs \times 0.084\ lb/lb)/2000$	0.015 tons of VOC in 2023
8 - Fipronil	$A_{c,s} \times EF_{VOC,s}$	$(299\ lbs \times 6.463\ lb/lb)/2000$	0.966 tons of VOC in 2023
9 - Bifenthrin	$A_{c,s} \times EF_{VOC,s}$	$(264\ lbs \times 1.566\ lb/lb)/2000$	0.207 tons of VOC in 2023
10 - Dicamba	$A_{c,s} \times EF_{VOC,s}$	$(187\ lbs \times 0.084\ lb/lb)/2000$	0.008 tons of VOC in 2023
			4.07 tons of VOC in 2023
Application Separation			
1 – Surface 2461800001	$E_{VOC,c,s} \times Application_{s,t}$	$4.07 tons \times 100\%$	4.07 tons of VOC in 2023
1 – Soil 2461800002	$E_{c,s,t}E_{VOC,c,s} \times Application_{s,t}$	$4.07 tons \times 0\%$	0 tons of VOC in 2023

I. References

[1] U.S. Department of Agriculture National Agricultural Statistics Service (USDA NAAS). *2022 Maryland Pesticide Survey Statistics.* https://www.nass.usda.gov/Statistics_by_State/Maryland/Publications/Pesticide/2022-MD-Pesticide.pdf

[2] U.S. Environmental Protection Agency. *Agricultural Pesticides NEMO 2017.* https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/nonpoint/Agricultural%20Pesticides%20NEMO%202017%20FINAL_4-2%20update.docx

[3] California Department of Pesticide Regulation, "CDPR_Emission_Potential_Database_10_2015.xlsx", provided by Pam Wofford, Environmental Program Manager, CA DPR to Jonathan Dorn, Associate, Abt Associates (January 2016).

[3] U.S. Department of Agriculture. *USDA 2022 - 2023 Agricultural Statistics Annual Bulletin Maryland.* https://www.nass.usda.gov/Statistics_by_State/Maryland/Publications/Annual_Statistical_Bulletin/2022/2022-2023_MD%20Bulletin.pdf.

APPENDIX

Table 1. USDA NAAS'S *2022 Maryland Pesticide Survey Statistics* Top 10 Publishable Pesticide Usage by County

TOP 10 PUBLISHABLE PESTICIDE USAGE BY COUNTY				
County	**FIPS Code**	**Pesticide Common Name**	**Type**	**Pounds of Active Ingredient**
ALLEGANY	24001	2,4-D	H	4,331
ALLEGANY	24001	Dithiopyr	H	1,312
ALLEGANY	24001	Permethrin	I	1,270
ALLEGANY	24001	Glyphosate	H	845
ANNE ARUNDEL	24003	Glyphosate	H	14,279
ANNE ARUNDEL	24003	Lambda-cyhalothrin	I	4,597
ANNE ARUNDEL	24003	Mineral oil	I	2,388
ANNE ARUNDEL	24003	2,4-D	H	1,868
ANNE ARUNDEL	24003	Chlorothalonil	F	890
ANNE ARUNDEL	24003	Pendimethalin	H	724
ANNE ARUNDEL	24003	Dicamba; dimet. salt	H	367
ANNE ARUNDEL	24003	Fipronil	I	299
ANNE ARUNDEL	24003	Bifenthrin	I	264
ANNE ARUNDEL	24003	Dicamba	H	187
BALTIMORE	24005	Glyphosate	H	73,190
BALTIMORE	24005	2,4-D	H	7,799
BALTIMORE	24005	Chlorothalonil	F	6,692
BALTIMORE	24005	Pendimethalin	H	4,015
BALTIMORE	24005	Atrazine	H	3,348
BALTIMORE	24005	S-Metolachlor	H	2,175
BALTIMORE	24005	Iprodione	F	2,052
BALTIMORE	24005	Thiophanate-methyl	F	1,903
BALTIMORE	24005	Imidacloprid	I	1,797
BALTIMORE	24005	Glufosinate-ammonium	H	1,675
CALVERT	24009	Lambda-cyhalothrin	I	39,196
CALVERT	24009	Mesotrione	H	22,909
CALVERT	24009	Glyphosate	H	7,941
CALVERT	24009	Atrazine	H	3,470
CALVERT	24009	2,4-D	H	1,079
CALVERT	24009	Prodiamine	H	989
CALVERT	24009	Bifenthrin	I	853
CALVERT	24009	MCPA; 2-ethylhexyl	H	575
CALVERT	24009	Propiconazole	F	426
CALVERT	24009	Azoxystrobin	F	184
CAROLINE	24011	Glyphosate	H	22,393
CAROLINE	24011	Atrazine	H	12,415

CAROLINE	24011	S-Metolachlor	H	10,164
CAROLINE	24011	2,4-D	H	6,413
CAROLINE	24011	Permethrin	I	1,086
CAROLINE	24011	Imidacloprid	I	1,014
CAROLINE	24011	Bifenthrin	I	726
CAROLINE	24011	Mesotrione	H	661
CAROLINE	24011	Buprofezin	I	33
CAROLINE	24011	Fipronil	I	32
CARROLL	24013	Glyphosate	H	53,062
CARROLL	24013	Atrazine	H	28,992
CARROLL	24013	2,4-D	H	25,255
CARROLL	24013	Paraquat	H	23,496
CARROLL	24013	S-Metolachlor	H	12,967
CARROLL	24013	Pendimethalin	H	12,592
CARROLL	24013	Metribuzin	H	4,895
CARROLL	24013	Dicamba; dimet. salt	H	3,065
CARROLL	24013	Sulfentrazone	H	2,849
CARROLL	24013	Glufosinate-ammonium	H	2,313
CECIL	24015	Glyphosate	H	14,498
CECIL	24015	2,4-D	H	2,554
CECIL	24015	Atrazine	H	674
CECIL	24015	S-Metolachlor	H	543
CECIL	24015	Propiconazole	F	244
CECIL	24015	Indaziflam	O	163
CECIL	24015	Lambda-cyhalothrin	I	126
CECIL	24015	Oryzalin	H	106
CECIL	24015	Clopyralid mono salt	H	88
CECIL	24015	Mesotrione	H	54
CHARLES	24017	2,4-D	H	17,586
CHARLES	24017	Glyphosate	H	12,559
CHARLES	24017	Chlorothalonil	F	1,539
CHARLES	24017	Dicamba; dimet. salt	H	1,139
CHARLES	24017	Bifenthrin	I	541
CHARLES	24017	Imidacloprid	I	51
CHARLES	24017	Paclobutrazol	O	34
CHARLES	24017	Tebuconazole	F	27
DORCHESTER	24019	Glyphosate	H	12,846
DORCHESTER	24019	Atrazine	H	7,321
DORCHESTER	24019	2,4-D	H	2,190
FREDERICK	24021	Glyphosate	H	30,292
FREDERICK	24021	Mesotrione	H	23,456
FREDERICK	24021	2,4-D	H	13,613
FREDERICK	24021	Atrazine	H	10,304

FREDERICK	24021	Chlorothalonil	F	9,472
FREDERICK	24021	S-Metolachlor	H	7,195
FREDERICK	24021	Mancozeb	F	5,986
FREDERICK	24021	Paraquat	H	4,367
FREDERICK	24021	Trifluralin	H	3,507
FREDERICK	24021	Iprodione	F	2,303
GARRETT	24023	Glyphosate	H	10,103
GARRETT	24023	Atrazine	H	5,229
GARRETT	24023	Metolachlor	H	2,925
GARRETT	24023	S-Metolachlor	H	1,492
GARRETT	24023	2,4-D	H	1,468
GARRETT	24023	Bifenthrin	I	363
GARRETT	24023	Mesotrione	H	344
GARRETT	24023	Rimsulfuron	H	18
GARRETT	24023	Nicosulfuron	H	11
HARFORD	24025	Fipronil	I	50,209
HARFORD	24025	Glyphosate	H	38,938
HARFORD	24025	S-Metolachlor	H	19,891
HARFORD	24025	2,4-D	H	9,391
HARFORD	24025	Atrazine	H	6,220
HARFORD	24025	Chlorothalonil	F	1,933
HARFORD	24025	Prodiamine	H	680
HARFORD	24025	Propiconazole	F	529
HARFORD	24025	Thiophanate-methyl	F	411
HARFORD	24025	MCPP-P; DMA Salt	H	249
HOWARD	24027	Glyphosate	H	18,728
HOWARD	24027	Azoxystrobin	F	5,447
HOWARD	24027	Chlorothalonil	F	5,363
HOWARD	24027	2,4-D	H	4,075
HOWARD	24027	Indoxacarb	I	1,036
HOWARD	24027	Bifenthrin	I	177
HOWARD	24027	Imidacloprid	I	169
HOWARD	24027	Acetamiprid	I	146
HOWARD	24027	Acibenzolar-S-Methyl	O	48
HOWARD	24027	Piperonyl butoxide	I	33
KENT	24029	Glyphosate	H	46,248
KENT	24029	2,4-D	H	21,838
KENT	24029	Atrazine	H	16,479
KENT	24029	Lambda-cyhalothrin	I	4,900
KENT	24029	Bifenthrin	I	764
KENT	24029	Pyroxasulfone	H	764
KENT	24029	Dicamba; sodium salt	H	469
KENT	24029	Diflufenzopyr-sodium	H	188

MONTGOMERY	24031	Glyphosate	H	5,435
MONTGOMERY	24031	2,4-D	H	2,862
MONTGOMERY	24031	Chlorothalonil	F	2,804
MONTGOMERY	24031	Mineral oil	I	2,569
MONTGOMERY	24031	Sulfentrazone	H	1,661
MONTGOMERY	24031	Glufosinate-ammonium	H	1,546
MONTGOMERY	24031	Fipronil	I	1,358
MONTGOMERY	24031	Trifluralin	H	1,353
MONTGOMERY	24031	Propiconazole	F	1,007
MONTGOMERY	24031	Mancozeb	F	807
PRINCE GEORGE'S	24033	2,4-D	H	10,166
PRINCE GEORGE'S	24033	Glyphosate	H	7,511
PRINCE GEORGE'S	24033	MCPP-P; DMA Salt	H	2,578
PRINCE GEORGE'S	24033	Dicamba; dimet. salt	H	1,486
PRINCE GEORGE'S	24033	Chlorothalonil	F	993
PRINCE GEORGE'S	24033	Imidacloprid	I	607
PRINCE GEORGE'S	24033	Triethylamine triclo	H	589
PRINCE GEORGE'S	24033	Piperonyl butoxide	I	366
PRINCE GEORGE'S	24033	Fipronil	I	359
PRINCE GEORGE'S	24033	Prodiamine	H	208
QUEEN ANNE'S	24035	Glyphosate	H	40,574
QUEEN ANNE'S	24035	Atrazine	H	20,246
QUEEN ANNE'S	24035	S-Metolachlor	H	13,580
QUEEN ANNE'S	24035	2,4-D	H	6,478
QUEEN ANNE'S	24035	Simazine	H	2,947
QUEEN ANNE'S	24035	Pyroxasulfone	H	1,214
QUEEN ANNE'S	24035	Captan	F	1,094
QUEEN ANNE'S	24035	Carbaryl	I	1,030
QUEEN ANNE'S	24035	Mesotrione	H	900
QUEEN ANNE'S	24035	Metribuzin	H	884
SOMERSET	24039	Glyphosate	H	58,673
SOMERSET	24039	2,4-D	H	3,394
SOMERSET	24039	Bifenthrin	I	406
SOMERSET	24039	Flumioxazin	H	266
SOMERSET	24039	Lambda-cyhalothrin	I	215
ST. MARY'S	24037	Glyphosate	H	13,376
ST. MARY'S	24037	Atrazine	H	4,654
ST. MARY'S	24037	Lambda-cyhalothrin	I	3,903
ST. MARY'S	24037	S-Metolachlor	H	1,907
ST. MARY'S	24037	2,4-D	H	1,813
ST. MARY'S	24037	Paraquat	H	1,800
ST. MARY'S	24037	Chlorothalonil	F	992
ST. MARY'S	24037	Sulfur	F	775

ST. MARY'S	24037	Tebuconazole	F	589
ST. MARY'S	24037	Captan	F	454
TALBOT	24041	Glyphosate	H	24,489
TALBOT	24041	2,4-D	H	2,255
TALBOT	24041	Propanoic acid	H	91
TALBOT	24041	Dicamba; dimet. salt	H	33
TALBOT	24041	Dicamba	H	27
WASHINGTON	24043	2,4-D	H	83,535
WASHINGTON	24043	Glyphosate	H	60,980
WASHINGTON	24043	Atrazine	H	53,721
WASHINGTON	24043	Metolachlor	H	30,309
WASHINGTON	24043	Paraquat	H	12,277
WASHINGTON	24043	S-Metolachlor	H	5,035
WASHINGTON	24043	Mancozeb	F	4,747
WASHINGTON	24043	Mesotrione	H	4,449
WASHINGTON	24043	Abamectin	I	2,612
WASHINGTON	24043	Clopyralid mono salt	H	2,496
WICOMICO	24045	Glyphosate	H	265,639
WICOMICO	24045	S-Metolachlor	H	18,794
WICOMICO	24045	Atrazine	H	15,840
WICOMICO	24045	2,4-D	H	8,869
WICOMICO	24045	Permethrin	I	4,141
WICOMICO	24045	Mesotrione	H	1,255
WICOMICO	24045	Novaluron	I	597
WICOMICO	24045	Dinotefuran	I	426
WICOMICO	24045	Flumioxazin	H	425
WICOMICO	24045	Bifenthrin	I	325
WORCESTER	24047	Glyphosate	H	62,998
WORCESTER	24047	Atrazine	H	17,677
WORCESTER	24047	S-Metolachlor	H	9,572
WORCESTER	24047	2,4-D	H	6,156
WORCESTER	24047	Chlorothalonil	F	2,314
WORCESTER	24047	Bifenthrin	I	876
WORCESTER	24047	Mesotrione	H	869
WORCESTER	24047	Pyroxasulfone	H	353
WORCESTER	24047	Fluazinam	F	299
WORCESTER	24047	Flumioxazin	H	148

Table 2. ***2017 Agricultural Pesticides Nonpoint Emissions Methodology and Operator Instructions (NEMO)*** **Pesticide Emission Factors**

COMPOUND	Emissions Factor	EF Numerator	EF Denominator
2,4-D	0.827	LB	LB

2,4-DB ACID	0.067	LB	LB
ABAMECTIN	15.236	LB	LB
ACEPHATE	0.275	LB	LB
ACEQUINOCYL	0.135	LB	LB
ACETAMIPRID	0.207	LB	LB
ACIBENZOLAR-S-METHYL	0.063	LB	LB
ACIFLUORFEN, SODIUM SALT	1.887	LB	LB
ALACHLOR	0.513	LB	LB
ALDICARB	0.064	LB	LB
ALUMINUM PHOSPHIDE	0.055	LB	LB
AMETOCTRADIN	0.041	LB	LB
AMETRYNE	0.024	LB	LB
AMINOPYRALID, TRIISOPROPANOLAMINE SALT	0.16	LB	LB
ASULAM, SODIUM SALT	0.202	LB	LB
ATRAZINE	0.148	LB	LB
AZADIRACHTIN	10.092	LB	LB
AZINPHOS-METHYL	0.464	LB	LB
AZOXYSTROBIN	0.344	LB	LB
BACILLUS AMYLOLIQUEFACIENS STRAIN D747	0.076	LB	LB
BACILLUS CEREUS, STRAIN BP01	0.106	LB	LB
BACILLUS FIRMUS (STRAIN I-1582)	0.052	LB	LB
BACILLUS PUMILUS GHA 180	2,050.00	LB	LB
BACILLUS SUBTILIS GB03	190.333	LB	LB
BACILLUS THURINGIENSIS (BERLINER)	0.487	LB	LB
BENOMYL	0.074	LB	LB
BENSULFURON METHYL	0.031	LB	LB
BENSULIDE	0.553	LB	LB
BENTAZON, SODIUM SALT	0.053	LB	LB
BIFENAZATE	0.084	LB	LB
BIFENTHRIN	1.566	LB	LB
BISPYRIBAC-SODIUM	0.038	LB	LB
BOSCALID	0.229	LB	LB
BROMACIL	0.85	LB	LB
BUPROFEZIN	0.164	LB	LB
CALCIUM HYDROXIDE	0.003	LB	LB
CAPTAN	0.144	LB	LB
CARBARYL	0.321	LB	LB
CARBOPHENOTHION	0.446	LB	LB
CARBOXIN	0.437	LB	LB
CARFENTRAZONE-ETHYL	0.653	LB	LB
CHLORANTRANILIPROLE	0.364	LB	LB
CHLORFENAPYR	0.137	LB	LB
CHLORMEQUAT CHLORIDE	0.586	LB	LB

CHLORONEB	0.074	LB	LB
CHLOROPICRIN	1.272	LB	LB
CHLOROTHALONIL	0.113	LB	LB
CHLORPROPHAM	0.325	LB	LB
CHLORPYRIFOS	1.538	LB	LB
CHLORSULFURON	0.028	LB	LB
CLETHODIM	1.84	LB	LB
CLOFENTEZINE	0.147	LB	LB
CLOMAZONE	0.149	LB	LB
CLOPYRALID	0.05	LB	LB
CLOTHIANIDIN	0.153	LB	LB
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	0.698	LB	LB
COPPER	0.218	LB	LB
COPPER HYDROXIDE	0.06	LB	LB
COPPER OCTANOATE	2.198	LB	LB
COPPER OXIDE (OUS)	0.029	LB	LB
COPPER OXYCHLORIDE	0.023	LB	LB
COPPER OXYCHLORIDE SULFATE	0.026	LB	LB
COPPER SULFATE (BASIC)	0.048	LB	LB
COPPER SULFATE (PENTAHYDRATE)	0.062	LB	LB
CRYOLITE	0.025	LB	LB
CYAZOFAMID	0.166	LB	LB
CYCLANILIDE	2.468	LB	LB
CYCLOATE	0.507	LB	LB
CYFLUFENAMID	0.175	LB	LB
CYFLUTHRIN	1.736	LB	LB
CYHALOFOP-BUTYL	0.452	LB	LB
CYMOXANIL	0.044	LB	LB
CYPERMETHRIN	1.521	LB	LB
CYPRODINIL	0.049	LB	LB
CYROMAZINE	0.228	LB	LB
CYTOKININ	0.254	LB	LB
DAMINOZIDE	0.045	LB	LB
DAZOMET	1	LB	LB
DELTAMETHRIN	3.949	LB	LB
DESMEDIPHAM	3.668	LB	LB
DIAZINON	0.76	LB	LB
DICAMBA	0.084	LB	LB
DICHLOBENIL	0.434	LB	LB
DICLOFOP-METHYL	1.042	LB	LB
DICLORAN	0.087	LB	LB
DICOFOL	0.424	LB	LB
DICROTOPHOS	0.258	LB	LB

DIENOCHLOR	0.182	LB	LB
DIFENOCONAZOLE	1.12	LB	LB
DIFLUBENZURON	0.159	LB	LB
DIMETHENAMID-P	0.135	LB	LB
DIMETHIPIN	0.367	LB	LB
DIMETHOATE	0.83	LB	LB
DIMETHOMORPH	0.038	LB	LB
DINOSEB	0.455	LB	LB
DINOTEFURAN	0.191	LB	LB
DIQUAT DIBROMIDE	1.456	LB	LB
DISULFOTON	1.186	LB	LB
DITHIOPYR	0.955	LB	LB
DIURON	0.072	LB	LB
DODINE	0.049	LB	LB
EMAMECTIN BENZOATE	3.055	LB	LB
ENDOSULFAN	0.492	LB	LB
EPTC	0.517	LB	LB
ESFENVALERATE	8.919	LB	LB
ETHALFLURALIN	1.554	LB	LB
ETHEPHON	0.302	LB	LB
ETHION	0.397	LB	LB
ETHOFUMESATE	0.691	LB	LB
ETHOPROP	0.416	LB	LB
ETOXAZOLE	0.059	LB	LB
FENAMIDONE	0.101	LB	LB
FENAMIPHOS	1.043	LB	LB
FENARIMOL	1.404	LB	LB
FENBUCONAZOLE	0.049	LB	LB
FENBUTATIN-OXIDE	0.058	LB	LB
FENHEXAMID	0.037	LB	LB
FENOXAPROP-ETHYL	3.132	LB	LB
FENOXYCARB	0.655	LB	LB
FENPROPATHRIN	1.469	LB	LB
FENPYROXIMATE	8.721	LB	LB
FENTIN HYDROXIDE	0.039	LB	LB
FERBAM	0.045	LB	LB
FIPRONIL	6.463	LB	LB
FLAZASULFURON	0.148	LB	LB
FLONICAMID	0.06	LB	LB
FLORASULAM	0.052	LB	LB
FLUAZIFOP-BUTYL	1.464	LB	LB
FLUAZINAM	0.406	LB	LB
FLUBENDIAMIDE	0.102	LB	LB

FLUDIOXONIL	0.308	LB	LB
FLUMICLORAC-PENTYL	0.565	LB	LB
FLUMIOXAZIN	0.075	LB	LB
FLUOMETURON	0.046	LB	LB
FLUOPICOLIDE	0.136	LB	LB
FLUOPYRAM	0.291	LB	LB
FLUOXASTROBIN	0.172	LB	LB
FLURIDONE	0.629	LB	LB
FLUROXYPYR	0.279	LB	LB
FLUTOLANIL	0.031	LB	LB
FLUTRIAFOL	0.331	LB	LB
FLUXAPYROXAD	0.02	LB	LB
FORAMSULFURON	0.252	LB	LB
FORMETANATE HYDROCHLORIDE	0.011	LB	LB
FOSETYL-AL	0.049	LB	LB
GIBBERELLINS	2.819	LB	LB
GLUFOSINATE-AMMONIUM	0.442	LB	LB
GLUTAMIC ACID	0.063	LB	LB
GLYPHOSATE	0.159	LB	LB
HALOSULFURON-METHYL	0.032	LB	LB
HARPIN PROTEIN	1.233	LB	LB
HEXAZINONE	0.142	LB	LB
HEXYTHIAZOX	0.423	LB	LB
HYDRAMETHYLNON	0.614	LB	LB
HYDROGEN PEROXIDE	0.356	LB	LB
IBA	0.559	LB	LB
IMAZALIL	0.794	LB	LB
IMAZAMETHABENZ	0.504	LB	LB
IMAZAMOX	0.016	LB	LB
IMAZAPIC	0.016	LB	LB
IMAZAPYR	0.025	LB	LB
IMAZETHAPYR	0.019	LB	LB
IMAZOSULFURON	0.049	LB	LB
IMIDACLOPRID	0.305	LB	LB
INDAZIFLAM	0.416	LB	LB
INDOXACARB	0.453	LB	LB
IPCONAZOLE	0.122	LB	LB
IPRODIONE	0.203	LB	LB
ISOXABEN	0.103	LB	LB
KAOLIN	0.015	LB	LB
KINOPRENE	0.466	LB	LB
KRESOXIM-METHYL	0.034	LB	LB
LINURON	0.077	LB	LB

MALATHION	0.409	LB	LB
MALEIC HYDRAZIDE	0.015	LB	LB
MANCOZEB	0.047	LB	LB
MANDIPROPAMID	0.209	LB	LB
MANEB	0.071	LB	LB
MCPA	0.47	LB	LB
MCPB, SODIUM SALT	1.206	LB	LB
MECOPROP-P	0.622	LB	LB
MEFENOXAM	0.587	LB	LB
MEPIQUAT CHLORIDE	0.661	LB	LB
MESOSULFURON-METHYL	0.822	LB	LB
MESOTRIONE	0.236	LB	LB
META-CRESOL	73.605	LB	LB
METALAXYL	0.506	LB	LB
METALDEHYDE	0.691	LB	LB
METAM-SODIUM	0.566	LB	LB
METCONAZOLE	0.369	LB	LB
METHAMIDOPHOS	0.71	LB	LB
METHIDATHION	1.068	LB	LB
METHIOCARB	0.22	LB	LB
METHOMYL	0.115	LB	LB
METHOXYFENOZIDE	0.223	LB	LB
METHYL BROMIDE	1.159	LB	LB
METHYL IODIDE	1.212	LB	LB
METHYL PARATHION	0.502	LB	LB
METIRAM	0.11	LB	LB
METOLACHLOR	0.198	LB	LB
METRAFENONE	0.074	LB	LB
METRIBUZIN	0.087	LB	LB
METSULFURON-METHYL	0.037	LB	LB
MEVINPHOS	0.534	LB	LB
MSMA	0.315	LB	LB
MYCLOBUTANIL	0.451	LB	LB
MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS	0.127	LB	LB
NALED	0.494	LB	LB
NAPROPAMIDE	0.385	LB	LB
NAPTALAM, SODIUM SALT	0.588	LB	LB
NICOSULFURON	0.037	LB	LB
NORFLURAZON	0.031	LB	LB
NOSEMA LOCUSTAE SPORES	7.085	LB	LB
NOVALURON	2.273	LB	LB
ORTHOSULFAMURON	0.097	LB	LB
ORYZALIN	0.212	LB	LB

OXADIAZON	0.182	LB	LB
OXAMYL	0.721	LB	LB
OXYDEMETON-METHYL	0.928	LB	LB
OXYFLUORFEN	1.012	LB	LB
OXYTETRACYCLINE HYDROCHLORIDE	0.199	LB	LB
PACLOBUTRAZOL	0.983	LB	LB
PARAQUAT DICHLORIDE	0.311	LB	LB
PARATHION	0.357	LB	LB
PENDIMETHALIN	0.559	LB	LB
PENOXSULAM	0.208	LB	LB
PENTHIOPYRAD	0.054	LB	LB
PERMETHRIN	3.345	LB	LB
PETROLEUM DISTILLATES	1.142	LB	LB
PETROLEUM NAPHTHENIC OILS	0.884	LB	LB
PHENMEDIPHAM	3.129	LB	LB
PHORATE	0.448	LB	LB
PHOSMET	1.162	LB	LB
PHOSPHORIC ACID	0.434	LB	LB
PICLORAM	0.398	LB	LB
PINOXADEN	10.388	LB	LB
PIPERONYL BUTOXIDE	4.504	LB	LB
POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR	8.922	LB	LB
POTASSIUM BICARBONATE	0.027	LB	LB
PRODIAMINE	0.126	LB	LB
PROFENOFOS	0.367	LB	LB
PROMETRYN	0.184	LB	LB
PROPAMOCARB HYDROCHLORIDE	0.18	LB	LB
PROPANIL	0.099	LB	LB
PROPARGITE	0.196	LB	LB
PROPAZINE	0.2	LB	LB
PROPICONAZOLE	1.052	LB	LB
PROPYZAMIDE	0.055	LB	LB
PROTHIOCONAZOLE	0.139	LB	LB
PSEUDOMONAS FLUORESCENS, STRAIN A506	0.022	LB	LB
PYMETROZINE	0.02	LB	LB
PYRACLOSTROBIN	0.549	LB	LB
PYRAFLUFEN-ETHYL	5.343	LB	LB
PYRETHRINS	6.737	LB	LB
PYRIDABEN	0.019	LB	LB
PYRIMETHANIL	0.188	LB	LB
PYRIPROXYFEN	1.387	LB	LB
PYRITHIOBAC-SODIUM	0.193	LB	LB
PYROXSULAM	0.135	LB	LB

QUINCLORAC	0.121	LB	LB
QUINOXYFEN	0.06	LB	LB
QUIZALOFOP-ETHYL	4.121	LB	LB
RIMSULFURON	0.07	LB	LB
ROTENONE	0.808	LB	LB
SABADILLA ALKALOIDS	2.018	LB	LB
SAFLUFENACIL	0.015	LB	LB
SETHOXYDIM	3.751	LB	LB
SILICA AEROGEL	0.381	LB	LB
SIMAZINE	0.089	LB	LB
SODIUM CHLORATE	0.025	LB	LB
SPINETORAM	0.138	LB	LB
SPINOSAD	0.483	LB	LB
SPIRODICLOFEN	0.229	LB	LB
SPIROMESIFEN	0.119	LB	LB
SPIROTETRAMAT	0.101	LB	LB
STREPTOMYCIN	0.133	LB	LB
SULFENTRAZONE	0.128	LB	LB
SULFOMETURON-METHYL	0.076	LB	LB
SULFOSULFURON	0.027	LB	LB
SULFOXAFLOR	0.06	LB	LB
SULFUR	0.013	LB	LB
SULFURIC ACID	0.088	LB	LB
TCMTB	0.995	LB	LB
TEBUCONAZOLE	0.178	LB	LB
TEBUFENOZIDE	0.163	LB	LB
TEBUTHIURON	0.075	LB	LB
TEMBOTRIONE	0.096	LB	LB
TERBACIL	0.023	LB	LB
TETRACONAZOLE	0.492	LB	LB
THIABENDAZOLE	0.117	LB	LB
THIACLOPRID	0.119	LB	LB
THIAMETHOXAM	0.178	LB	LB
THIAZOPYR	1.756	LB	LB
THIDIAZURON	0.396	LB	LB
THIFENSULFURON-METHYL	0.049	LB	LB
THIOBENCARB	0.158	LB	LB
THIODICARB	0.133	LB	LB
THIOPHANATE-METHYL	0.118	LB	LB
THIRAM	0.219	LB	LB
TRALKOXYDIM	0.141	LB	LB
TRIADIMEFON	0.162	LB	LB
TRIADIMENOL	0.243	LB	LB

TRIALLATE	0.573	LB	LB
TRIBENURON-METHYL	0.03	LB	LB
TRICLOPYR, BUTOXYETHYL ESTER	0.433	LB	LB
TRIFLOXYSTROBIN	0.083	LB	LB
TRIFLOXYSULFURON-SODIUM	0.014	LB	LB
TRIFLUMIZOLE	0.067	LB	LB
TRIFLURALIN	0.737	LB	LB
TRINEXAPAC-ETHYL	2.386	LB	LB
TRITICONAZOLE	0.24	LB	LB
UNICONIZOLE-P	125.636	LB	LB
VINCLOZOLIN	0.055	LB	LB
ZINC CHLORIDE	0.329	LB	LB
ZINEB	0.082	LB	LB
ZIRAM	0.031	LB	LB
DEFAULT	0.400383954	LB	LB

Table 3. USDA *2022-2023 Agricultural Statistics Annual Bulletin Maryland*

FIPS State and County Code	County	Surface Pesticide Application Harvested Acres	Soil Pesticide Application Harvested Acres	Total	% surface	% soil
24001	ALLEGANY	0	0	0.00	0	0
24003	ANNE ARUNDEL	8,240	0	8,240.00	1.00	0.00
24005	BALTIMORE	28,400	0	28,400.00	1.00	0.00
24009	CALVERT	5,960	1,110	7,070.00	0.84	0.16
24011	CAROLINE	84,600	13,900	98,500.00	0.86	0.14
24013	CARROLL	54,400	8,230	62,630.00	0.87	0.13
24015	CECIL	40,900	5,270	46,170.00	0.89	0.11
24017	CHARLES	11,000	0	11,000.00	1.00	0.00
24019	DORCHESTER	23,400	0	23,400.00	1.00	0.00
24021	FREDERICK	71,600	9,530	81,130.00	0.88	0.12
24023	GARRETT	6,550	0	6,550.00	1.00	0.00
24025	HARFORD	29,000	0	29,000.00	1.00	0.00
24027	HOWARD	0	0	0.00	0	0
24029	KENT	81,000	18,700	99,700.00	0.81	0.19
24031	MONTGOMERY	0	0	0.00	0	0
24033	PRINCE GEORGE'S	0	0	0.00	0	0
24035	QUEEN ANNE'S	45,500	20,600	66,100.00	0.69	0.31
24037	ST. MARY'S	22,740	5,690	28,430.00	0.80	0.20
24039	SOMERSET	30,000	5,780	35,780.00	0.84	0.16
24041	TALBOT	69,300	21,500	90,800.00	0.76	0.24
24043	WASHINGTON	23,120	4,410	27,530.00	0.84	0.16

24045	WICOMICO	43,900	0	43,900.00	1.00	0.00
24047	WORCESTER	65,900	7,700	73,600.00	0.90	0.10
24510	BALTIMORE CITY	0	0	0.00	0	0

PORTABLE FUEL CONTAINERS

A. Source Category Description

Portable fuel containers (PFCs) store and transport fuel from gasoline service stations to residential homes and businesses. Permeation emissions are produced after fuel has been stored long enough in a can for fuel molecules to infiltrate and saturate the can material. Diurnal emissions result when stored fuel vapors escape to the outside of a gas can through any possible openings while the gas can is subjected to daily cycle of increasing and decreasing ambient temperatures. Diurnal emissions are dependent on the closed- or open-storage condition of a gas can. Transport emissions arise when fuel escapes (e.g., spills, etc.) from gas cans that are in transit.

Table 1: 2023 NEI Portable Fuel Containers SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501011011	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Permeation
2501011012	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Evaporation (includes Diurnal losses)
2501011013	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Spillage During Transport
2501012011	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Permeation
2501012012	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Evaporation (includes Diurnal losses)
2501012013	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Spillage During Transport

B. Overview of Calculations

Portable fuel container Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using housing and business data and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific and county-level housing data from the Maryland Department of Planning[1] and business establishment data from the U.S. Census Bureau[1]. For residential portable fuel containers, the Maryland Department of Planning supplied the number of 1-unit detached dwellings and mobile homes, by county, for 2022. For commercial portable fuel containers, County Business Pattern

NAICS Codes 11, 23, 31, 311, 441, 447, 484, 488, 493, 811, 5321, 5323, 5324, 7212, 45299, 53131, 54132, 54162, 54169, 56173, 71391, 71393, 81293, and 532291 are utilized to estimate the number of businesses in 2021.

To convert the number of homes and businesses to the number of portable fuel containers, each count must be multiplied by (1) the percentage of homes or businesses with at least one gas can and (2) the number of gas cans per home or business. This data comes from a California Air Resources Board (CARB) Gas Can Survey.[3] The survey concluded, for residential fuel containers, that 46% of households have at least one gas can, and there are approximately 1.8 gas cans per household. The survey also concluded, for commercial fuel containers, that 80% of businesses have at least one gas can, and that there are approximately 6.9 gas cans per business.

The 2023 NEI uses gas can populations, as shown in Table 2.

Table 2: County Level Gas Can Population

County Name	State County FIPs	No. of 1-Unit Detached Dwellings + Mobile Homes	Residential Gas Can Population (Homes*0.46*1.80)	No. of Establishments	Commercial Gas Can Population (Businesses*0.8*6.9)
Allegany	24001	24,825	20,555.10	241	1,330.32
Anne Arundel	24003	142,167	117,714.28	2,888	15,941.76
Baltimore	24005	168,607	139,606.60	3,532	19,496.64
Calvert	24009	31,312	25,926.34	425	2,346.00
Caroline	24011	11,481	9,506.27	210	1,159.20
Carroll	24013	51,312	42,486.34	1,153	6,364.56
Cecil	24015	33,543	27,773.60	440	2,428.80
Charles	24017	44,933	37,204.52	570	3,146.40
Dorchester	24019	13,326	11,033.93	175	966.00
Frederick	24021	64,030	53,016.84	1,374	7,584.48
Garrett	24023	16,224	13,433.47	275	1,518.00
Harford	24025	65,703	54,402.08	1,315	7,258.80
Howard	24027	64,071	53,050.79	1,417	7,821.84
Kent	24029	8,458	7,003.22	104	574.08
Montgomery	24031	190,138	157,434.26	3,625	20,010.00
Prince Georges	24033	184,134	152,462.95	3,414	18,845.28
Queen Anne's	24035	18,515	15,330.42	387	2,136.24
St. Mary's	24037	34,952	28,940.26	442	2,439.84
Somerset	24039	8,327	6,894.76	104	574.08
Talbot	24041	15,770	13,057.56	290	1,600.80
Washington	24043	41,096	34,027.49	716	3,952.32
Wicomico	24045	31,994	26,491.03	507	2,798.64

Worcester	24047	27,227	22,543.96	362	1,998.24
Baltimore City	24510	43,422	35,953.42	1,490	8,224.80

D. Emissions Factors

The emission factor used to estimate emissions from portable fuel containers are based on a CARB Gas Can Survey [4], as demonstrated in Table 3 below.

Table 3. 2023 NEI VOC emissions factors for Portable Fuel Containers

SCCs	Description	Open Plastic (g/day)	Open Metal (g/day)	Closed plastic (g/gal-day)	Closed metal (g/gal-day)	Open Plastic (g/refill)	Open Metal (g/refill)	Closed Plastic (g/refill)	Closed Metal (g/refill)
2501011011 & 2501012011	Permeation			1.57	0.06				
2501011012 & 2501012012	Diurnal Evaporation	21.8	21.8	1.38	0.44				
2501011013 & 2501012013	Spillage During Transport					32.5	32.5	23	23

E. Controls

VOC emissions from portable fuel containers are controlled through Code of Maryland Regulations (COMAR) 26.11.13: Control of Gasoline and Volatile Organic Compound Storage and Handling. [5] COMAR 26.11.13.07 requires performance standards for portable fuel containers and/or spouts that reduce emissions due to storage, transport, and refueling activities.

F. Emissions

Total VOC permeation emissions from portable fuel containers (plastic and metal) are calculated using the following equation.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times S \times B_C \times Size_R \times Level \times Activity_{Yr} \times CF \times [1 - CE]}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = VOC emissions factor for source category s (Table 3)
S = Percentage of gas cans stored with fuel (70%)
B_C = Percentage of Cans Stored in Closed Condition with respect to Material (Residential: 53% Plastic & 13% Metal. Commercial: 33% Plastic & 18% Metal.)
$Size_r$ = Weighted Average Capacity of Residential-Gas Cans (Residential: 2.34 gallons. Commercial: 3.4 gallons.)

$Level$ = Weighted Average Amount of Stored Fuel (49%)
$Activity_{Yr}$ = Number of Activity Days Per Year (365)
CF = Conversion Factor (0.002204623 lbs/g)
CE = Control Efficiency (85.3%)

Total VOC diurnal evaporation emissions from portable fuel containers (plastic and metal) are calculated using the following equation.

$$\boldsymbol{E_{VOCc,s} = \left[A_{c,s} \times EF_{VOC,s} \times S \times B_C \times Size_R \times Level \times Activity_{Yr} \times CF\right] + \left[A_{c,s} \times EF_{VOC,s} \times S \times B_O \times Size_R \times Level \times Activity_{Yr} \times CF\right] \times [1 - CE]}$$

Where:

$E_{VOC,c,s}$ =Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ =Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = VOC emissions factor for source category s (Table 3)
S = Percentage of gas cans stored with fuel (70%)
B_C = Percentage of Cans Stored in Closed Condition with respect to Material (Residential: 53% Plastic & 13% Metal. Commercial: 33% Plastic & 18% Metal.)
B_O = Percentage of Cans Stored in Open Condition with respect to Material (Residential: 23% Plastic & 11% Metal. Commercial: 39% Plastic & 10% Metal.)
$Size_r$ = Weighted Average Capacity of Residential-Gas Cans (Residential: 2.34 gallons. Commercial: 3.4 gallons.)
$Level$ = Weighted Average Amount of Stored Fuel (49%)
$Activity_{Yr,}$ = Number of Activity Days Per Year (365)
CF = Conversion Factor (0.002204623 lbs/g)
CE = Control Efficiency (85.3%)

Total VOC transport spillage emissions from portable fuel containers (plastic and metal) are calculated using the following equation.

$$\boldsymbol{E_{VOCc,s} = \left[A_{c,s} \times EF_{VOC,s} \times S \times B_C \times RF \times Activity_{Yr} \times CF\right] + \left[A_{c,s} \times EF_{VOC,s} \times S \times B_O \times RF \times Activity_{Yr} \times CF\right] \times [1 - CE]}$$

Where:

$E_{VOC,c,s}$ =Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ =Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = VOC emissions factor for source category s (Table 3)
S = Percentage of gas cans stored with fuel (70%)
B_C = Percentage of Cans Stored in Closed Condition with respect to Material (Residential: 53% Plastic & 13% Metal. Commercial: 33% Plastic & 18% Metal.)
B_O = Percentage of Cans Stored in Open Condition with respect to Material (Residential: 23% Plastic & 11% Metal. Commercial: 39% Plastic & 10% Metal.)

RF = Refills per Can per Day (Residential: 0.01740. Commercial: 0.96438)
$Activity_{Yr,}$ = Number of Activity Days Per Year (365)
CF = Conversion Factor (0.002204623 lbs/g)
CE = Control Efficiency (85.3%)

G. Point Source Subtraction

There are no point source-specific SCCs for portable fuel containers, therefore point source subtraction is not performed for this category

H. Sample Calculations

Sample calculations for VOC emissions from portable fuel containers in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for Portable Fuel Containers Residential Permeation (2501011011) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
Plastic Portable Fuel Container			
1	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s} \times S \times B_R \times Size_R \times Level \times Activity_{Yr} \times CF \times [1 - CE]}$	$\left(117{,}714\ gas\ cans \times 1.57\ {}^{g}/_{gal-day} \times 70\%\ stored\ w/fuel \times 53\%\ plastic\ stored\ closed \times 2.34\ gallon\ weighted\ capacity \times 49\%\ stored\ fuel\ volume \times 365\ activity\ days\ per\ year \times 0.002204623\ {}^{lbs}/_{g}\ conversion\ \frac{factor}{2000} \times [1 - 0.853]\right)$	4.6497 tons of VOC in 2023
Metal Portable Fuel Container			
2	$\boldsymbol{E_{VOC_{c,s}} = A_{c,s} \times EF_{VOC,s} \times S \times B_R \times Size_R \times Level \times Activity_{Yr} \times CF \times [1 - CE]}$	$\left(117{,}714\ gas\ cans \times 0.06\ {}^{g}/_{gal-day} \times 70\%\ stored\ w/fuel \times 13\%\ metal\ stored\ closed \times 2.34\ gallon\ weighted\ capacity \times 49\%\ stored\ fuel\ volume \times 365\ activity\ days\ per\ year \times 0.002204623\ {}^{lbs}/_{g}\ conversion\ \frac{factor}{2000} \times [1 - 0.853]\right)$	0.0436 tons of VOC in 2023
			4.6933 tons of VOC in 2023

I. References

[1] Maryland Department of Planning: No. of 1-Unit Detatched Dwellings + Mobile Homes. https://apps.planning.maryland.gov/hb1045/index.html

[2] U.S. Census Bureau. CBP and NES Combined Report. Retrieved October 21, 2024 from https://www.census.gov/programs-surveys/cbp/data/tables.html?text-list-7a11e2dc71%3Atab=2021#text-list-7a11e2dc71

[3] ARB's Mailout MSC 99-25, "Public Meeting to Consider Approval of CA's Portable Gasoline-Container Emissions Inventory, " (ARB, 199b).

[4] ARB's Mailout MSC 99-25, "Public Meeting to Consider Approval of CA's Portable Gasoline-Container Emissions Inventory, " (ARB, 199b) .

[5] COMAR 26.11.13: Control of Gasoline and Volatile Organic Compound Storage and Handling. https://dsd.maryland.gov/regulations/Pages/26.11.13.00.aspx

PUBLICLY OWNED TREATMENT WORKS

A. Source Category Description

Publicly Owned Treatment Works (POTWs) include treatment works that are owned by a state, municipality, city, town, special sewer district, or other publicly owned and financed entity as opposed to a privately (industrial) owned treatment facility. The definition includes intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment. The wastewater treated by these POTWs is generated by industrial, commercial, and domestic sources.[1]

Table 1: 2023 POTW SCC

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2630020000	Waste Disposal, Treatment, and Recovery	Wastewater Treatment	Public Owned	Total Processed

B. Overview of Calculations

Publicly Owned Treatment Works Volatile Organic Compound (VOC) emissions in the 2023 NEI are estimated using wastewater flow rate and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific state- and facility-level wastewater design flow rate from the U.S. EPA Clean Watersheds Needs Survey.[2] For a given county, county-level wastewater flow rates are calculated by summing the flow rates for all POTWs within the county. The 2023 NEI uses 2022 wastewater flow rates, as shown in Table 2.

Table 2: 2022 County Flow Rate

County Name	State County FIPs	2022 Design Flow Rate (million gal/day)
Allegany	24001	44.136
Anne Arundel	24003	45.790
Baltimore	24005	180.095
Calvert	24009	2.955
Caroline	24011	2.545
Carroll	24013	12.700
Cecil	24015	9.170
Charles	24017	17.988
Dorchester	24019	10.168
Frederick	24021	20.430
Garrett	24023	5.960
Harford	24025	30.040
Howard	24027	27.030

Kent	24029	2.265
Montgomery	24031	22.270
Prince Georges	24033	73.330
Queen Annes	24035	4.145
Saint Mary's	24037	7.108
Somerset	24039	2.865
Talbot	24041	5.180
Washington	24043	19.044
Wicomico	24045	8.960
Worcester	24047	20.259
Baltimore City	24510	73.000

D. Emissions Factors

The emission factor used to estimate VOC emissions from POTW sites is derived from the U.S. EPA's POTW Nonpoint Emissions Methodology and Operation (NEMO) instructions, Table 1 (see Appendix Table 1).[3] Per EPA, the VOC emissions factor was based on a TriTAC study.[4]

VOC emission factors for POTW SCCs are listed in table 3 below.

Table 3. 2023 NEI VOC emissions factors for POTW

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2630020000	Publicly Owned Treatment Work	VOC	0.85	lb/million gal	[5]

E. Controls

There are no controls available for this source category.

F. Emissions

Total VOC emissions for POTW are calculated by multiplying the activity data for the source category by the emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times 365\ days}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
$EF_{VOC,s}$ = VOC emissions factor for source category s (Table 3)

HAP emissions are estimated by multiplying the activity data for the source category by the emissions factor for that category (see Table 1 in Appendix).

$$\boldsymbol{E_{HAPc,s} = A_{c,s} \times EF_{HAP,s} \times 365\ days}$$

Where:

$E_{HAP,c,s}$ = Annual HAP emissions in county c for source category s, in tons per year

$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Table 2)
$EF_{HAP,s}$ = HAP emissions factor for source category *s* (see Table 1 in Appendix)

G. Point Source Subtraction

Since emissions for POTWs occur from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 2 of the Appendix.

Point source subtraction for this sector is completed at the county level through adjusting flow rate. Facility level annual flow from the mapped SCCs are summed to the county level, which yields the wastewater flow in the county associated with the point source category. The county flow rate is then adjusted downward by the point source million gallons/day flow. Nonpoint emissions are then estimated using the point source adjusted flow rate. The resultant emissions represent emissions only associated with nonpoint activity.

The point source flow estimates for POTW are outlined in Table 4 below.

Table 4: Point Source Wastewater Flow Adjustment for POTW (SCC 2630020000)

FIPS State and County Code	FIPS State Code	FIPS County Code	County Name	County Type	Postal State Code	Point Source Reduction Flow (million gal/day)
24001	24	001	Allegany	County	MD	0.00
24003	24	003	Anne Arundel	County	MD	0.00
24005	24	005	Baltimore	County	MD	180.00
24009	24	009	Calvert	County	MD	0.00
24011	24	011	Caroline	County	MD	0.00
24013	24	013	Carroll	County	MD	0.00
24015	24	015	Cecil	County	MD	0.00
24017	24	017	Charles	County	MD	0.00
24019	24	019	Dorchester	County	MD	0.00
24021	24	021	Frederick	County	MD	0.00
24023	24	023	Garrett	County	MD	0.00
24025	24	025	Harford	County	MD	0.00
24027	24	027	Howard	County	MD	0.00
24029	24	029	Kent	County	MD	0.00
24031	24	031	Montgomery	County	MD	0.00
24033	24	033	Prince George's	County	MD	30.00
24035	24	035	Queen Anne's	County	MD	0.00
24037	24	037	St. Mary's	County	MD	0.00
24039	24	039	Somerset	County	MD	0.00
24041	24	041	Talbot	County	MD	0.00

24043	24	043	Washington	County	MD	0.00
24045	24	045	Wicomico	County	MD	0.00
24047	24	047	Worcester	County	MD	0.00
24510	24	510	Baltimore	City	MD	0.00

H. Sample Calculations

Sample calculations for VOC emissions from PTOW in Anne Arundel County, Maryland are included in the table below.

Table 5. Sample Calculations of VOC emissions for POTW (SCC 2630020000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s} \times 365\ days}$	$\left(45.79\ million\frac{gallons}{day} \times 0.85\frac{lb/million\ gallons}{2000} \times 365 days\right)$	7.1032 tons of VOC in 2023

I. References

[1] U.S. EPA, 64FR57572, National Emission Standards for Publicly Owned Treatment Works, Final Rule, 40 CFR Part 63, 26 October 1999. https://www.gpo.gov/fdsys/pkg/FR-1999-10-26/pdf/99-27799.pdf

[2] U.S. Environmental Protection Agency, Clean Watersheds Needs Survey 2022 Data and Reports, 2022 CWNS Dataset by State, at https://sdwis.epa.gov/ords/sfdw_pub/f?p=148:5:12053774677728::NO::P5_STATE:MD

[3] U.S. Environmental Protection Agency. *POTWs NEMO.* Retrieved December 7, 2024. https://usepa.sharepoint.com/:w:/r/sites/NEI/_layouts/15/Doc.aspx?sourcedoc=%7BEA4B4D62-E14C-4086-8B7C-D3C54A93C289%7D&file=POTWs%20NEMO.docx&action=default&mobileredirect=true

[4] Prakasam Tata, Jay Witherspoon, Cecil Lue-Hing (eds.), VOC Emissions from Wastewater Treatment Plants: Characterization, Control, and Compliance, Lewis Publishers, 2003, p. 261.

[5] Prakasam Tata, Jay Witherspoon, Cecil Lue-Hing (eds.), VOC Emissions from Wastewater Treatment Plants: Characterization, Control, and Compliance, Lewis Publishers, 2003, p. 261.

APPENDIX

Table 1. Emissions Factors for Publicly Owned Treatment Works (SCC 2630020000)

Pollutant	Pollutant Codes	Emissions Factor (lbs./MMGAL)	Emissions Factor Reference(s)
1,1,2,2-Tetrachloroethane	79345	1.75E-06	A, B
1,1,2-Trichloroethane	79005	1.17E-06	A, B
1,2,4-Trichlorobenzene	120821	8.67E-05	A, B
1,3-Butadiene	106990	2.51E-05	A, B
1,4-Dichlorobenzene	106467	2.16E-04	A, B
1-Chloro-2,3-Epoxypropane	106898	4.52E-06	A, B
2,4-Dinitrotoluene	121142	4.81E-05	A, B
2-Nitropropane	79469	2.92E-07	A, B
Acetaldehyde	75070	3.10E-04	A, B
Acetonitrile	75058	3.45E-04	A, B
Acrolein	107028	3.84E-04	A, B
Acrylonitrile	107131	3.86E-04	A, B
Allyl Chloride	107051	1.94E-05	A, B
Ammonia	NH3	1.69E-01	C
Benzene	71432	6.73E-03	A, B
Benzyl Chloride	100447	8.17E-06	A, B
Biphenyl	92524	7.52E-05	A, B
Carbon Disulfide	75150	4.32E-03	A, B
Carbon Tetrachloride	56235	1.12E-03	A, B
Chlorobenzene	108907	4.83E-04	A, B
Chloroform	67663	6.44E-03	A, B
Chloroprene	126998	2.38E-05	A, B
Cresols/Cresylic Acid (Isomers and Mixture)	1319773	1.61E-06	A, B
Dimethyl Sulfate	77781	1.31E-06	A, B
Ethyl Acrylate	140885	1.75E-06	A, B
Ethyl Benzene	100414	7.66E-03	A, B
Ethylene Oxide	75218	2.22E-04	A, B
Formaldehyde	50000	1.97E-05	A, B
Glycol Ethers	171	1.15E-02	A, B
Hexachlorobutadiene	87683	7.29E-07	A, B
Hexachlorocyclopentadiene	77474	5.83E-07	A, B
Methanol	67561	1.14E-02	A, B

Pollutant	Pollutant Codes	Emissions Factor (lbs./MMGAL)	Emissions Factor Reference(s)
Methyl Chloroform	71556	5.63E-04	A, B
Methyl Isobutyl Ketone	108101	2.69E-03	A, B
Methyl Methacrylate	80626	3.11E-04	A, B
Methyl Tert-Butyl Ether	1634044	6.37E-05	A, B
Methylene Chloride	75092	9.10E-03	A, B
N,N-Dimethylaniline	121697	3.22E-04	A, B
Naphthalene	91203	1.31E-03	A, B
Nitrobenzene	98953	6.56E-06	A, B
O-Toluidine	95534	1.75E-06	A, B
P-Dioxane	123911	1.79E-05	A, B
Propionaldehyde	123386	3.50E-06	A, B
Propylene Dichloride	78875	1.15E-05	A, B
Propylene Oxide	75569	7.32E-04	A, B
Styrene	100425	2.73E-03	A, B
Tetrachloroethylene	127184	4.27E-03	A, B
Toluene	108883	1.23E-02	A, B
Trichloroethylene	79016	3.06E-04	A, B
Vinyl Acetate	108054	7.66E-05	A, B
Vinyl Chloride	75014	6.71E-06	A, B
Vinylidene Chloride	75354	4.23E-04	A, B
Volatile Organic Compounds	VOC	8.50E-01	D
Xylenes (Mixture of O, M, And P Isomers)	1330207	5.98E-02	A, B

A. Memorandum from Bob Lucas, U.S Environmental Protection Agency to Greg Nizich, U.S. Environmental Protection Agency, "Review of Baseline Emissions Inventory," 16 October 1998.

B. U.S. Environmental Protection Agency, "Facilities Database (Needs Survey) - Frequently Asked Questions," at https://permanent.access.gpo.gov/websites/epagov/www.epa.gov/OWM/mtb/cwns/1996rtc/faqwfd.htm, accessed 30 April 2019.

C. C: Stephen M. Roe, Melissa D. Spivey, Holly C. Lindquist, Kirstin B. Thesing, and Randy P. Strait, E.H. Pechan & Associates, Inc., Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report, prepared for U.S. Environmental Protection Agency, Emission Inventory Improvement Program, April 2004. https://www.epa.gov/sites/production/files/2015-08/documents/eiip_areasourcesnh3.pdf

D. Prakasam Tata, Jay Witherspoon, Cecil Lue-Hing (eds.), VOC Emissions from Wastewater Treatment Plants: Characterization, Control, and Compliance, Lewis Publishers, 2003, p. 261.

Table 2. Point-Nonpoint Crosswalk for Solvent Utilization for Publicly Owned Treatment Works (SCC 2630020000)

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint Description
50100701	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Entire Plant Not Elsewhere Classified	2630020000	Wastewater Treatment
50100702	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Primary Settling Tank	2630020000	Wastewater Treatment
50100703	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Secondary Settling Tank	2630020000	Wastewater Treatment
50100704	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Aeration Basin	2630020000	Wastewater Treatment
50100705	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Equalization Basin	2630020000	Wastewater Treatment
50100706	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Junction Box	2630020000	Wastewater Treatment
50100707	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Headworks Screening	2630020000	Wastewater Treatment
50100708	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Comminutor/Grinder	2630020000	Wastewater Treatment
50100710	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Collector Sewers	2630020000	Wastewater Treatment
50100711	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Manhole	2630020000	Wastewater Treatment
50100712	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Drain	2630020000	Wastewater Treatment
50100715	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Aerated Grit Chamber	2630020000	Wastewater Treatment
50100719	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Lift Station	2630020000	Wastewater Treatment
50100721	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Primary Clarifier	2630020000	Wastewater Treatment
50100731	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Diffused Air Activated Sludge Thickener	2630020000	Wastewater Treatment
50100732	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Mechanical Mix Air Activated Sludge	2630020000	Wastewater Treatment
50100733	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Pure Oxygen Activated Sludge	2630020000	Wastewater Treatment
50100734	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Trickling Filter	2630020000	Wastewater Treatment
50100740	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Secondary Clarifier	2630020000	Wastewater Treatment
50100750	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Tertiary Filters	2630020000	Wastewater Treatment

50100760	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Chlorine Contact Basin	2630020000	Wastewater Treatment
50100761	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Dechlorination	2630020000	Wastewater Treatment
50100765	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Effluent Weir	2630020000	Wastewater Treatment
50100769	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Storage Basin or Open Tank	2630020000	Wastewater Treatment
50100771	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Gravity Sludge Thickener	2630020000	Wastewater Treatment
50100772	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	DAF Sludge Thickener	2630020000	Wastewater Treatment
50100781	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Anaerobic Digester	2630020000	Wastewater Treatment
50100789	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Sludge Digester Gas Flare	2630020000	Wastewater Treatment
50100791	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Belt Filter Press	2630020000	Wastewater Treatment
50100792	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Sludge Centrifuge	2630020000	Wastewater Treatment
50100793	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Sludge Drying Bed	2630020000	Wastewater Treatment
50100795	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Sludge Storage Lagoons/Drying Beds	2630020000	Wastewater Treatment
50100799	Waste Disposal	Solid Waste Disposal - Government	Publicly Owned Treatment Works	Other Not Classified	2630020000	Wastewater Treatment

RESIDENTIAL WOOD COMBUSTION

Last Updated June 11, 2025

A. Source Category Description

Residential wood combustion (RWC) appliances, such as wood-burning fireplaces, woodstoves, and wood-burning hydronic heaters, are significant sources of air pollution in the United States—especially during winter months. The appliances create heat or ambience by combusting wood, firelogs or wood pellets. RWC emits large amounts of fine particulate matter (PM25-PRI), volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) that are known to contribute to poor human health, air quality, and visibility. Since the 2017 NEI, EPA has used an approach based on data from a national survey of woodburning activity conducted in 2018 by the Commission on Environmental Cooperation (CEC), the Northeast States for Coordinated Air Use Management (NESCAUM), and Abt Associates [ref 1]. The results of this survey were used, along with other data sources, to estimate county-level burning activity, as discussed in more detail below.

All active SCCs for the RWC sector are provided in Table 1; the last column indicates the SCCs that EPA estimates (as "X"). The SCC level 1 and 2 descriptions are "Stationary Source Fuel Combustion; Residential" for all SCCs.

Table 1: Active RWC SCCs, with EPA-estimated SCCs highlighted

SCC	SCC Level 3	SCC Level 4	RWC Subcategory	EPA
2104008011	Wood	Woodstove: non-certified wood stoves <=4FT3	Woodstoves	X
2104008012	Wood	Woodstove: non-EPA certified/exempt, >4FT3 (e.g., barrel stoves)	Woodstoves	X*
2104008021	Wood	Woodstove: EPA certified wood stoves non-catalytic	Woodstoves	X
2104008031	Wood	Woodstove: EPA certified, catalytic or hybrid	Woodstoves	X
2104008100	Wood	Fireplace: general	Fireplaces	X
2104008110	Wood	Fireplace: open	Fireplaces	
2104008120	Wood	Fireplace: enclosed (or otherwise modified)	Woodstoves	
2104008130	Wood	Fireplace: qualified for EPA voluntary program	Woodstoves	
2104008200	Wood	Woodstove: fireplace inserts; general	Woodstoves	
2104008210	Wood	Woodstove: fireplace inserts; non-EPA certified	Woodstoves	
2104008220	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic	Woodstoves	
2104008230	Wood	Woodstove: fireplace inserts; EPA certified; catalytic	Woodstoves	
2104008300	Wood	Woodstove: freestanding, general	Woodstoves	
2104008400	Wood	Woodstove: pellet-fired, general	Woodstoves	X
2104008410	Wood	Woodstove: pellet-fired, non-EPA certified (freestanding or FP insert)	Woodstoves	
2104008420	Wood	Woodstove: pellet-fired, EPA certified (freestanding or FP insert)	Woodstoves	

SCC	SCC Level 3	SCC Level 4	RWC Subcategory	EPA
2104008500	Wood	Furnace: Indoor, cordwood-fired, general	Central Heaters	X
2104008510	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified	Central Heaters	
2104008520	Wood	Furnace: Indoor, cordwood-fired, EPA certified	Central Heaters	
2104008530	Wood	Furnace: Indoor, pellet-fired, general	Central Heaters	X
2104008540	Wood	Furnace: Indoor, pellet-fired, non-EPA certified	Central Heaters	
2104008550	Wood	Furnace: Indoor, pellet-fired, EPA certified	Central Heaters	
2104008600	Wood	Hydronic heater: general, all types	Central Heaters	
2104008610	Wood	Hydronic heater: outdoor	Central Heaters	
2104008611	Wood	Hydronic heater: outdoor, non-EPA certified	Central Heaters	X
2104008612	Wood	Hydronic heater: outdoor, EPA certified	Central Heaters	X
2104008614	Wood	Hydronic heater: indoor, non-EPA certified	Central Heaters	X
2104008615	Wood	Hydronic heater: indoor, EPA certified	Central Heaters	X
2104008616	Wood	Hydronic heater: EPA certified	Central Heaters	
2104008620	Wood	Hydronic heater: indoor	Central Heaters	
2104008630	Wood	Hydronic heater: pellet-fired	Central Heaters	X
2104008640	Wood	Hydronic heater: meets NESCAUM phase II standards	Central Heaters	
2104008700	Wood	Outdoor wood burning device, NEC (fire-pits, chimineas, etc)	Other	X
2104009000	Firelog	Total: All Combustor Types	Other	X

* The barrel stove SCC (2104008012) is included in the Wagon Wheel (WW) tool, but EPA does not estimate emissions for this SCC due to a lack of activity data. Estimates will be generated only if States provide activity data to EIS/WW or submit direct emissions.

B. Overview of Calculations

The activity data for this category is the amount of wood burned in each county, which is based on data from a number of sources and a regression model. A regression model applied to data from the CEC survey was used to compute: 1) the fraction of homes in each county that use each type of wood-burning appliance ("appliance fraction"), and 2) the average amount of wood burned in each type of appliance by each home ("burn rate"). For some SCCs (those expected to not be prevalent in densely populated areas such as hydronic heaters), adjustments to the appliance fraction generated by the regression model were made to reduce the appliance fraction based on housing density. The product of housing counts, adjusted appliance fraction and burn rate results in the amount of wood burned (in cords for cordwood stoves and pellets for pellet appliances). For some SCCs, the wood burned is adjusted using state-level residential wood consumption from the Energy Information Administration's US State Energy Data System (SEDS)[ref 2]. Cords of wood are converted to tons using county-level density factors from the U.S. Forest Service [ref 3].

For the 2023 NEI an additional adjustment is applied to the county-level wood consumption. This adjustment, computed from microdata from the 2020 Residential Energy Consumption (RECS) survey, re-distributes the county level

consumption such that the urban and rural wood usage matches that from the survey's microdata state-level. This adjustment is made to the same SCCs as those for which the SEDS adjustment is applied.

More information on the sources of data and calculations for the amount of wood burned are discussed in section C. Emissions factors are discussed in section E. The estimation of emissions from RWC is discussed in section G.

C. Activity Data

The activity data (amount of wood burned) for RWC relies on a regression model developed from the CEC survey, along with other sources of data and assumptions that are used to make adjustments to the regression model's results. The CEC survey received 2,984 responses, and it asked questions about whether and how often the respondent used the different wood burning appliances and how much wood they burned annually. Note that the survey didn't ask how many appliances of each type were in the home, just the amount of wood by appliance type. It also asked demographic questions about the respondents. EPA used statistical regression approaches to develop appliance fractions and burn rates for each county, based on predictor variables from the survey responses. These predictor variables include:

- The number of heating degree days in 2017, by county, associated with the climate zone where the respondent lives, from the National Oceanic and Atmospheric Administration (NOAA) [ref 4].
- The population density (people per square mile) in 2017 of the county the respondent lives in, from the Census Bureau [ref 5].
- Whether the zip code where the respondent lives is considered urban or rural, according to data from the Census Bureau [ref 6].
- The percentage of forest cover in the county whether the respondent lives, according to the Biogenic Emissions Landuse Database (BELD, v4.1) [ref 7].
- The fraction of homes that use natural gas as a primary heat source in 2017 in the county where the respondent lives, according to data from the American Community Survey [ref 8].
- The type of home the respondent lives in (single family detached, single family attached, multifamily, mobile), based on responses in the CEC survey.

The regression analysis compared all respondents who said they used a given appliance type, such as a woodstove, to develop an equation based on each of these predictor variables. For example, survey respondents who lived in areas with more heating degree days (i.e. colder climates) or areas where few homes used natural gas as a primary heat source (i.e. they might not have much natural gas service) tended to be more likely to say that they used a given wood-burning appliance.

Table 2 lists the predictor variables used in the regression models to develop appliance fractions for each appliance type, along with the sign and significance of the coefficient. A plus sign indicates a positive coefficient, meaning a positive relationship between the variable and the fraction of homes in a county that use the appliance. For example, in the regression model for woodstoves, there is a positive relationship between homes that use woodstoves and heating degree days. This means that areas with more heating degree days (i.e., colder areas) are more likely to use woodstoves. Type of home (e.g., single family detached, multi-family) was also used as a predictor variable. In most cases, single family detached homes are more likely to use woodburning appliances and multifamily homes are less likely to use woodburning appliances.

Note that not all predictor variables were used for each regression model. If the coefficient of a predictor variable was significant at the 0.05 level (indicted in Table 2 by an asterisk), it was used in the model. If the sign on the coefficient matched expectations, it was used in the model, even if the coefficient was not statistically significant. For example, it was expected that there would be a negative relationship between percent of homes that use natural gas as a primary heat source and homes that burn wood, indicating that areas with more natural gas availability would be less likely to burn wood. The models for fireplace inserts, hydronic heaters, and furnaces found this relationship, but it was not

statistically significant. Nevertheless, this predictor variable was retained in the models for these appliances to improve the predictive ability of the regression equations.

Table 2. Predictor variables used to develop appliance fractions, along with the sign and significance of the coefficient estimated by the regression analysis

Predictor Variable	Fireplaces	Woodstoves	Fireplace Inserts	Hydronic Heaters	Furnaces	Outdoor Recreational Equipment
Heating Degree Days		+*		+*	+*	
Percent of Home that Use Natural Gas as Primary Heat Source	+*	-*	-	-	-	
Respondent is in Urban ZIP code	+	-*			-	-
Percentage of Forest Cover in County	+*	+	+	+		+
Population Density		-	-	-*	+*	
House Type: Mobile Homes	+	+	+*	-	+	-
House Type: Multi-family 3-5 Units	+	-*	-*	-*	-*	-*
House Type: Multi-family 6+ Units	+	-	-*	-*	-*	-*
House Type: Single Family Attached	+	+	+	-	+	+
House Type: Single Family Detached	+*	+*	+*	+	+	+

* Indicates the coefficient is significant at the 0.05 level.

The regression equation estimates the probability that a home in a given county, with a given set of predictor variables (using data from the inventory year), will use each type of wood-burning appliance. Therefore, when values of the predictor variables from each county are plugged into the equation, the result is a county-specific appliance fraction, which represents the fraction of homes in that county that use each type of wood-burning appliance. For example, urban counties with a low number of heating degree days, high population density, low forest cover, and many homes using natural gas tend to have a low appliance fraction for most appliances. County-specific appliance fractions are calculated separately for six appliance types: fireplaces, fireplace inserts, free-standing woodstoves, pellet stoves, central heaters (e.g. wood hydronic heaters or furnaces), and outdoor recreational equipment (such as fire pits). For the 2023 NEI, predictor variables with 2023 data will be used with the regression equations to estimate appliance fractions. The process for splitting or aggregating these appliance types into each of the 15 SCCs is discussed below. Wax firelogs were not included in the survey and therefore appliance fractions for that SCC were pulled forward from the 2014 NEI, which was mostly based on expert judgment.

Burn rates, which represent the annual average amount of wood burned by each type of appliance in a home, are also calculated using regression analysis and the same predictor variables listed above. When county-level values of the predictor variables are plugged into the burn rate regression equation, the result is county-specific burn rates for each appliance type. The burn rates are estimated for each of the same 6 appliance types as the appliance fractions. Predictor variables and the sign and significance of the estimated coefficients are shown in Table 3.

Table 3. Predictor variables used to develop burn rates, along with the sign and significance of the coefficient estimated by the regression analysis.

Predictor Variable	Fireplaces	Woodstoves	Fireplace Inserts	Hydronic Heaters	Furnaces	Outdoor Recreational Equipment
Heating Degree Days	-	+		+	+	
Percent of Home that Use Natural Gas as Primary Heat Source				-		
Respondent is in Urban ZIP code	-	-*				

Predictor Variable	Fireplaces	Woodstoves	Fireplace Inserts	Hydronic Heaters	Furnaces	Outdoor Recreational Equipment
Percentage of Forest Cover in County	-	+	+*			
Population Density	-*	-	-		-	
House Type: Mobile Homes	+	-	-	+*	+*	+
House Type: Multi-family 3-5 Units	+*	-*				
House Type: Multi-family 6+ Units	-*	-*				
House Type: Single Family Attached	+*	-*	+*	+*	+*	+
House Type: Single Family Detached	+*	-*	+*	+*	+*	+

* Indicates the coefficient is significant at the 0.05 level.

Note that starting with the 2023 NEI, a new SCC structure is used in which freestanding woodstoves and fireplace inserts are aggregated into a single set of SCCs for all woodstoves (with separate SCCs for non-catalytic, catalytic, and non-EPA certified), as shown in Table 1. The appliance fractions and burn rates are estimated separately for freestanding woodstoves and fireplace inserts, and the total amount of wood consumed by both appliance types in each county is summed together.

After an initial review of the wood-burning activity predicted by the appliance fractions and burn rates developed from the CEC survey data, EPA decided to make two adjustments to the estimates. The first adjustment applies to central heaters and outdoor recreational equipment. After an initial review of predicted wood-burning activity, EPA felt that the estimated amount of wood burned in these appliances in dense urban areas was unreasonably high. Therefore, EPA developed an adjustment factor based on the housing density (homes/mi^2) in each county, based on the equation for a sigmoid curve. The housing density adjustment factor is calibrated such that it approaches 0 when county-level housing density approaches 1,000 homes/mi^2. The housing density adjustment factor is multiplied by the predicted wood-burning activity only for central heating appliances (wood hydronic heaters and furnaces) and outdoor recreational wood-burning appliances.

$$HAF_c = -\frac{1}{1 + e^{-0.01\,(HD_c - 500)}} + 1 \qquad (1)$$

Where:

HAF_s = Housing density adjustment factor for county *c*
HD_c = Housing density in county *c,* in homes/mi^2

The appliance fractions are then adjusted using the housing density adjustment factor.

$$AF_{c,a} = HAF_c \times AF_{unadj,c,a} \qquad (2)$$

Where:

$AF_{c,a}$ = Adjusted appliance fraction for appliance type *a* in county *c*
HAF_s = Housing density adjustment factor for county *c*
$AF_{unadj,c,a}$= Appliance fraction for appliance type *a* in county *c*, determined from the CEC survey

In some cases, the regression model predicts appliance fractions of 0 for certain counties and appliance types, particularly in dense urban areas. In these cases, the burn rates for those counties and appliances are also set to 0.

The appliance fractions and burn rates are multiplied by the number of occupied homes in each county from the 2023 American Community Survey [ref 9] using the 5-year average for the current data year to estimate the amount of wood

burned in each county, in cords or tons, depending on whether the appliance burns cordwood or pellets. For devices that burn cordwood, the estimated number of cords burned in each county is multiplied by a county-level wood density factor from the U.S. Forest Service.[Error! Bookmark not defined.]

$$W_{c,a} = H_c \times AF_{c,a} \times BR_{c,a} \times D_c \quad (3)$$

Where:

- $W_{c,a}$ = Amount of wood burned in appliance type *a* in county *c*, in tons per year
- H_c = Number of occupied homes in county *c*
- $AF_{c,a}$ = Adjusted appliance fraction for appliance type *a* in county *c*
- $BR_{c,a}$ = Burn rate for appliance type *a* in county *c*, determined from the CEC survey, in cords or tons burned per appliance
- D_c = Wood density factor for county *c*, in tons per cord of wood (used only for cordwood appliance types)

As discussed above, the appliance fractions and burn rates are used to estimate wood-burning activity at the appliance level in each county. This activity for certain appliance types must be distributed from the appliance level to the specific SCC level. For example, wood burned in "woodstoves" must be apportioned to three SCCs: non-EPA certified stoves, EPA certified non-catalytic stoves, and EPA certified catalytic stoves. For woodstoves and fireplace inserts, EPA used distribution profiles based on a combination of census-region-level data from the EIA Residential Energy Consumption Survey (RECS) to determine whether woodstoves or fireplace inserts are EPA certified. Although RECS does not specifically ask whether the woodstove is EPA certified, it does ask the age of the appliance. It is assumed that any appliance in the oldest age bin in RECS (20 years or older) is uncertified.[1] All appliances less than 20 years old are assumed to be EPA certified. The split between EPA certified non-catalytic and catalytic stoves is based on an analysis of stove sales data from 2017 to 2021 [ref 10], which suggests that certified stoves are 80 percent non-catalytic and 20 percent catalytic. The distribution profiles for woodstoves and fireplace inserts are shown in Table 4.

The CEC survey data were seen to be more reliable for developing distribution profiles for central heaters, i.e., wood hydronic heaters and furnaces. Survey respondents listed whether they owned a furnace or a hydronic heater, whether it was located inside or outside the home, and whether it burned cordwood or pellets. These responses were used to develop distribution profiles for the central heaters, which are shown in Table 5. However, because the SCCs for the 2023 NEI were expanded to delineate certified versus uncertified units for hydronic heaters (as they have different emission factors), the Table 5 distribution factors need to be further disaggregated. To do this, we assumed that 95% of hydronic heaters are uncertified cordwood and the remaining hydronic heater types are equally distributed across the remaining 5%. The resulting central heater distributions (with adjustments to ensure the sum of the factors is equal to 1) is provided in Table 6.

The default distribution profiles are estimated at the Census Region level for woodstoves and fireplace inserts and nationally for central heaters, but the RWC tool allows the profiles to be adjusted for each county. Not all appliance types need to be distributed. Appliance populations of fireplaces, pellet stoves, and outdoor recreational equipment are estimated directly from the regression equations and are not multiplied distribution fractions.

The amount of wood-burning activity in each SCC in each county is determined by multiplying the county-level wood-burning activity by appliance type by the distribution profile for each SCC.

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[1] A 20-year-old appliance in the 2020 RECS would have been manufactured in 2000, which is after the 1988 NSPS for wood stoves. However, this is the oldest age bin in RECS. EPA lacks data on the fraction of appliances in this age bin that were manufacturer before or after 1988. Therefore, EPA assumed that all appliances in this age bin were uncertified.

$$W_{c,SCC} = W_{c,a} \times DP_{SCC} \quad (4)$$

Where:

$W_{c,SCC}$ = Amount of wood burned in each SCC in county *c*, in tons per year
$W_{c,a}$ = Amount of wood burned in appliance type *a* in county *c*, in cords or tons per year, from equation 1
DP_{SCC} = Distribution profile for each SCC from Table 4 or Table 6, depending on the appliance type

Table 4. Distribution profiles for woodstoves and fireplace inserts by Census Region

Woodstove or Fireplace Insert Type	Census Region			
	NE	MW	S	W
Uncertified	0.16	0.12	0.31	0.31
Certified Catalytic	0.17	0.18	0.14	0.14
Certified Non-catalytic	0.67	0.70	0.55	0.55

Table 5. Distribution profiles for central heaters from the CEC Survey

Type of Central Heater	SCC	Distribution Profile
Indoor pellet hydronic heater	2104008630	0.01
Indoor pellet furnace	2104008530	0.03
Indoor cordwood hydronic heater	2104008620	0.23
Indoor cordwood furnace	2104008510	0.37
Outdoor cordwood hydronic heater	2104008610	0.36

Table 6. Resulting distribution profiles for all central heaters SCCs

Type of Central Heater	SCC	Distribution Profile
Pellet hydronic heater	2104008630	0.01
Indoor pellet furnace	2104008530	0.03
Indoor cordwood hydronic heater – certified	2104008615	= 0.23*5% = 0.0115
Indoor cordwood hydronic heater – non-certified	2104008614	=0.23*95%=0.2185
Indoor cordwood furnace	2104008500	0.37
Outdoor cordwood hydronic heater – certified	2104008612	=0.36*5%=0.018
Outdoor cordwood hydronic heater, non-EPA certified	2104008611	=0.36*95%=0.342

The second adjustment EPA made to the predicted wood consumption corrects the total wood-burning activity in each state. The amount of residential wood-burning activity initially predicted by the appliance fractions and burn rates was significantly higher than the state-level totals reported by EIA's State Energy Data System (SEDS) [ref 2] for most states. As a result, EPA developed an adjustment factor to normalize the state-level residential wood-burning activity predicted by the tool to the amount predicted by SEDS. The SEDS adjustment factor is developed by summing the predicted amount of wood-burning activity to the state level in each state and dividing it by the state-level amount of residential wood consumption reported by SEDS. SEDS reports wood consumption in Btu, rather than cords; therefore the wood-burning activity predicted by the RWC tool is converted from cords to Btu using a conversion factor of 20 million Btu per cord, from the SEDS documentation [ref 11], use_technotes.pdf (eia.gov), or 16.4 million Btu per ton of pellets [ref 12]. In addition, SEDS only includes wood consumption for residential heating; therefore, predicted wood consumption from outdoor recreational wood-burning (2104008700) and wax firelogs (2104009000) are not summed to calculate the SEDS

adjustment.

In 2018, SEDS updated the methodology for estimating state-level residential wood consumption. Previously, SEDS estimated residential wood consumption using state-level data from the 2009 Residential Energy Consumption Survey (RECS), and for states that did not have data, using ACS data on housing units to allocate the national estimate of wood consumption from RECS. From 2018 forward, SEDS began using national-level data on wood consumption from the Monthly Energy Review (MER), which, for the version of 2023 SEDS used for the NEI, is based on data from the 2020 RECS, with projections based on the Annual Energy Outlook. SEDS allocates the national-level wood consumption to the state level using a combination of data from the American Community Survey on the number of housing units that use wood as a primary heat source and data on heating degree days [ref 13].

$$SAF_s = \frac{W_{s,SEDS}}{\sum W_{c,SCC}} \quad (5)$$

Where:

SAF_s = SEDS adjustment factor for state *s*
$W_{c,SCC}$ = Amount of wood burned in each SCC in county *c*, in BBtu
$W_{s,SEDS}$ = Amount of wood consumption in state *s* reported by SEDS, in BBtu

Analysis of the RECS microdata shows that both the fraction of homes burning wood and the amount of wood burned in urban areas tends to be lower than the fraction of urban wood burning homes estimated by the Wagon Wheel for most states. Similarly, rural wood burning fractions among RECS survey respondents tend to be higher than urban wood burning fractions estimated by the Wagon Wheel for most states. To better align with state-level urban and rural wood burning fractions calculated using RECS microdata, an urban/rural adjustment is applied.

The RECS microdata indicates the amount of wood burned by respondent and whether the respondent lives in an urban or rural census tract, as defined by the Census Bureau. RECS rural and urban consumption across respondents is summed to the state level to calculate the urban and rural fractions.

$$Frac_{s,\frac{urban}{rural},RECS} = \frac{\sum W_{s,\frac{urban}{rural},RECS}}{\sum W_{s,total,RECS}} \quad (6)$$

Where:

$Frac_{s,urban/rural/RECS}$ = Fraction of wood consumption in state *s* that is urban or rural according to RECS
$W_{s,urban/rural,RECS}$ = Wood consumption in state *s* that is urban or rural from the RECS survey
$W_{s.total,RECS}$ = Total wood consumption in state *s* from the RECS survey

The RECS urban and rural fractions are compared to those derived from the Wagon Wheel data. To do this we first determine the amount of urban and rural wood consumption estimated by the Wagon Wheel, based on the fraction of urban and rural homes in each county. Note that because the RECS survey is focused on wood consumption for heating, outdoor recreational burning and wax firelogs are excluded from these calculations.

$$W_{c,\frac{urban}{rural},WW} = W_{c,total,WW} \times \frac{OccupiedHomes_{c,\frac{urban}{rural}}}{OccupiedHomes_{c,total}} \quad (7)$$

Where:

$W_{,c,urban/rural/WW}$ = Fraction of wood consumption in county *c* that is urban or rural according to the Wagon Wheel
$W_{,c,total,WW}$ = Total wood consumption (tons) in county *c* from the Wagon Wheel

$OccupiedHomes_{c,urban/rural}$ = Number of urban or rural occupied homes from county *c*
$OccupiedHomes_{c,total}$ = Total number of occupied homes from county *c*

Urban and rural wood consumption is then summed to the state level and divided by the total wood consumption in the state to develop urban and rural fractions for the Wagon Wheel estimations.

$$Frac_{s,\frac{urban}{rural},WW} = \frac{\sum W_{c,\frac{urban}{rural},WW}}{\sum W_{c,total,WW}} \quad (8)$$

Where:

$Frac_{s,urban/rural/WW}$ = Fraction of wood consumption in state *s* that is urban or rural according to the Wagon Wheel
$W_{c,urban/rural,WW}$ = Wood consumption in county *c* that is urban or rural according to the Wagon Wheel
$W_{c.total,WW}$ = Total wood consumption in county *c* according to the Wagon Wheel

The adjustment factor is calculated by dividing the RECS urban or rural wood consumption by the WW urban or rural wood consumption for the state (Table 7).

$$AF_{s,urban/rural} = \frac{Frac_{s,\frac{urban}{rural},RECS}}{Frac_{s,\frac{urban}{rural},WW}} \quad (9)$$

Where:

$AF_{s,urban/rural}$ = Urban or rural adjustment factor for state *s*
$Frac_{s,urban/rural,RECS}$ = Fraction of wood consumption in state *s* that is urban or rural according to RECS
$Frac_{s,urban/rural,WW}$ = Fraction of wood consumption in state *s* that is urban or rural according to the WW

Table 7. State-Level Adjustment Factors

State	Rural Adjustment Factor	Urban Adjustment Factor
AK	1.86	0.46
AL	1.85	0.24
AR	1.60	0.38
AZ	3.38	0.60
CA	5.32	0.45
CO	2.36	0.60
CT	2.74	0.60
DC	N/A	1.00
DE	2.12	0.67
FL	4.39	0.42
GA	1.95	0.41
HI	0.00	1.18
IA	1.93	0.20
ID	1.73	0.46
IL	1.88	0.70

State	Rural Adjustment Factor	Urban Adjustment Factor
IN	2.29	0.22
KS	1.55	0.71
KY	1.30	0.59
LA	0.51	1.28
MA	3.48	0.64
MD	1.75	0.79
ME	1.32	0.35
MI	1.83	0.40
MN	2.15	0.09
MO	1.32	0.74
MS	1.14	0.81
MT	1.53	0.35
NC	1.73	0.41
ND	1.49	0.30
NE	1.68	0.48
NH	1.43	0.61
NJ	3.28	0.74
NM	2.65	0.37
NV	3.51	0.67
NY	1.92	0.47
OH	2.72	0.19
OK	1.47	0.64
OR	2.27	0.60
PA	2.28	0.31
RI	5.88	0.38
SC	2.00	0.40
SD	1.26	0.64
TN	1.62	0.50
TX	1.78	0.72
UT	4.22	0.45
VA	1.43	0.60
VT	1.27	0.36
WA	1.93	0.72
WI	1.81	0.25
WV	1.57	0.22
WY	1.33	0.74

Urban and rural wood consumption in each county is multiplied by the urban or rural adjustment factor for that state along with the SEDS adjustment factor. Note that the wood consumption in this calculation has already been adjusted using the housing adjustment factor, in equations 1-4. This following calculation further adjusts the wood consumption to redistribute consumption to match urban and rural consumption patterns from RECS and to align with EIA's SEDS estimates.

$$Wadj_{c,urban/\,rural} = W_{c,urban/rural,WW} \times AF_{s,urban/rural} \times SAF_s \quad (10)$$

Where:

$Wadj_{c,urban/rural}$ = Adjusted urban or rural wood burned in county *c*
$W_{c,urban/rural,WW}$ = Unadjusted urban or rural wood burned in county *c* according to the WW
$AF_{s,urban/rural}$ = Urban or rural adjustment factor in state *s*
SAF_s = SEDS adjustment factor for state *s*

Finally, the total adjusted wood consumption in each county is determined by adding the adjusted urban and rural wood consumption in each county.

$$AW_{c,SCC} = Wadj_{c,urban,WW} + Wadj_{c,rural,WW} \quad (11)$$

Where:

$AW_{c,SCC}$ = Adjusted amount of wood burned in each SCC in county *c*, in tons per year
$Wadj_{c,urban,WW}$ = Adjusted urban wood burned in county *c*
$Wadj_{c,rural,WW}$ = Adjusted rural wood burned in county *c*

In summary, regression data from the CEC survey was used to estimate wood activity, with several adjustments applied at different stages in the process. For convenience, the adjustments that impact the each of the SCCs is in Table 8 provided below.

Table 8. Wagon Wheel RWC SCCs, summary of adjustments

SCC	**SCC Level 3**	**SCC Level 4**	**CEC Survey appliance type**	**Appliance fraction Housing Density adjustment**	**SEDS adjustment**	**Urban/ Rural adjustment**
2104008011	Wood	Woodstove: non-certified wood stoves <=4FT3	Woodstoves; fireplace inserts	N	Y	Y
2104008012	Wood	RWC: non-certified wood stoves >4FT3 (e.g., barrel stoves)	Woodstoves; fireplace inserts	N	Y	Y
2104008021	Wood	Woodstove: EPA certified wood stoves non-catalytic	Woodstoves; fireplace inserts	N	Y	Y
2104008031	Wood	Woodstove: EPA certified, catalytic or hybrid	Woodstoves; fireplace inserts	N	Y	Y
2104008100	Wood	Fireplace: general	Fireplaces	N	Y	Y
2104008400	Wood	Woodstove: pellet-fired, general	Woodstoves	N	Y	Y
2104008500	Wood	Furnace: Indoor, cordwood-fired, general	Central Heaters	Y	Y	Y
2104008530	Wood	Furnace: Indoor, pellet-fired, general	Central Heaters	Y	Y	Y

SCC	SCC Level 3	SCC Level 4	CEC Survey appliance type	Appliance fraction Housing Density adjustment	SEDS adjustment	Urban/ Rural adjustment
2104008611	Wood	Hydronic heater: outdoor, non-EPA certified	Central Heaters	Y	Y	Y
2104008612	Wood	Hydronic heater: outdoor, EPA certified	Central Heaters	Y	Y	Y
2104008614	Wood	Hydronic heater: indoor, non-EPA certified	Central Heaters	Y	Y	Y
2104008615	Wood	Hydronic heater: indoor, EPA certified	Central Heaters	Y	Y	Y
2104008630	Wood	Hydronic heater: pellet-fired	Central Heaters	Y	Y	Y
2104008700	Wood	Outdoor wood burning device, NEC (fire-pits, chimeas, etc.)	Outdoor wood burning device, NEC (fire-pits, chimeas, etc.)	Y	N	N
2104009000	Firelog	Total: All Combustor Types	Firelogs	N	N	N

D. Allocation Procedure

Appliance fractions and burn rates are calculated at the county-level. There is no need to allocate data to the county level for this category.

E. Emissions Factors

Emissions factors for RWC come primarily from AP-42 [ref 14] and Houck and Eagle (2006) [ref 15], but also from Traviss et al. (2024) [ref 16]. Emissions factors for wax firelogs are from Li and Rosenthal (2006) [ref 17]. Additional emission factors are taken from Houck et al. (2001) [ref 18] and Aurell et al. (2012) [ref 19]. Emission factors for condensable PM (PM-CON) were developed using EPA's PM Augmentation Tool, and emission factors for filterable PM (PM25-FIL and PM10-FIL) were calculated by taking the difference between the primary PM emission factors and the PM-CON factor for each appliance.

A complete list of emission factors for all RWC SCCs and pollutants are provided in the "RWC EFs" worksheet in the workbook "RWC 2023 EF compendium_15nov2024.xlsx" available on the 2023 NEI Supplemental nonpoint data FTP site. Emission factors and sources for 2020 emission factors are also provided for comparison in this worksheet.

F. Controls

There are no controls assumed for this category. However, SLT agencies may submit state- or county-level control factors that will adjust the emissions by SCC.

G. Emissions

Emissions from RWC are calculated by multiplying the adjusted amount of wood burned in each SCC in each county by SCC- and pollutant-specific emissions factors from the RWC EF compendium available on the 2023 NEI Supplemental nonpoint data FTP site.

$$E_{c,SCC,p} = AW_{c,SCC} \times EF_{SCC,p} \quad (12)$$

Where:

$E_{c,SCC,p}$ = Emissions of pollutant *p* from each SCC in county *c*
$AW_{c,SCC}$ = Adjusted amount of wood burned in each SCC in county *c*, in tons per year
$EF_{SCC,p}$ = Emissions factor for pollutant *p* for each SCC, from Table 4

H. Point Source Subtraction

There are no point source-specific SCCs for RWC; therefore, point source subtraction is not performed for this category.

I. Sample Calculations

Table 9 lists sample calculations for the estimation of emissions of PM25-PRI from non-EPA certified wood stoves in Delaware County, OH (39041).

Note that the appliance fractions and burn rates provided in the input templates already consider the housing density and SEDS adjustments. Therefore, the input templates for RWC do not ask SLT agencies to submit values for the housing density or SEDS adjustments. Rather, SLT agencies need only to submit revisions to the appliance fractions and burn rates themselves. Equations 4 and 5 are included here only to provide more information about how the appliance fractions and burn rates were adjusted.

Table 9. Sample calculations for PM25-PRI emissions from non-EPA certified woodstoves ≤ 4ft^3 (SCC 2104008011) in Delaware County, OH

Eq. #	Equation	Values for Delaware County, OH	Result
1	$HAF_c = -\frac{1}{1+e^{-0.01\,(HD_c-500)}} + 1$	*This equation is not applied for woodstoves*	n/a
2	$AF_{c,a} = HAF_c \times AF_{unadj,c,a}$	*This equation is not applied for woodstoves*	n/a
3	$W_{c,a} = H_c \times AF_{c,a} \times BR_{c,a} \times D_c$	71,521 homes × 0.0751 × 1.9304 × 1.643 tons/cord	17,028 tons of wood burned in woodstoves
4	$W_{c,SCC} = W_{c,a} \times DP_{SCC}$	17,028 × 0.12	2,043.4 tons of wood burned in non-EPA certified woodstoves
5	$SAF_s = \frac{W_{s,SEDS}}{\sum W_{c,SCC}}$	$\frac{18{,}147\ BBtu}{17{,}780\ BBtu}$	1.02 SEDS adjustment factor
6.1	$Frac_{s,urban,RECS} = \frac{\sum W_{s,urban,RECS}}{\sum W_{s,total,RECS}}$	$\frac{2{,}900{,}545{,}796.7}{22{,}232{,}155{,}310.8}$	0.13 RECS urban fraction
6.2	$Frac_{s,rural,RECS} = \frac{\sum W_{s,rural,RECS}}{\sum W_{s,total,RECS}}$	$\frac{19{,}331{,}609{,}514}{22{,}232{,}155{,}310.8}$	0.87 RECS rural fraction
7.1	$W_{c,urban,WW} = W_{c,total,WW} \times \frac{OccupiedHomes_{c,urban}}{OccupiedHomes_{c,total}}$	$2{,}043.4 \times 0.8$	1,641.6 tons of wood burned in urban counties

Eq. #	Equation	Values for Delaware County, OH	Result
7.2	$W_{c,rural,WW} = W_{c,total,WW} \times \frac{OccupiedHomes_{c,rural}}{OccupiedHomes_{c,total}}$	$2{,}043.4 \times 0.2$	401.8 tons of wood burned in rural counties
8.1	$Frac_{s,urban,WW} = \frac{\sum W_{s,urban,WW}}{\sum W_{s,total,WW}}$	$\frac{1{,}641.6}{2{,}043.4}$	0.68 WW urban fraction
8.2	$Frac_{s,rural,WW} = \frac{\sum W_{s,rural,WW}}{\sum W_{s,total,WW}}$	$\frac{401.8}{2{,}043.4}$	0.32 WW rural fraction
9.1	$AF_{s,urban} = \frac{Frac_{s,urban,RECS}}{Frac_{s,urban,WW}}$	$\frac{0.13}{0.68}$	0.19 urban adjustment
9.2	$AF_{s,rural} = \frac{Frac_{s,rural,RECS}}{Frac_{s,rural,WW}}$	$\frac{0.87}{0.32}$	2.75 rural adjustment
10.1	$Wadj_{c,urban} = W_{c,urban,WW} \times AF_{s,urban} \times SAF_s \times HAF_c$	$1{,}641.6 \times 0.19 \times 1.02$	319.4 tons of urban wood
10.2	$Wadj_{c,rural} = W_{c,rural,WW} \times AF_{s,rural} \times SAF_s \times HAF_c$	$401.8 \times 2.75 \times 1.02$	1,129.6 tons of rural wood
11	$AW_{c,SCC} = Wadj_{c,rural,WW} + Wadj_{c,rural,WW}$	$1{,}129.6 + 319.4$	1,449 tons of wood burned
12	$E_{c,SCC,p} = AW_{c,SCC} \times EF_{SCC,p}$	1,449 × 30.6 lb/ton	44,339 lbs. (22.17 tons) PM25-PRI from non-EPA certified woodstoves ≤ 4 ft^3 in Delaware County, OH

J. Changes from 2020 Methodology

SCCs were updated for the 2023 NEI. In addition, emission factors were updated, as described in section E, and emissions factors for GHG emissions were added.

Based on an analysis of RECS microdata that suggested the NEI has historically overestimated wood burning in urban areas and underestimated wood burning in rural areas, the methodology was updated in 2023 to include an urban/rural adjustment. This adjustment redistributes wood consumption and associated emissions in most states from urban areas to rural areas.

Current year inputs (e.g., 2023 climate and housing data) will be plugged into the regressions for estimating appliance fractions and burn rates for the 2023 NEI.

In addition, based on a review of stove sales data (2017 to 2021) required to be reported per the 2015 Subpart AAA - Standards of Performance for New Residential Wood Heaters, the distribution profiles for stoves were updated to reflect an assumption that certified stoves are 80% non-catalytic and 20% catalytic. While the sales data were not complete, and only account for new sales, there were over 500,000 units reported. The distribution used in previous NEIs was 60% non-catalytic and 40% catalytic. Distribution profiles for hydronic heaters were added in order to estimate wood burned associated with the new hydronic heater SCCs (which break out the indoor and outdoor hydronic heaters into certified and uncertified types) based on an assumption that 95% of wood-burning hydronic heaters are certified and 5% are uncertified.

It should be noted that in December 2024, Kilkeny et. al. published a paper[20] providing results of a survey of 210 respondents (with a high proportion of them in Oregon – per Figure 1, it looks like 60 or so) that reported that approximately 30% of freestanding and inserts were catalytic and 70% were noncatalytic (or unknown). While this supports that the previous catalytic estimate of 40% is too high, we decided to keep the 80/20 non-catalytic/catalytic split as the national default because the survey was not representative.

K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, so emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emission factor. For each Puerto Rico and US Virgin Island County, the tons per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

L. References

1. CEC. 2019. Residential Wood Use Survey to Improve Black Carbon Emissions Inventory Data for Small-Scale Biomass Combustion. Montreal, Canada: Commission for Environmental Cooperation.
2. Energy Information Administration. 2023. State Energy Data System. https://www.eia.gov/state/seds/
3. U.S. Department of Agriculture (USDA). 2009. "Timber Products Output Survey," U.S. Forest Service, retrieved via query from https://www.fs.usda.gov/srsfia/php/tpo_2009/tpo_rpa_int1.php
4. NOAA. 2019. Degree Days Statistics. Washington, DC: National Weather Service, Climate Prediction Center. https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/degree_days/
5. U.S. Census Bureau. 2019. County Population Totals and Components of Change: 2010-2018. Washington, DC. https://www.census.gov/programs-surveys/popest/data/data-sets.2017.html
6. U.S. Census Bureau. 2018. Urban and Rural. Washington, DC. https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html
7. U.S. Environmental Protection Agency. 2018. Biogenic Emissions Sources. https://www.epa.gov/air-emissions-modeling/biogenic-emission-sources
8. U.S. Census Bureau. 2018. American Community Survey. Washington, DC. https://www.census.gov/programs-surveys/acs
9. U.S. Census Bureau. 2024. American Community Survey. Washington, DC. https://www.census.gov/programs-surveys/acs.
10. Email correspondence between John Crouch, HPBA and Madeleine Strum, EPA "RE catalytic vs noncatalytic question – for the national emissions inventory.msg", available on the 2023 NEI Supplemental nonpoint data FTP site
11. Energy Information Administration. 2022. State Energy Data System 2020: Consumption Technical Notes. https://www.eia.gov/state/seds/sep_use/notes/use_technotes.pdf.
12. U.S. Forest Service. 2024. Tech Line: Fuel Value Calculator. https://www.fpl.fs.usda.gov/documnts/techline/fuel-value-calculator.pdf
13. Energy Information Administration. 2024. State Energy Data System 2022: Consumption Technical Notes, Section 5: Renewable Energy. https://www.eia.gov/state/seds/sep_use/notes/use_renew.pdf
14. U.S. Environmental Protection Agency. 1996. AP-42, Fifth Edition, Chapter 1 External Combustion Sources, Sections 1.9 Residential Fireplaces and 1.10 Residential Wood Stove.

15. Houck, J.E. and B.N. Eagle. 2006. Task 6 Technical Memorandum 4 (Final Report): Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA.
16. Traviss, N., G. Allen, and M. Ahmadi. 2024. Criteria, Greenhouse Gas, and Hazardous Air Pollutant Emissions Factors from Residential Cordwood and Pellet Stoves Using an Integrated Duty Cycle Test Protocol. ACS ES&T Air, *1*(9), 1190-1202. https://doi.org/10.1021/acsestair.4c00135
17. Li, V.S. and S.R. Rosenthal. 2006. Content and Emission Characteristics of Artificial Wax Firelogs. Poster presentation at 15th International Emission Inventory Conference. New Orleans, Louisiana. May 15-18, 2006.
18. Houck, J.E., J. Crouch, and R.H. Huntley. 2001. Review of Wood Heater and Fireplace Emission Factors. Technical presentation at the International Emission Inventory Conference. Denver, CO.
19. Aurell, J., B.K. Gullett, D. Tabor, et al. 2012. Semivolatile and Volatile Organic Compound Emissions from Wood-Fired Hydronic Heaters. Environmental Science and Technology, 46: 7898-7904.
20. Kilkenny, K., S. Zhang, N. MacCarty. 2024. Residential wood heat in the US: Results of a survey investigating user behavior and operation of wood heating appliances. Energy and Buildings, Volume 324: 114911 (https://doi.org/10.1016/j.enbuild.2024.114911.)

Appendix: HAP Metal Emission Factors

Overview

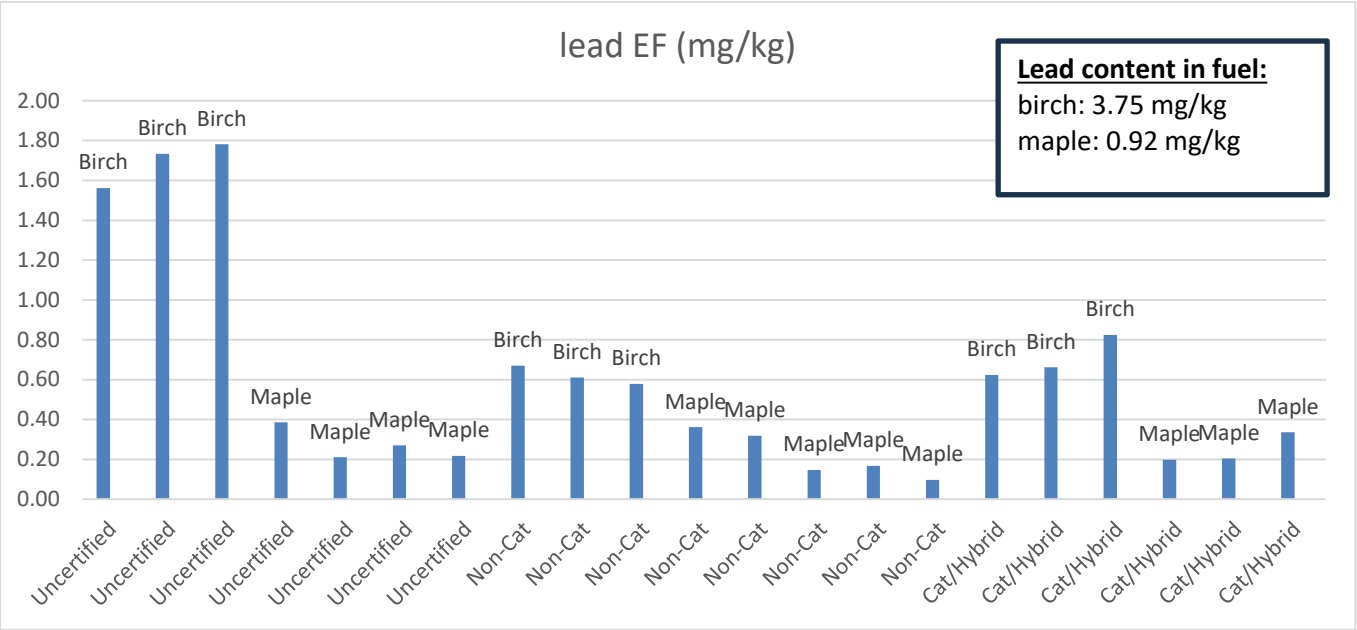
Emission factors for lead and other HAP metals (arsenic, cadmium, manganese, nickel) were developed using run-specific data (rather than the reported averages by appliance type) from Traviss, et. al, 2024 [ref A-1]. For these metal HAP, we developed wood-species specific (i.e., birch and maple) emission factors (EF) by cordwood appliance type (non-catalytic, catalytic, and uncertified) using the data developed for the Traviss et. al 2024 paper [ref A-1]. We then weighted the birch and maple EFs by the relative prevalence of the two species using the same tree species information we use to estimate county-level wood density for the NEI [2]. We devised this approach initially for lead but chose to use it for all the metal/ion constituents. The approach assumes that the lead emissions are more influenced by the fuel than the appliance. The finding stated by Traviss, et. all 2024 [ref A-1] that "There were no significant differences in Pb, Mn, and Cd EFs between cordwood technology types" supports this assumption for lead, manganese, and cadmium, and we chose to additionally use the approach for nickel and arsenic even though the data did not show that (plots of all metal runs are provided in the section "Other metal HAP EFs"). In particular, they found, wood fuel species type influenced Pb, Cd, and Mn emissions from two of the three stove types, with birch hardwood emitting more than maple. The paper's supplemental information shows that there is a significant difference between the lead content of birch (3.75 mg/kg) and maple (0.92 mg/kg). Across all technology types, the birch EFs were higher than maple, although for the non-catalytic stove the difference was not as large as the uncertified and catalytic stoves. This approach was not used for pellet stoves, for which 2 types of pellets were used in the paper- hardwood and softwood. This is because we have no information on the hardwood/softwood pellet split and the pellet lead content varied less than the cordwood lead content.

Wood Species-Specific Emission Factors

The individual run EFs showing the differences by both cordwood species and appliance type can be seen in Figure A-1, which shows individual cordwood stove run Integrated Duty Cycle (IDC) data from Traviss et. al. 2024 (provided by the author) [ref A-1]. For the noncatalytic stoves, the birch is still higher, but the difference is not as large as with the other 2 appliance types.

[2] USDA state survey on tree populations in 27-3 the file "Number of trees by county and species CONUS most recent_Feb2022.xlsx" on the 2020 NEI Supplemental nonpoint data FTP site.

Figure A-1. Plot of lead results for individual IDC runs, showing impact of appliance type and fuel type



Tree-species based EFs were computed by averaging the run-specific EFs across the 3 appliance types; these are shown in Table A-1.

Table A-1 provides the tree species-based emission factors (mg/kg) compared to the averaged in the Traviss paper [ref A-1] for lead.

Table A-1. Lead Emission Factors (mg/kg) by Tree Species and Appliance Type, Run-Specific data

Appliance Type	Lead EF from Maple	Lead EF from Birch	Lead EF Average by appliance type only
Uncertified	0.2708 (4 runs)	1.6918 (3 runs)	0.88
Certified non-catalytic	0.2181 (6 runs)	0.6195 (3 runs)	0.37
Certified catalytic	0.2643 (3 runs)	0.7035 (3 runs)	0.47

Weighting Factors and development of appliance average metal HAP EFs

EPA developed wood species weighting factors which account for the relative prevalence of birch and compared to maple. We used results from the USDA state survey on tree populations (a dataset used to compute wood densities which is used to estimate RWC activity data. The are in the file "Number of trees by county and species CONUS most recent_Feb2022.xlsx" which is posted on the 2020 NEI Supplemental nonpoint data FTP site). From this file we summed tree species nationally, multiplied the number of each type of tree by its volume using average diameters and heights through google searches. The underlying data and resulting weighting factors are shown in Table A-2.

Table A-2. Tree Species Information Used to Develop Weighting Factor for Species-based EFs

Fuel	# Trees (national sum)	Diameter (ft)	Height (ft)	#trees * volume of each tree	fraction
Birch	1,910,447,349	1.5	45	1.519E+11	0.074
Maple	8,039,943,923	2	75	1.894E+12	0.926

Table A-3 shows the difference in EFs using the averages provided in Traviss, et. al, 2024 [ref A-1] and the species-

weighted emission factors for all metal HAP. In nearly all cases, the species-weighted averages result in lower EFs due to the differences in EFs by wood species within the appliance types. An excel workbook, "Air_Toxics_Total_Run_EFs_Final_documentation_RWC.xlsx" providing the used for the wood species-weighted EFs can be found with supplemental files on the 2023 NEI Supplemental nonpoint data FTP site.

Table A-3. Species-Weighted Emission Factors (mg/kg) for all HAP metals

Metal HAP & Appliance Type	Traviss average EF	NEI wood species-weighted average EF
Lead - uncertified	0.88	0.3763
Lead - certified noncatalytic	0.37	0.2479
Lead - certified catalytic	0.47	0.2280
Manganese - uncertified	0.10	0.06794
Manganese - certified noncatalytic	0.06	0.06067
Manganese - certified catalytic	0.07	0.04700
Cadmium - uncertified	0.11	0.084432
Cadmium - certified noncatalytic	0.07	0.055167
Cadmium - certified catalytic	0.09	0.042817
Nickel - uncertified	0.03	0.005492
Nickel - noncatalytic	0.01	0.007106
Nickel - certified catalytic	0.05	0.03042
Arsenic - uncertified	0.001	0.000696
Arsenic - noncatalytic	0.0012	0.00073
Arsenic - certified catalytic	0.003	0.001513

Mapping to non-tested EFs

For all metals, mapping from uncertified stoves, certified noncatalytic stoves and pellet stoves was used to gap fill metal HAP EFs for all RWC SCCs that were not tested except for SCC 2104009000 (Firelog; Total: All Combustor Types). Table A-4 provides the mapping methodology.

Table A-4. Mapping Metal HAP EFs to tested and non-tested SCCs

SCC	SCC Level 3 & 4 Description	Map from*
2104008100	Wood; Fireplace: general	non-certified wood stoves <=4FT3
2104008011	Woodstove: non-certified wood stoves <=4FT3	tested
2104008012	Woodstove: non-EPA certified/exempt, >4FT3 (e.g., barrel stoves)	non-certified wood stoves <=4FT3
2104008021	Woodstove: EPA certified wood stoves non-cat	tested
2104008031	Woodstove: EPA certified, catalytic or hybrid	tested
2104008400	Woodstove: pellet-fired, general	tested
2104008500	Furnace: Indoor, cordwood-fired, general	non-certified wood stoves <=4FT3
2104008530	Furnace: Indoor, pellet-fired, general	Woodstove: pellet-fired, general
2104008615	Hydronic heater: indoor, EPA certified	EPA certified wood stoves non-cat
2104008614	Hydronic heater: indoor, non-EPA certified	non-certified wood stoves <=4FT3
2104008612	Hydronic heater: outdoor, EPA certified	EPA certified wood stoves non-cat
2104008611	Hydronic heater: outdoor, non-EPA certified	non-certified wood stoves <=4FT3
2104008630	Hydronic heater: pellet fired	Woodstove: pellet-fired, general
2104008700	Outdoor wood burning device, NEC (fire-pits, chimineas, etc)	non-certified wood stoves <=4FT3

*Tested appliance types have "Map from" column that says "tested"

Additional Considerations for Lead

Additional analysis was done for lead, considering this CAP/HAP was not previously in the RWC inventory and its inclusion is expected to make RWC one of the highest lead sources in the NEI, at an estimate of 11.5 tons, based on using the 2020 NEI EPA-estimated residential wood burning activity with these wood species-weighted EFs. Specifically when comparing with lead emissions from the 2020 NEI, this 11.5 tons RWC would be the 7th highest, after Mobile - Aircraft (423 tons), Industrial Processes - NEC (37.6 tons), Industrial Processes - Non-ferrous Metals (28.3 tons), Industrial Processes - Ferrous Metals (27.6 tons), Fuel Comb - Electric Generation - Coal (15.1 tons) and Fuel Comb - Industrial Boilers, ICEs - Oil (14.7 tons).

We also examined the lead emission estimates for fires in the 2020 NEI. The 2020 NEI estimates of lead from wildfires and prescribed burning are 8.6 tons and 7.6 tons, respectively. The NEI lead emissions estimation approach for fires relies on regional-specific emission factors due to differences in lead content in the fuel nationally [ref A-2]. In the Traviss, 2024 et. al. study [ref A-1], the hardwood (maple) was just from one part of the country – rural Connecticut (per email from Nora Traviss to Rich Mason, 11/4/2024). As shown in Holder, et. al. 2023 [ref A-2], the emission factors vary regionally and are generally lower (in regions other than Minnesota, the median is less than 0.2 mg/kg) than found for the cordwood stoves.

For RWC, the portion of lead in the fuel emitted via a mass balance (amount emitted divided by amount in the fuel), and the value ranged from 11% (noncatalytic stove, maple) to 47% (uncertified stove, birch). For fires, less than 10% of the lead is emitted in the woodsmoke which is much lower than for RWC; however, this is expected due to the more complete combustion expected from a woodburning device which burns much hotter than naturally occurring wildland fires. Since we have only the 2 wood species from this study and no regional variation reflecting where these species were sourced, we chose to use national-level weighting for this initial introduction of lead to the NEI. This approach may be improved as additional data on regional lead content and additional emissions testing with these and other wood species are done.

Other HAP Metals Emission Factors

Besides lead, arsenic is the other HAP metal that was not previously estimated for this category in the NEI. Arsenic has the lowest EFs of all metals from the Traviss et. all 2024 study [ref A-1]. Mercury was estimated previously but was not covered by the Traviss study [ref 16] so the EF remains the same as in previous NEIs.

For reference, we provide plots of the individual run EF results for the other HAP metals are provided below in Figure A-2 for Manganese, Figure A-3 for Cadmium, Figure A-4 for Nickel, and Figure A-5 for Arsenic.

Figure A-2. Manganese Individual Run Emission Factors

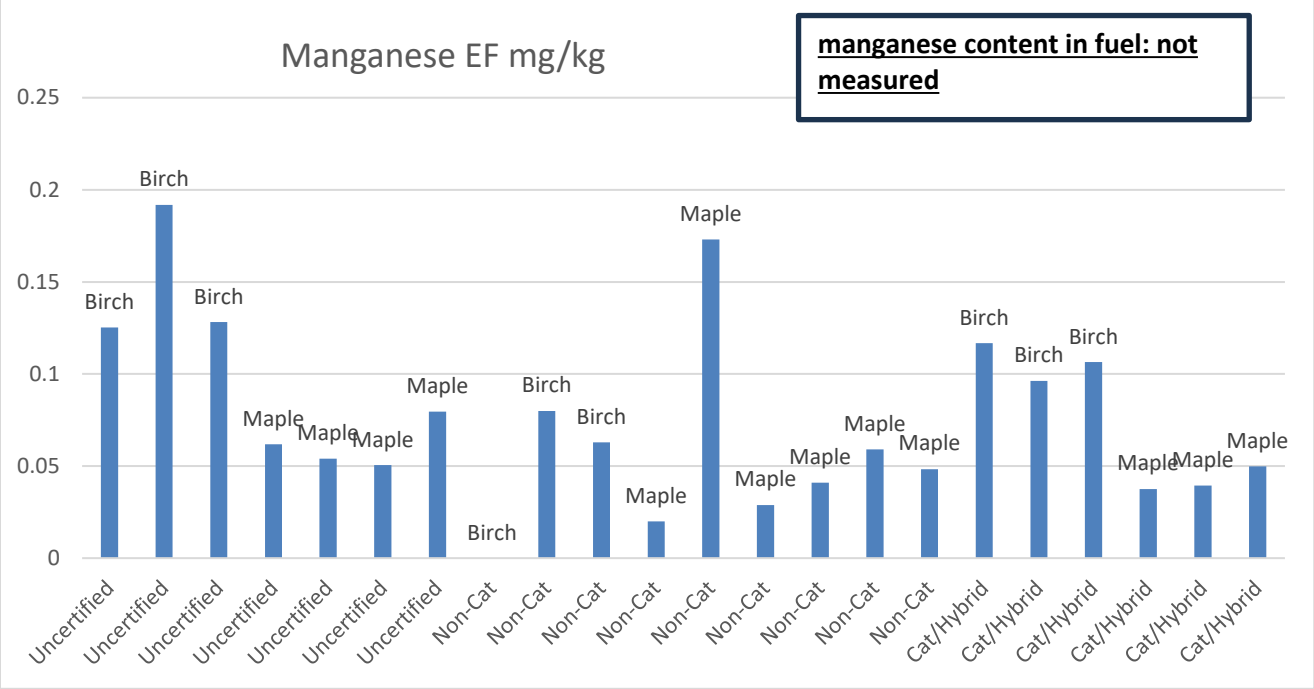


Figure A-3. Cadmium Individual Run Emission Factors

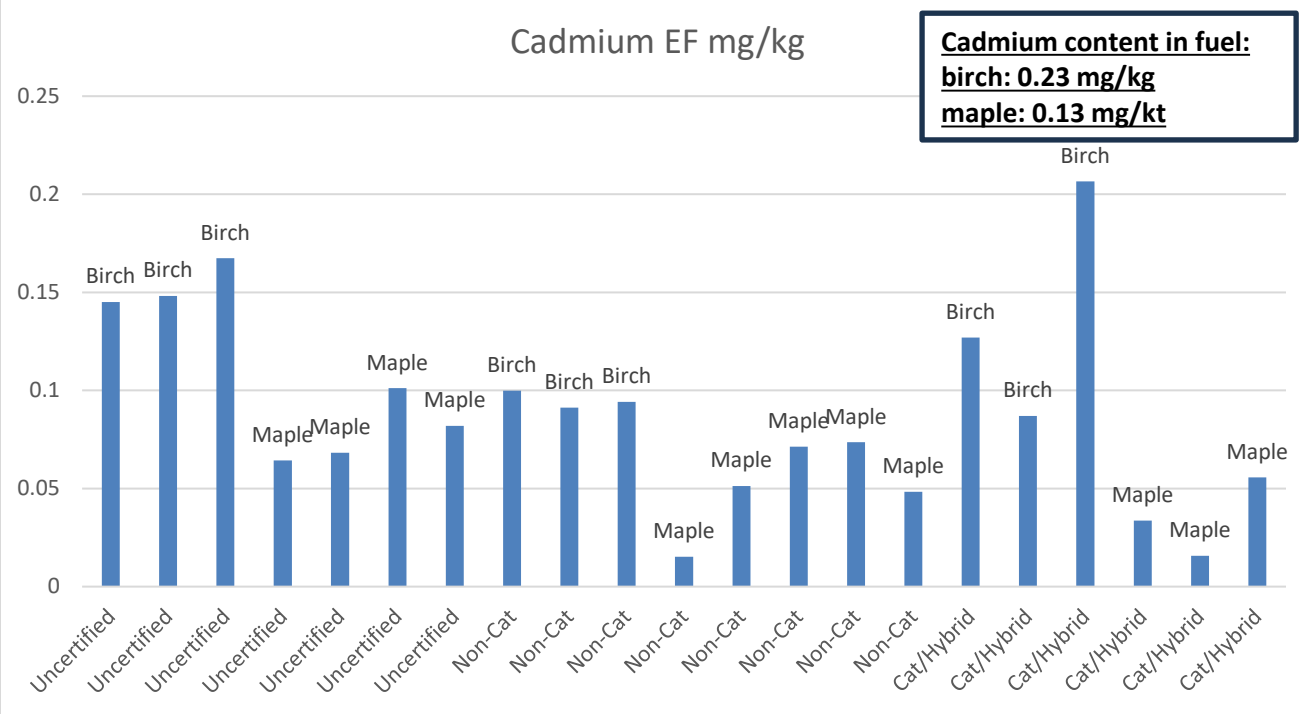


Figure A-4. Nickel Individual Run Emission Factors

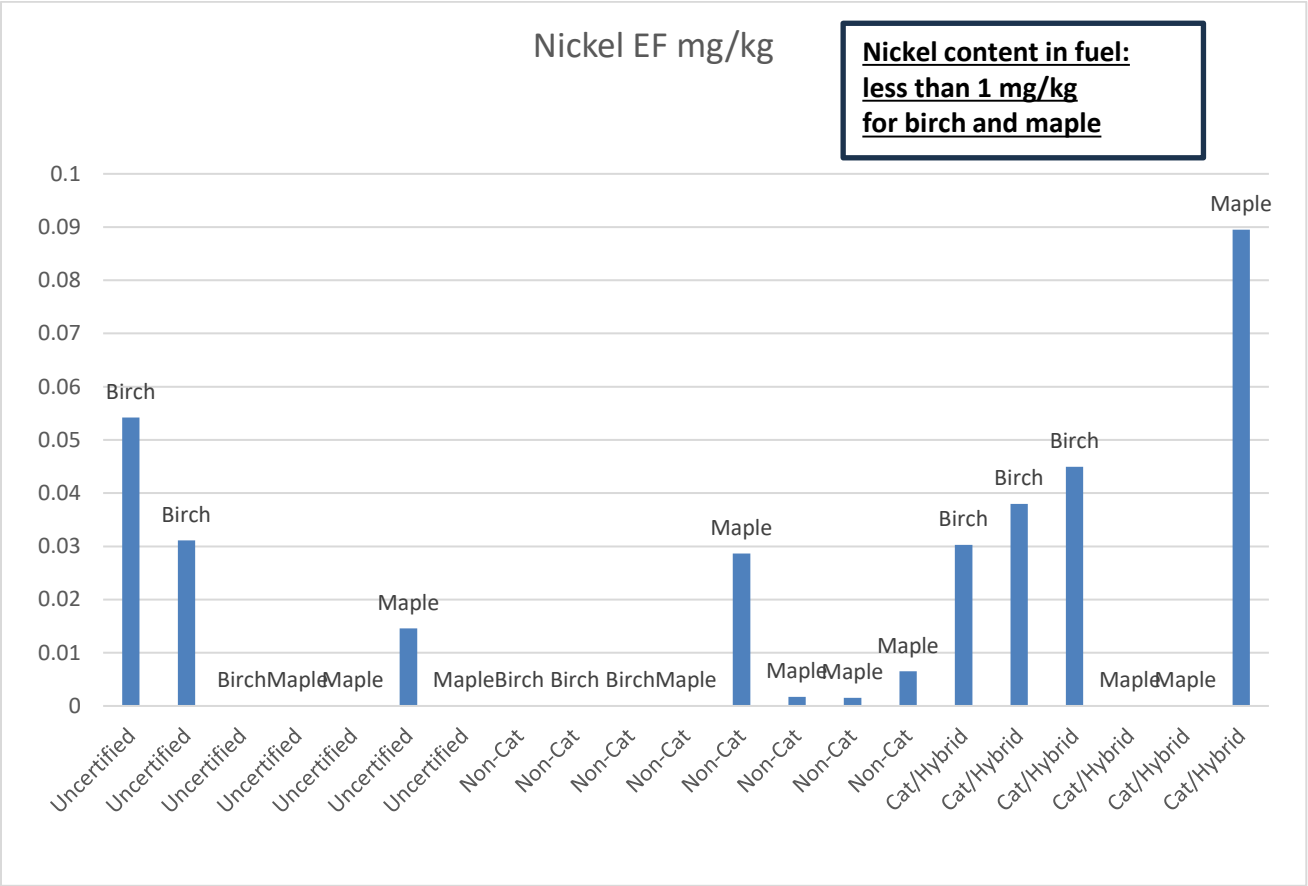
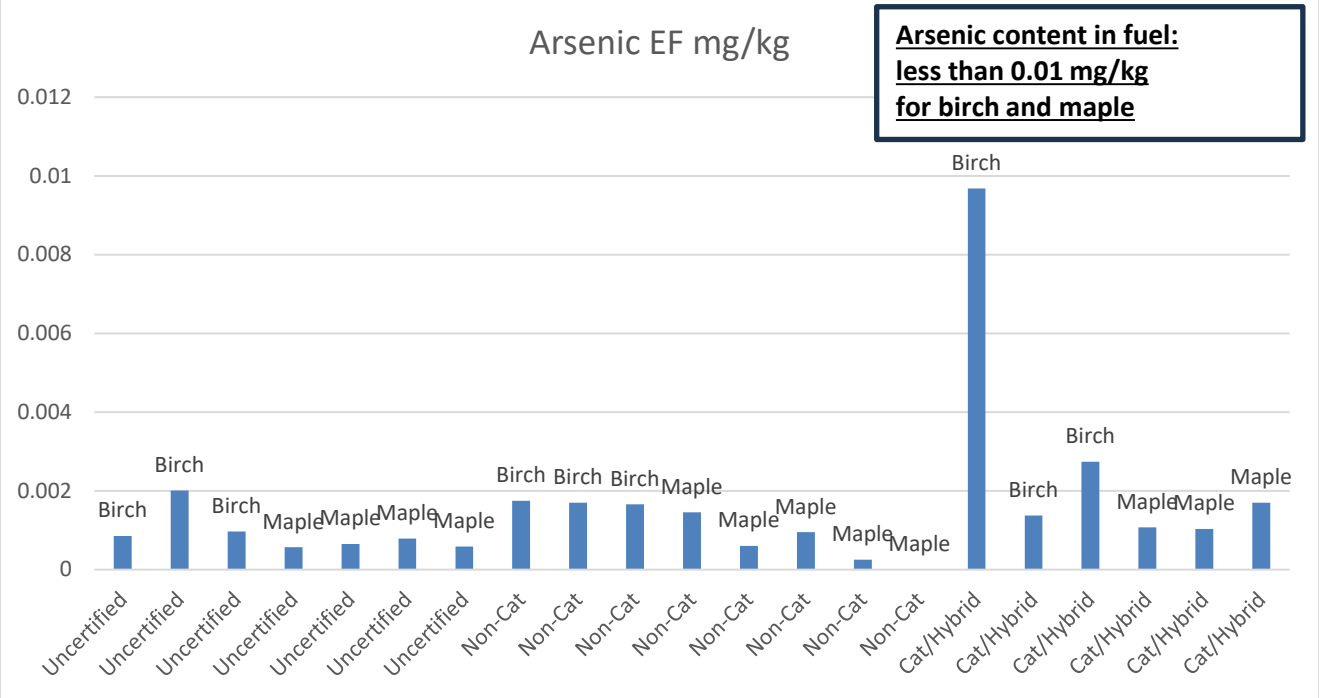


Figure A-5. Arsenic Individual Run Emission Factors



Appendix References

A-1. Traviss, N., G. Allen, and M. Ahmadi. 2024. Criteria, Greenhouse Gas, and Hazardous Air Pollutant Emissions Factors from Residential Cordwood and Pellet Stoves Using an Integrated Duty Cycle Test Protocol. ACS ES&T Air, *1*(9), 1190-1202. https://doi.org/10.1021/acsestair.4c00135

A-2. Holder, A. L., V. Rao, K. Kovalcik, L. Virtaranta. 2023. Particulate Pb emission factors from wildland fires in the United States. Atmospheric Environment: X, V 20, 100229, ISSN 2590-1621, https://doi.org/10.1016/j.aeaoa.2023.100229

SOLVENT UTILIZATION

A. Source Category Description

The solvent sector is a diverse collection of residential, commercial, institutional, and industrial sources of gas-phase organic emissions. Included in this sector are everyday items, such as cleaners, personal care products, adhesives, coatings, printing inks, and pesticides. These sources generate emissions through evaporative processes and include organics that fulfill product functions beyond acting as a traditional solvent (e.g., propellants, fragrances). As such, this sector is often described as the volatile chemical product (VCP) sector.

For the 2017 NEI, the magnitude of VOC emission estimates for this sector were largely based on national-level solvent usage reported by the Freedonia Group[1]. The reader is referred to the 2017 NEMO for more information on those methods. For the 2020 NEI, EPA has adopted emission factors generated using a new framework[2] for most of this sector. Here, we summarize key methodological updates, provide emission factors for 2020 using this new methodology, and include sample calculations.

The 2020 NEI will add one SCC to this sector (2460030999; see Table 1). All remaining SCCs were included in the 2017 NEI. In addition, emissions from agricultural pesticides (2461850000) will be estimated using the new methodology.

Table 1: 2020 NEI solvent utilization SCCs.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types
2401005000	Solvent Utilization	Surface Coating	Auto Refinishing	Total: All Solvent Types
2401008000	Solvent Utilization	Surface Coating	Traffic Markings	Total: All Solvent Types
2401015000	Solvent Utilization	Surface Coating	Factory Finished Wood	Total: All Solvent Types
2401020000	Solvent Utilization	Surface Coating	Wood Furniture	Total: All Solvent Types
2401025000	Solvent Utilization	Surface Coating	Metal Furniture	Total: All Solvent Types
2401030000	Solvent Utilization	Surface Coating	Paper	Total: All Solvent Types
2401040000	Solvent Utilization	Surface Coating	Metal Cans	Total: All Solvent Types
2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment	Total: All Solvent Types
2401060000	Solvent Utilization	Surface Coating	Large Appliances	Total: All Solvent Types
2401065000	Solvent Utilization	Surface Coating	Electronics and Other Electrical	Total: All Solvent Types
2401070000	Solvent Utilization	Surface Coating	Motor Vehicles	Total: All Solvent Types
2401075000	Solvent Utilization	Surface Coating	Aircraft	Total: All Solvent Types
2401085000	Solvent Utilization	Surface Coating	Railroad	Total: All Solvent Types
2401080000	Solvent Utilization	Surface Coating	Marine	Total: All Solvent Types
2401090000	Solvent Utilization	Surface Coating	Misc. Manufacturing	Total: All Solvent Types
2401100000	Solvent Utilization	Surface Coating	Industrial Maintenance Coatings	Total: All Solvent Types
2401200000	Solvent Utilization	Surface Coating	Other Special Purpose Coatings	Total: All Solvent Types
2415000000	Solvent Utilization	Degreasing	All Processes/All Industries	Total: All Solvent Types
2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types
2460100000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Personal Care Products	Total: All Solvent Types
2460200000	Solvent Utilization	Misc. Non-industrial:	All Household	Total: All Solvent Types

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
		Consumer and Commercial	Products	
2460400000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Total: All Solvent Types
2460600000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Total: All Solvent Types
2460800000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All FIFRA Related Products	Total: All Solvent Types
2460500000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Coatings and Related Products	Total: All Solvent Types
2461850000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Pesticide Application: Agricultural	All Processes
2460900000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	Misc. Products	Total: All Solvent Types
2420000000	Solvent Utilization	Dry Cleaning	All Processes	Total: All Solvent Types
2460030999	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	Lighter Fluid, Fire Starter, Other Fuels	Total: All Volatile Chemical Product Types

B. Overview of Calculations

Solvent utilization emissions in the 2020 NEI will largely be based on estimates of national-level usage and allocated to the county-level using more geographically specific sources of data. Product usage of each SCC is preferentially estimated using economic statistics from the U.S. Census Bureau's Annual Survey of Manufacturers, commodity prices from the U.S. Department of Transportation's 2012 Commodity Flow Survey and the U.S. Census Bureau's Paint and Allied Products Survey, and producer price indices, which scale commodity prices (e.g., 2012) to target years (e.g., 2020) and are retrieved from the Federal Reserve Bank of St. Louis. If any of the datasets are unavailable, default usage estimates will be derived using functional solvent usage statistics reported by The Freedonia Group (e.g., 2420000000) or sales quantities reported in a California Air Resources Board (CARB) California-specific survey[3] (e.g., 2460900000 and 2460030999). The composition of products will be estimated by generating composites from CARB surveys[4,5,6,7,8] and profiles reported in the U.S. EPA's SPECIATE database[9]. Emissions are subsequently estimated using a framework that considers product composition, timescales of product usage, and timescales of evaporation for individual components.

In the following sections, details are provided related to the collection of activity data (Section C), allocation of national-level emission estimates to the county-level (Section C), calculation of emission factors (Section D) and emissions (Section F), state-specific variations in emission factors due to assumed nonpoint VOC controls (Section E), point source subtraction (Section G), and other topics.

C. Activity and Allocation Data

Activity data for solvent utilization is SCC-specific. For most SCCs, activity data is based on year-specific county-level population or employment data from the U.S. Census Bureau. Exceptions include county-level use estimates of active ingredients in agricultural pesticides from the United States Geological Survey[10] (2461850000) and vehicular lane miles traveled on paved roads from the Federal

Highway Administration[11] and MOVES model (2401008000). All activity data reflects the most recently available dataset.

The eleven SCCs allocated from the national-level to the county-level using population are listed in Table 2 below.

Table 2: SCCs quantified using population activity data.

SCC	Description
2401001000	Architectural Coatings
2401100000	Industrial Maintenance Coatings
2401200000	Other Special Purpose Coatings
2460100000	All Personal Care Products
2460200000	All Household Products
2460400000	All Automotive Aftermarket Products
2460600000	All Adhesives and Sealants
2460800000	All FIFRA Related Products
2460500000	All Coatings and Related Products
2460900000	Misc. Products
2460030999	Lighter Fluid, Fire Starter, Other Fuels

The SCCs allocated from the national-level to the county-level using employment statistics from the U.S. Census Bureau's County Business Patterns are all typically industrial in nature and listed in Table 3. On occasion, data in the County Business Patterns is withheld due to confidentiality concerns. In those instances, the midpoint of the range associated with each data suppression flag is utilized.

Table 3. SCCs quantified using employment activity data and associated NAICS codes.

SCC	Description	NAICS
2401005000	Auto Refinishing	81112/, 4411//, 4412//
2401015000	Factory Finished Wood	321///
2401020000	Wood Furniture	337110, 337121, 337122, 337127*, 337211, 337212, 337215*
2401025000	Metal Furniture	337124, 337127*, 337214, 337215*
2401030000	Paper	322220
2401040000	Metal Cans	33243/
2401055000	Machinery and Equipment	333///
2401060000	Large Appliances	3352//
2401065000	Electronics and Other Electrical	331318, 3314//, 33592/, 335311
2401070000	Motor Vehicles	3361//, 3362//, 3363//, 3369//
2401075000	Aircraft	3364//
2401085000	Railroad	3365//
2401080000	Marine	3366//
2401090000	Misc. Manufacturing	339///
2415000000	Degreasing: All Processes/All Industrial	331///, 332///, 333///, 334///, 335///, 336///, 337///, 339///, 441///, 483///, 484///, 485///, 488///, 8111//, 8112//
2425000000	Graphic Arts	32311/, 32221/, 32222/, 32223/, 322299
2420000000	Dry Cleaning	812320

***Employment data is split evenly between Wood Furniture and Metal Furniture**

Emissions from agricultural pesticides (2461850000) are allocated from the national-level to the county-level using active ingredient application statistics from the United States Geological Survey. These statistics are reported at the county-level and the EPEST_HIGH_KG value in the associated dataset is

utilized. The most recent dataset available is from 2017. Pending an update, 2017 usage data will be used for the 2020 NEI. Due to data limitations, the USGS statistics do not contain active ingredient usage statistics for Alaska and Hawaii and similar methods employed in the 2017 NEI will be applied for the 2020 NEI. For these jurisdictions, the mass of active ingredients applied in the conterminous United States will be summed and divided by the total acres treated with pesticides, insecticide, and fungicide in the conterminous United States, as reported by the United States Department of Agriculture's Census of Agriculture[12]. These usage factors (kg pesticide active ingredient usage per acre treated) are then applied to the Census of Agriculture's reporting of total acres treated per-county in Alaska and Hawaii.

Emissions from traffic markings (2401008000) were previously allocated from the national-level to the state-level using data from the U.S. Department of Transportation's Federal Highway Administration, and from the state-level to the county-level using population data. For the 2020 NEI, national-level allocation methods for traffic markings will utilize estimates of county-level paved vehicular miles traveled, which is consistent with the methods employed for asphalt paving (i.e., 2461021000, 2461022000, 2461025100, and 2461025200). This update assumes application of traffic markings is correlated with pavement of roads. Overall, these allocation methods do not substantially change the magnitude of emissions assigned to each county.

D. Emissions Factors

For the 2020 NEI, EPA will utilize a new framework to estimate emission factors for the Solvent Tool. Within this framework, the magnitude and speciation of VOC emissions from this sector are directly related to:

1. The mass of chemical products used,
2. The composition of these chemical products,
3. The physiochemical properties of the chemical product constituents that govern volatilization, and
4. The timescale available for these constituents to evaporate.

This methodology resolves several issues in prior methods. First, prior methods did not account for fate-and-transport. Often, chemical products (e.g., personal care products) are quickly sequestered and thus unavailable for emission. Therefore, the speciation and magnitude of organics in emissions can differ from the speciation and magnitude of organics in the composition of products from which they volatilize. To consider fate-and-transport, the new methodology accounts for the evaporation timescale of the individual components within products and the use timescale available for evaporation (i.e., the elapsed time between application and any explicit removal process). Second, prior methods only quantified mass usage of chemicals that function as solvents. Sources in this sector include organics that evaporate and fulfill product functions beyond acting as a traditional solvent (e.g., isobutane as propellants, monoterpenes as fragrances). The new methodology attempts to quantify all organic mass that evaporates on relevant timescales. Third, prior methods assumed all mass usage and subsequent evaporation consisted of organics classified as regulatory VOCs. Evaporative organics from chemical products include many organics that are exempt compounds (e.g., acetone, siloxanes) and their proportions much be accounted for to accurately estimate regulatory VOC emissions.

Like the 2017 NEI, sector-relevant usage estimates will be based on national-level data. 2020 usage estimates will rely upon data from the U.S. Census Bureau's Annual Survey of Manufacturers, commodity prices from the U.S. Department of Transportation's 2012 Commodity Flow Survey and the U.S. Census Bureau's Paint and Allied Products Survey, and producer price indices from the Federal Reserve Bank of St. Louis. Quantification of 2019 usage estimates, as well as the mapping of SCCs to relevant North American Product Classification System (NAPCS) codes and North American Industry

Classification System (NAICS) codes can be found in Table 7 of the appendix. Derivation of product usage is as follows:

$$U = {(S \times 1000)} \Big/ {\left(CP \times \left({PPI_{2019}} \Big/ {PPI_x}\right) \times Pop\right)}$$

Where:

U	=	Annual usage in kg person^{-1} year^{-1}
S	=	Annual Survey of Manufacturers shipment value in \$1000 year^{-1}
CP	=	Commodity Price from the U.S. Department of Transportation's 2012 Commodity Flow Survey or the U.S. Census Bureau's Paint and Allied Products Survey in kg year^{-1}
PPI_{2019f}	=	Producer Price Index from the Federal Reserve Bank of St. Louis for the appropriate NAICS code in 2019 (unitless)
PPI_x	=	Producer Price Index from the Federal Reserve Bank of St. Louis for the appropriate NAICS code in "Price Year" (unitless)
Pop	=	National-level population count from the U.S. Census Bureau

Due to data limitations, usage estimates for three SCCs follow different methods. Miscellaneous products (2460900000) and lighter fluid (2460030999) usage estimates are retrieved from sales quantities reported in a California-specific survey, and dry-cleaning (2420000000) usage estimates are retrieved from a report published by The Freedonia Group. These values are also included in Table 7 of the appendix.

To translate from usage to emissions, fate-and-transport is considered. Here, fate-and-transport is a function of the predicted evaporation timescale of each compound and the assigned use timescale of each product category. The evaporation timescale is the compound specific, characteristic timescale of emission from a surface layer and is calculated using previously published methods[13,14]. This timescale is defined as a relationship between the mass of a compound applied and the rate of its emission, which can be expressed by:

$$\textbf{Evaporation Timescale}\ [hr] = {M_{applied}} \Big/ {R_{emission}} = {K_{OA} \times d} \Big/ {v_e}$$

where K_{OA} is the octanol-air partitioning coefficient of the compound, d [m] is the assumed depth of the applied product layer, and v_e [m/hr] is the mass transfer coefficient of the compound from the surface layer into the bulk air, which is a function of aerodynamic and boundary layer resistances.

A compound's K_{OA} it is the ratio of an organic chemical's concentration in octanol to the organic chemical's concentration in air at equilibrium. It is often used to quantify the partitioning behavior of an organic compound between air and a matrix. As experimental values of K_{OA} are sparse, modeled estimates from the QSAR model OPERA[15] are used and are retrieved from the U.S. EPA's CompTox Chemistry Dashboard. In the newest iteration of the modeling framework, each product category is assigned an indoor usage fraction (see Table 8 in the Appendix). This assignment enables the mass transfer coefficient to vary between indoor and outdoor conditions. Typically, the mass transfer coefficent indoors is smaller than the mass transfer coefficient outdoors due to more stagnant atmospheric conditions, and the newest version of the modeling framework reflects these dynamics. Indoor product usage utilizes a v_e of 5 m/hr, and the remaining outdoor portion is assigned a v_e of 30 m/hr[13,14]. Median values for d [0.1 mm] from Khare and Gentner (2018)[13] are applied for both indoors and outdoors.

Emissions are then determined by comparing the calculated evaporation timescale for each component with the assigned use timescale for the product category from which the component resides. The use

timescale is the timescale available for a product category to evaporate and is based on the length of its direct use phase. If the use timescale for the product category is greater than the evaporation timescale of an organic ingredient, the compound is assumed to be emitted. Else, the compound is assumed to be retained in the product or other condensed phase and permanently sequestered. Overall, organic emissions (E) for the complete sector are calculated as a summation over all organic compounds, *i*, and product categories, *j*, as follows:

$$E = \sum_{i,j} \begin{cases} 0 & \textit{if Use Timescale}_j < \textit{Evaporation Timescale}_i \\ U_j \times f_{E_j} \times f_{S_{i,j}} \times \left(1 - f_{C_j}\right) & \textit{if Use Timescale}_j \geq \textit{Evaporation Timescale}_i \end{cases}$$

where U is the product usage, f_E is the evaporative organic fraction, f_S is the fraction of an organic compound in the evaporative organics portion of a product category, and f_C is the fraction of emissions that feature post-use controls on a mass basis.

VOC emission factors for all solvent utilization SCCs are listed in Table 4 below.

Table 4. 2020 Estimates of VOC emissions factors for solvent utilization.

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2401001000	Architectural Coatings (Controlled)	VOC	1.05	lb/capita	2,4,6,7
2401001000	Architectural Coatings (Uncontrolled)**	VOC	1.41	lb/capita	2,4,6,7
2401005000	Auto Refinishing	VOC	30.32	lb/employee	2,9,16
2401008000	Traffic Markings	VOC	3.62E-05	lb/PVMT*	2,6,9,11
2401015000	Factory Finished Wood	VOC	7.93	lb/employee	2,6,9
2401020000	Wood Furniture	VOC	135.62	lb/employee	2,6,9
2401025000	Metal Furniture	VOC	429.11	lb/employee	2,6,9
2401030000	Paper	VOC	93.14	lb/employee	2,6,9
2401040000	Metal Cans	VOC	407.77	lb/employee	2,6,9
2401055000	Machinery and Equipment	VOC	11.79	lb/employee	2,6,9
2401060000	Large Appliances	VOC	39.14	lb/employee	2,6,9
2401065000	Electronic and Other Electrical	VOC	37.63	lb/employee	2,6,9
2401070000	Motor Vehicles	VOC	29.03	lb/employee	2,6,9
2401075000	Aircraft	VOC	5.24	lb/employee	2,6,9
2401085000	Railroad	VOC	90.99	lb/employee	2,6,9
2401080000	Marine	VOC	242.10	lb/employee	2,6,9
2401090000	Misc. Manufacturing	VOC	49.01	lb/employee	2,6,9
2401100000	Industrial Maintenance Coatings (Controlled)	VOC	0.33	lb/capita	2,6,9
2401100000	Industrial Maintenance Coatings (Uncontrolled)**	VOC	0.44	lb/capita	2,6,9
2401200000	Other Special Purpose Coatings	VOC	0.21	lb/capita	2,6,9
2415000000	Degreasing: All Processes/All Industries	VOC	8.23	lb/employee	2,3,9
2425000000	Graphic Arts	VOC	699.00	lb/employee	2,4,9
2460100000	All Personal Care Products (Controlled)	VOC	2.84	lb/capita	2,3,9
2460100000	All Personal Care Products (Uncontrolled)**	VOC	2.85	lb/capita	2,3,9
2460200000	All Household Products (Controlled)	VOC	1.99	lb/capita	2,3,9
2460200000	All Household Products (Uncontrolled)**	VOC	2.15	lb/capita	2,3,9
2460400000	All Automotive Aftermarket Products (Controlled)	VOC	0.08	lb/capita	2,3,9
2460400000	All Automotive Aftermarket Products (Uncontrolled)**	VOC	0.29	lb/capita	2,3,9
2460600000	All Adhesives and Sealants (Controlled)	VOC	1.33	lb/capita	2,3,9
2460600000	All Adhesives and Sealants (Uncontrolled)**	VOC	1.84	lb/capita	2,3,9
2460800000	All FIFRA Related Products	VOC	0.08	lb/capita	2,3,9
2460500000	All Coatings and Related Products (Controlled)	VOC	1.40	lb/capita	2,5,7,9

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2460500000	All Coatings and Related Products (Uncontrolled)**	VOC	2.85	lb/capita	2,5,7,9
2461850000	Agriculture Pesticides	VOC	0.54	lb/kg***	2,3,9,12
2460900000	Misc. Products	VOC	0.04	lb/capita	2,3,9
2420000000	Dry Cleaning	VOC	18.64	lb/employee	1,2,9
2460030999	Lighter Fluid, Fire Starter, Other Fuels	VOC	0.04	lb/capita	2,3,9

***PVMT = Paved Vehicle Miles Traveled.**
****See Section E for methods to generate "Uncontrolled" emission factors.**
*****The Agriculture Pesticides emission factors are expressed in pounds of VOC per-kg of *active ingredient* pesticide usage. Note that *active ingredients* are a component of total agricultural pesticide usage, which also includes water, inorganic, and non-active ingredient organic components.**

E. Nonpoint Controls from Nonpoint Solvent Utilization

There are two methods for controlling organic emissions from the nonpoint solvent utilization sector. The first method involves product reformulation, where existing VOC ingredients are substituted with exempt organic compounds (e.g., acetone) or the VOC mass content of products is lowered. Regulations are often set to limit the VOC content of chemical products, with California typically setting the most stringent limits in the country[17]. To reflect local regulations, the 2017 NEI made additional reductions to consumer solvent, architectural coating, and industrial maintenance coating SCCs for several states. The consumer solvent reductions were calculated using a phased approach developed in an Ozone Transport Commission (OTC) report where each marginal reduction reflect fractional changes to California Air Resource Board's (ARB) VOC inventory for consumer products. As ARB's most recent consumer and commercial product survey, which reports the VOC content and composition of products, is used in the underlying methodology, the fractional reductions to consumer products through product reformulation over time are implicitly captured. Therefore, it is assumed that these phased controls are represented, and further reductions are not necessary. However, application of emission factors whose derivation use the VOC content and composition of products from ARB's most recent survey to all states would artificially reduce emissions where area source VOC rules relevant to the solvent sector have not been adopted. The states for which area source VOC rules have been adopted will largely follow the 2017 NEI and are shown below.

Table 5. States with area source VOC rules relevant to the solvent sector.

State	Consumer Solvents	Architectural/Industrial Maintenance Coatings
AZ		X
CA	X	X
CT	X	X
DE	X	X
DC	X	X
ME	X	X
MD	X	X
MA	X	X
NH	X	X
NJ	X	X
NY	X	X
PA	X	X
RI	X	X
TX		X
UT	X	X
VT		X

State	Consumer Solvents	Architectural/Industrial Maintenance Coatings
VA	X	X

To account for emission variations for relevant consumer solvent SCCs, supplemental data from the OTC report are paired with information from ARB's most recent survey to quantify the VOC content of products prior to rule adoption. These pre-rule VOC content values are then used to generate emission factor multipliers for relevant SCCs (see Table 8 in Appendix) and have been applied to generate the emission factors in Table 4 above. For example, ARB's most recent survey reports 10.14 tons per day of Brake Cleaner sales. The OTC documentation reports a 3.7 tons per day reduction in VOC emissions due to the adoption of a VOC limit of 10%, by weight. Therefore, the VOC limit prior to the rule adoption was 46.5%, by weight, which is derived using the following equation:

$$\boldsymbol{P_{VOC_r} = S \times \left(VOC_{wt\%_i} - VOC_{wt\%_f}\right)}$$

Where:

P_{VOC_r} = Daily VOC emission reduction for a given product
S = Daily sales of a given product
$VOC_{wt\%_i}$ = Initial VOC weight %
$VOC_{wt\%_f}$ = Final VOC weight %

Similar VOC content updates were applied to multipurpose solvents, paint thinners, disinfectants, floor polish, windshield washer fluids, construction adhesives, and all other products considered in the OTC documentation[16]. The updated VOC content values for all listed products were then applied to the derivation of the VOC content for all relevant product categories in the new emissions framework.

Uncontrolled emission factors for architectural coatings and industrial maintenance coatings are quantified using the prior ratio of controlled to uncontrolled emissions, which were based on estimates from the Eastern Regional Technical Advisory Committee. In the 2017 NEI, architectural and industrial maintenance coatings generated 2.03 lb/capita in states with applicable area source VOC rules and 2.72 lb/capita in states without rules. The resulting 1.340 scaling factor (2.72 / 2.03) is used to generate the uncontrolled emission factor shown in Table 4 above.

The second pathway for controlling organic emissions from the solvent utilization sector involves post-use controls. These methods include add-on controls, manufacturing process modifications, and disposal techniques. A post-use control assumption is applied in the derivation of two SCCs (2460500000 and 2460030999; see Table 8 in Appendix). Since adoption of additional post-use control technologies vary widely in space and time, assigning blanket post-use controls beyond these two SCCs is not considered here. In lieu of these blanket assumptions, the Solvent Tool allows users to adjust emissions factors to account for controls, if needed.

F. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$$

Where:

$E_{VOC,c,s}$ = Annual VOC emissions in county c for source category s, in tons per year

$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Section C)
$EF_{VOC,s}$ = Calculated VOC emissions factor for source category *s* (Table 4)

HAP emissions are estimated using the VOC emissions and HAP speciation factors (see Table 9 in Appendix). This step is completed after the point source subtraction step discussed in section H. It should be noted that if a speciation profile normalized to Total Organic Gas (TOG) is used for HAP-augmentation, the TOG/VOC ratio must first be applied to the Speciation Factor.

$$\boldsymbol{E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s}}$$

Where:

$E_{p,c,s}$ = Annual emissions of HAP *p* county *c* for source category *s*, in tons per year
$E_{VOC,c,s}$ = Annual VOC emissions in county *c* for source category *s*, in tons per year (Eqn. 2)
$SF_{p,s}$ = Speciation factor for HAP *p* for source category *s* (Table 9)

G. Point Source Subtraction

Since emissions from solvent utilization occur from both point and nonpoint SCCs, point source subtraction is required to ensure emissions from this sector are not double-counted. To accomplish this task, nonpoint SCCs must be mapped to corresponding point SCCs. This crosswalk can be found in Table 10 of the Appendix.

Point source subtraction for this sector should be completed at the county level using *uncontrolled* point source emissions. As such, assumptions related to the control efficiency of the point sources must be made. In some cases, the point source emission estimates submitted to the NEI feature 80-90% control efficiencies. *Uncontrolled* point source emission calculations will be calculated, as necessary, using the submitted point source emissions, engineering judgement, and an assumed control efficiency.

The net calculation of nonpoint emissions following point source subtraction is as follows:

$$\boldsymbol{NP_{s,c} = TE_{s,c} - PS_{s,c}}$$

Where:

$NP_{s,c}$ = Nonpoint source emissions in county *c* for source category *s*, in tons per year
$TE_{s,c}$ = Total emissions *s* in county *c* for source category *s*, in tons per year
$PS_{s,c}$ = Uncontrolled point source emissions in county *c* for source category *s*, in tons per year

If point source subtraction results in negative emissions, the Solvent Tool will zero out emissions for that source category in that county. HAP emissions are speciated from the estimated nonpoint source VOC emissions following point source subtraction.

H. Sample Calculations

Sample calculations for VOC emissions from adhesives and sealants solvent utilization in Apache County, Arizona are included in the table below.

Table 6. Sample calculations of VOC emissions for All Adhesives and Sealants (SCC: 2460600000) in Apache County, AZ.

Eq. #	Equation	Values for Apache County, AZ	Result
1	$E_C = EF_{SCC} \times P_C$	$1.84\ {}^{lb}/_{capita} \times 71{,}900\ people$	66.15 tons of VOC in 2019

I. Changes from 2017 Methodology

Substantial methodological changes to estimate emissions from this sector was made for the 2020 NEI. The reader is directed to Section D and the previously cited reference[2] for additional details on the emission factor generation methods. In addition, agricultural pesticide (2461850000) emissions are now generated using the updated methods and are not estimated via a separate tool.

J. Puerto Rico and U.S. Virgin Islands Emissions Calculations

For all SCCs that utilize population and employment statistics, emissions from Puerto Rico and the U.S. Virgin Islands are calculated using the same methodology described above. For agricultural pesticides and traffic markings, emissions are estimated using per-capita activity data from representative counties in Florida (Broward County and Monroe County for Puerto Rico and the U.S. Virgin Islands, respectively).

K. Instructions for Submitting Point Emissions Data to Input Template

The Solvent Input Template includes all point SCCs that map to nonpoint SCCs for this sector and allows submission of point source emissions data, which should be done at the county-level. To limit the file size, the template does not include all combinations of county 5-digit FIPS codes and point SCCs. Rather, the template contains a single row for each point SCC that maps to a nonpoint SCC. To enter emissions for more than one county, copy the necessary rows to the bottom of the table. There is no need to copy rows for which you will not be submitting point source data. The 5-digit FIPS code must be entered for all counties for which point source emissions data is being submitted.

L. References

[1] The Freedonia Group: Solvents, Industry Study #3429, The Freedonia Group, Cleveland, OH, 2016.

[2] Seltzer, K. M., Pennington, E., Rao, V., Murphy, B. N., Strum, M., Isaacs, K. K., and Pye, H. O. T.: Reactive organic carbon emissions from volatile chemical products, Atmos. Chem. Phys., 21, 5079–5100, https://doi.org/10.5194/acp-21-5079-2021, 2021. Note: emissions model is available and updated at https://github.com/USEPA/VCPy.

[3] California Air Resources Board (CARB): Final 2015 Consumer & Commercial Product Survey Data Summaries, 2019.

[4] California Air Resources Board (CARB): 2005 Architectural Coatings Survey – Final Report, 2007.

[5] California Air Resources Board (CARB): 2010 Aerosol Coatings Survey Results, 2012.

[6] California Air Resources Board (CARB): 2014 Architectural Coatings Survey - Draft Data Summary, 2014.

[7] California Air Resources Board (CARB): ORGPROF - Organic chemical profiles for source categories, 2018. https://ww2.arb.ca.gov/speciation-profiles-used-carb-modeling

[8] California Air Resources Board (CARB): Final 2015 Consumer & Commercial Product Survey Data Summaries, 2019.

[9] U.S. Environmental Protection Agency: Final Report, SPECIATE Version 5.0, Database Development Documentation, Research Triangle Park, NC, EPA/600/R-19/988, 2019.

[10] Wieben, C.M., 2019, Estimated Annual Agricultural Pesticide Use for Counties of the Conterminous United States, 2013-17 (ver. 2.0, May 2020): U.S. Geological Survey data release, https://doi.org/10.5066/P9F2SRYH.

[11] U.S. Department of Transportation, Federal Highway Administration, Office of Highway Policy Information; Table HM-51 – Highway Statistics 2018.

[12] U.S. Department of Agriculture, 2012 Census of Agriculture, Volume 1– Part 51; AC-12-A-51.

[13] Khare, P. and Gentner, D. R.: Considering the future of anthropogenic gas-phase organic compound emissions and the increasing influence of non-combustion sources on urban air quality, Atmos. Chem. Phys., 18, 5391–5413, https://doi.org/10.5194/acp-18-5391-2018, 2018.

[14] Weschler, C. J. and Nazaroff, W. W.: Semivolatile organic compounds in indoor environments, Atmos. Environ., 42, 9018–9040, 2008.

[15] Mansouri, K., Grulke, C. M., Judson, R. S., and Williams, A. J.: OPERA models for predicting physicochemical properties and environmental fate endpoints, J. Cheminformatics, 10, 10, https://doi.org/10.1186/s13321-018-0263-1, 2018.

[16] U.S. Environmental Protection Agency: Emission Inventory Improvement Program, Auto Body Refinishing, Volume III: Chapter 13, January 2000.

[17] Ozone Transport Commission: OTC Model Regulations for Nitrogen Oxides (NOx) and Photo-reactive Volatile Organic Compounds (VOCs), Technical Support Document, Ozone Transport Commission, Boston, MA, 2016.

APPENDIX

Table 7. 2020 estimates of solvent utilization.

SCC	NAPCS2017	NAICS2017	Annual Survey of Manufacturers [$1000/yr]	Producer Price Index			Commodity Price [$/kg]		Annual Usage Estimates [kg/person/yr]
			2020	2010	2012	2020	$/kg	Price Year	
2460200000	2007775000	325611	2540477	1.00	1.07	1.12	1.615	2012	4.527
2460200000	2007925000	325611	9482000	1.00	1.07	1.12	1.615	2012	16.897
2460200000	2007925000	325612	53484	1.00	1.07	1.12	1.615	2012	0.095
2460200000	2007925000	325620	34944	1.00	1.07	1.12	1.615	2012	0.062
2460200000	2007875000	325611	15082	1.00	1.05	1.12	1.615	2012	0.027
2460200000	2007875000	325612	160658	1.00	1.05	1.12	1.615	2012	0.286
2460200000	2007875000	325620	35634	1.00	1.05	1.23	1.615	2012	0.057
2460200000	2005375000	325612	1364032	1.00	1.05	1.23	1.615	2012	2.170
2460200000	2007900000	325612	24427	1.00	1.05	1.23	1.615	2012	0.039
2460200000	2007850000	325611	52396	1.00	1.05	1.23	1.615	2012	0.083
2460200000	2007850000	325612	119011	1.00	1.05	1.23	1.615	2012	0.189
2460200000	2007850000	325620	6140	1.00	1.05	1.23	1.615	2012	0.010
2460200000	2007825000	325611	642670	1.00	1.05	1.23	1.615	2012	1.022
2460200000	2007825000	325612	61928	1.00	1.05	1.23	1.615	2012	0.099
2460200000	2021775000	325613	14532	1.00	1.16	1.23	1.615	2012	0.023
2460200000	2025125000	325611	1540262	1.00	1.07	1.23	1.615	2012	2.451
2460200000	2021800000	325611	5713951	1.00	1.05	1.24	1.615	2012	9.913
2460200000	2021800000	325613	6032	1.00	1.05	1.12	1.615	2012	0.011
2460200000	2046200000	325612	945859	1.00	1.05	1.23	1.615	2012	1.505
2460200000	2010475000	325620	1763040	1.00	1.03	1.23	1.615	2012	2.805
2415000000	2046350000	325611	1127383	1.00	1.07	1.10	1.615	2012	1.970
2415000000	2046050000	325611	639479	1.00	1.07	1.12	1.615	2012	1.140
2415000000	2046075000	325611	2306794	1.00	1.07	1.12	1.615	2012	4.111
2415000000	2046225000	325611	1192662	1.00	1.07	1.12	1.615	2012	2.125
2415000000	2046300000	325612	502793	1.00	1.05	1.12	1.615	2012	0.896
2415000000	2046250000	325611	489365	1.00	1.05	1.23	1.615	2012	0.779
2415000000	2046250000	325612	10322	1.00	1.05	1.23	1.615	2012	0.016
2415000000	2046275000	325611	201677	1.00	1.05	1.23	1.615	2012	0.321
2415000000	2046275000	325612	13751	1.00	1.05	1.23	1.615	2012	0.022
2415000000	2046125000	325611	76882	1.00	1.07	1.23	1.615	2012	0.122
2415000000	2046125000	325612	1292721	1.00	1.05	1.23	1.615	2012	2.057
2415000000	2051375000	327910	39931	1.00	1.05	1.23	1.615	2012	0.064
2460400000	2042275000	325611	334065	1.00	1.05	1.23	1.615	2012	0.531
2460400000	2042275000	325612	24085	1.00	1.05	1.23	1.615	2012	0.038
2460400000	2042300000	325612	3776228	1.00	1.05	1.10	1.615	2012	1.147

SCC	NAPCS2017	NAICS2017	Annual Survey of Manufacturers [$1000/yr]	Producer Price Index			Commodity Price [$/kg]		Annual Usage Estimates [kg/person/yr]
			2020	2010	2012	2020	$/kg	Price Year	
2460100000	2010500000	325620	31554	1.00	1.03	1.10	9.290	2012	0.010
2460100000	2010625000	325611	9137746	1.00	1.03	1.10	9.290	2012	2.777
2460100000	2010625000	325620	572727	1.00	1.03	1.10	9.290	2012	0.174
2460100000	2010675000	325611	12176011	1.00	1.03	1.10	9.290	2012	3.700
2460100000	2010675000	325612	875010	1.00	1.03	1.10	9.290	2012	0.266
2460100000	2010675000	325620	578488	1.00	1.03	1.10	9.290	2012	0.176
2460100000	2010550000	325620	965054	1.00	1.03	1.12	9.290	2012	0.299
2460100000	2010650000	325620	2211870	1.00	1.03	1.12	9.290	2012	0.685
2460100000	2010575000	325611	1481487	1.00	1.07	1.10	9.290	2012	0.450
2460100000	2010600000	325620	5443565	1.00	1.03	1.10	9.290	2012	1.654
2460100000	2010525000	325620	4236307	1.00	1.03	1.10	9.290	2012	1.287
2460100000	2010475000	325611	877783	1.00	1.03	1.21	9.290	2012	0.923
2460600000	2040400000	325520	3959880	1.00	1.10	1.21	2.602	2012	4.163
2460600000	2040425000	325520	94592	1.00	1.10	1.21	2.602	2012	0.099
2460600000	2042325000	325520	1184845	1.00	1.10	1.21	2.602	2012	1.246
2460600000	2050425000	325520	1531918	1.00	1.10	1.21	2.602	2012	1.611
2460600000	2050450000	325520	1718696	1.00	1.10	1.21	2.602	2012	1.807
2460600000	2050475000	325520	665629	1.00	1.10	1.21	2.602	2012	0.700
2460600000	2050500000	325520	715796	1.00	1.10	1.21	2.602	2012	0.753
2460600000	2050525000	325520	288695	1.00	1.10	1.21	2.602	2012	0.304
2460600000	2050550000	325520	2050932	1.00	1.10	1.21	2.602	2012	2.156
2460600000	2050575000	325520	11254974	1.00	1.10	1.27	2.602	2012	9.850
2401001000	2040325000	325510	400203	1.00	1.14	1.27	2.694	2010	0.204
2460500000	2040350021	325510	2399575	1.00	1.14	1.27	4.616	2010	1.894
2402000000	2040375000	325510	422815	1.00	1.14	1.27	2.987	2010	0.158
2401005000	2040350012	325510	829462	1.00	1.14	1.27	6.323	2010	0.999
2401008000	2040350009	325510	53981	1.00	1.14	1.27	1.957	2010	0.032
2401015000	2032600027	325510	644525	1.00	1.14	1.27	4.023	2010	0.381
2401020000	2032600024	325510	575385	1.00	1.14	1.27	3.985	2010	0.373
2401025000	2032600039	325510	116113	1.00	1.14	1.27	3.633	2010	0.102
2401030000	2032600042	325510	153366	1.00	1.14	1.27	2.672	2010	0.115
2401040000	2032600033	325510	480687	1.00	1.14	1.27	3.142	2010	0.169
2401055000	2032600036	325510	29984	1.00	1.14	1.27	6.709	2010	0.019
2401060000	2032600021	325510	284269	1.00	1.14	1.27	3.732	2010	0.076
2401065000	2032600045	325510	822303	1.00	1.14	1.27	8.816	2010	0.244
2401070000	2032600003	325510	447650	1.00	1.14	1.27	7.946	2010	0.102
2401070000	2032600006	325510	187374	1.00	1.14	1.27	10.332	2010	0.073
2401070000	2032600009	325510	168000	1.00	1.14	1.27	6.080	2010	0.050

SCC	NAPCS2017	NAICS2017	Annual Survey of Manufacturers [$1000/yr]	Producer Price Index			Commodity Price [$/kg]		Annual Usage Estimates [kg/person/yr]
			2020	2010	2012	2020	$/kg	Price Year	
2401075000/ 2401085000	2032600012	325510	794292	1.00	1.14	1.27	7.926	2010	0.357
2401080000	2040350015	325510	242962	1.00	1.14	1.27	5.251	2010	0.173
2401090000	2032600018	325510	426510	1.00	1.14	1.27	3.320	2010	0.192
2401090000	2032600031	325510	1303382	1.00	1.14	1.27	5.241	2010	1.254
2401100000	2040350003	325510	800239	1.00	1.14	1.27	2.451	2010	0.410
2401100000	2040350006	325510	2029800	1.00	1.14	1.27	4.597	2010	1.037
2401200000	2040350024	325510	353274	1.00	1.14	1.21	4.616	2010	0.222
2425000000	2023750000	325910	59623	1.00	1.07	1.21	4.217	2012	0.037
2425000000	2023825000	325910	1218840	1.00	1.07	1.21	4.217	2012	0.765
2425000000	2023875000	325910	980180	1.00	1.07	1.21	4.217	2012	0.615
2425000000	2023900000	325910	109766	1.00	1.07	1.21	4.217	2012	0.069
2425000000	2023775000	325910	237822	1.00	1.07	1.21	4.217	2012	0.149
2425000000	2023800000	325910	64929	1.00	1.07	1.21	4.217	2012	0.041
2425000000	2023850000	325910	43741	1.00	1.07	1.21	4.217	2012	0.027
2425000000	2023725000	325910	712287	1.00	1.07	1.21	4.217	2012	0.447
2425000000	2023925000	325910	831256	1.00	1.07	1.10	4.217	2012	0.517
2460800000	2034875000	325320	358039	1.00	1.04	1.10	4.552	2012	0.223
2460800000	2034900000	325320	1010981	1.00	1.04	1.09	4.552	2012	0.688
2461850000	2034825000	325199	127385	1.00	1.12	1.10	4.552	2012	0.079
2461850000	2034850000	325199	12336303	1.00	1.04	1.10	4.552	2012	7.674
2461850000	2034850000	325320	2540477	1.00	1.04	1.12	4.552	2012	4.527
2460900000	--	--	--	--	--	--	--	--	0.180
2420000000	--	--	--	--	--	--	--	--	0.024
2461030999	--	--	--	--	--	--	--	--	2.800

Table 8. Post-use control assumptions, fraction of application assumed to occur indoors, and emission factor inflation percentages for non-controlled states.

SCC	Description	Post-Use Control Assumption [fraction]	Assumed Indoor Emission [fraction]	Emission Factor Multiplier for Uncontrolled States
2401001000	Architectural Coatings	0.00	0.50	1.340
2401005000	Auto Refinishing	0.00	0.50	--
2401008000	Traffic Markings	0.00	0.50	--
2401015000	Factory Finished Wood	0.00	0.50	--
2401020000	Wood Furniture	0.00	0.50	--
2401025000	Metal Furniture	0.00	0.50	--
2401030000	Paper	0.00	0.50	--

SCC	Description	Post-Use Control Assumption [fraction]	Assumed Indoor Emission [fraction]	Emission Factor Multiplier for Uncontrolled States
2401040000	Metal Cans	0.00	0.50	--
2401055000	Machinery and Equipment	0.00	0.50	--
2401060000	Large Appliances	0.00	0.50	--
2401065000	Electronic and Other Electrical	0.00	0.50	--
2401070000	Motor Vehicles	0.00	0.50	--
2401075000	Aircraft	0.00	0.50	--
2401085000	Railroad	0.00	0.50	--
2401080000	Marine	0.00	0.50	--
2401090000	Misc. Manufacturing	0.00	0.50	--
2401100000	Industrial Maintenance Coatings	0.00	0.50	1.340
2401200000	Other Special Purpose Coatings	0.00	0.50	--
2415000000	Degreasing: All Processes/All Industries	0.00	1.00	--
2425000000	Graphic Arts	0.00	0.50	--
2460100000	All Personal Care Products	0.00	***	1.003
2460200000	All Household Products	0.00	1.00	1.079
2460400000	All Automotive Aftermarket Products	0.00	0.00	3.548
2460600000	All Adhesives and Sealants	0.00	1.00	1.380
2460800000	All FIFRA Related Products	0.00	0.00	--
2460500000	All Coatings and Related Products	*	0.50	2.025
2461850000	Agriculture Pesticides	0.00	0.00	--
2460900000	Misc. Products	0.00	1.00	--
2420000000	Dry Cleaning	0.00	0.50	--
2460030999	Lighter Fluid, Fire Starter, Other Fuels	0.90**	0.00	--

***Emissions for All Coating and Related Products are calculated separately for aerosol coatings and allied paint products (e.g., paint thinners, clean up solvents, multipurpose solvents, etc.). The final emission factor reflects a summation of both emission categories. Within the emissions modeling, a 0.33 post-use control factor is applied to allied paint products to reflect disposal of clean up solvents and paint thinners.**

****Emissions for Lighter Fluid, Fire Starter, Other Fuels are assumed to feature 90% destruction via in-use combustion.**

*****Emissions for Personal Care Products are calculated separately for short-use products and daily-use products. The final emission factor reflects a summation of both emission categories. Within the emissions modeling, a 1.00 indoor emission fraction is assumed for short-use products and a 0.50 indoor emission fraction is assumed for daily-use products.**

Table 9. HAP speciation factors for the solvent utilization sector. For estimating HAPs, EPA will multiply the VOC emissions for each SCC by the appropriate speciation factor provided in this table.

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401001000	Architectural Coatings	107211	Ethylene glycol	2.87E-01	95816
2401001000	Architectural Coatings	171	Glycol Ethers	5.55E-02	95816

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401001000	Architectural Coatings	67561	Methanol	1.45E-02	95816
2401001000	Architectural Coatings	1330207	Xylenes	2.56E-03	95816
2401001000	Architectural Coatings	108883	Toluene	1.16E-03	95816
2401001000	Architectural Coatings	121448	Triethylamine	4.39E-04	95816
2401001000	Architectural Coatings	122996	Phenoxyethanol	4.27E-04	95816
2401001000	Architectural Coatings	75070	Acetaldehyde	3.07E-04	95816
2401001000	Architectural Coatings	75092	Dichloromethane	2.81E-04	95816
2401001000	Architectural Coatings	100414	Ethylbenzene	2.44E-04	95816
2401001000	Architectural Coatings	N590	Polycyclic Organic Matter	1.98E-04	95816
2401001000	Architectural Coatings	110543	N-hexane	1.94E-04	95816
2401001000	Architectural Coatings	95476	O-xylene	1.72E-04	95816
2401001000	Architectural Coatings	108101	Methyl isobutyl ketone	1.51E-04	95816
2401001000	Architectural Coatings	108383	M-xylene	1.42E-04	95816
2401005000	Auto Refinishing	1330207	Xylenes	2.65E-01	2402
2401005000	Auto Refinishing	108883	Toluene	1.34E-01	2402
2401005000	Auto Refinishing	108101	Methyl isobutyl ketone	3.19E-02	2402
2401005000	Auto Refinishing	171	Glycol Ethers	9.61E-03	2402
2401005000	Auto Refinishing	107211	Ethylene glycol	1.65E-03	2402
2401008000	Traffic Markings	1330207	Xylenes	1.42E-01	3135
2401008000	Traffic Markings	108883	Toluene	9.90E-02	3135
2401008000	Traffic Markings	110543	N-hexane	3.21E-02	3135
2401008000	Traffic Markings	100414	Ethylbenzene	1.06E-02	3135
2401008000	Traffic Markings	67561	Methanol	1.93E-03	3135
2401008000	Traffic Markings	107211	Ethylene glycol	1.39E-03	3135
2401008000	Traffic Markings	108383	M-xylene	9.63E-04	3135
2401008000	Traffic Markings	95476	O-xylene	4.28E-04	3135
2401008000	Traffic Markings	106423	P-xylene	4.28E-04	3135
2401015000	Factory Finished Wood	108883	Toluene	2.66E-01	2405
2401015000	Factory Finished Wood	1330207	Xylenes	1.51E-01	2405
2401015000	Factory Finished Wood	108101	Methyl isobutyl ketone	7.35E-02	2405
2401015000	Factory Finished Wood	171	Glycol Ethers	3.94E-03	2405
2401015000	Factory Finished Wood	107211	Ethylene glycol	7.08E-04	2405
2401020000	Wood Furniture	108883	Toluene	2.66E-01	2405
2401020000	Wood Furniture	1330207	Xylenes	1.51E-01	2405
2401020000	Wood Furniture	108101	Methyl isobutyl ketone	7.35E-02	2405
2401020000	Wood Furniture	171	Glycol Ethers	3.94E-03	2405
2401020000	Wood Furniture	107211	Ethylene glycol	7.08E-04	2405
2401025000	Metal Furniture	1330207	Xylenes	1.96E-01	2406
2401025000	Metal Furniture	108883	Toluene	9.88E-02	2406
2401025000	Metal Furniture	171	Glycol Ethers	2.60E-02	2406

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401025000	Metal Furniture	108101	Methyl isobutyl ketone	2.15E-02	2406
2401025000	Metal Furniture	107211	Ethylene glycol	9.31E-03	2406
2401030000	Paper	108883	Toluene	3.55E-02	2552
2401030000	Paper	71432	Benzene	2.60E-02	2552
2401030000	Paper	108383	M-xylene	1.42E-02	2552
2401030000	Paper	95476	O-xylene	1.37E-02	2552
2401030000	Paper	98828	Cumene	1.02E-02	2552
2401030000	Paper	110543	N-hexane	1.02E-02	2552
2401030000	Paper	100414	Ethylbenzene	9.60E-03	2552
2401030000	Paper	106423	P-xylene	5.60E-03	2552
2401040000	Metal Cans	108883	Toluene	1.20E-01	2408
2401040000	Metal Cans	1330207	Xylenes	1.08E-01	2408
2401040000	Metal Cans	108101	Methyl isobutyl ketone	8.48E-02	2408
2401040000	Metal Cans	171	Glycol Ethers	3.41E-02	2408
2401040000	Metal Cans	107211	Ethylene glycol	3.05E-02	2408
2401055000	Machinery and Equipment	108883	Toluene	1.58E-01	3149
2401055000	Machinery and Equipment	1330207	Xylenes	1.38E-01	3149
2401055000	Machinery and Equipment	100414	Ethylbenzene	2.15E-02	3149
2401055000	Machinery and Equipment	75092	Dichloromethane	9.66E-03	3149
2401055000	Machinery and Equipment	108101	Methyl isobutyl ketone	5.97E-03	3149
2401055000	Machinery and Equipment	110543	N-hexane	4.55E-03	3149
2401055000	Machinery and Equipment	67561	Methanol	4.26E-04	3149
2401055000	Machinery and Equipment	171	Glycol Ethers	2.84E-04	3149
2401055000	Machinery and Equipment	91203	Naphthalene	2.84E-04	3149
2401055000	Machinery and Equipment	107211	Ethylene glycol	1.42E-04	3149
2401055000	Machinery and Equipment	98828	Cumene	1.42E-04	3149
2401055000	Machinery and Equipment	108383	M-xylene	1.42E-04	3149
2401055000	Machinery and Equipment	108054	Vinyl acetate	1.42E-04	3149
2401060000	Large Appliances	1330207	Xylenes	2.42E-01	2411
2401060000	Large Appliances	108883	Toluene	9.38E-02	2411
2401060000	Large Appliances	171	Glycol Ethers	1.92E-02	2411
2401060000	Large Appliances	107211	Ethylene glycol	1.27E-02	2411
2401065000	Electronics and Other Electrical	108883	Toluene	5.22E-02	3138
2401065000	Electronics and Other Electrical	1330207	Xylenes	4.46E-02	3138
2401065000	Electronics and Other Electrical	75092	Dichloromethane	2.01E-02	3138
2401065000	Electronics and Other Electrical	100414	Ethylbenzene	6.11E-03	3138
2401065000	Electronics and Other Electrical	108054	Vinyl acetate	2.35E-03	3138
2401065000	Electronics and Other Electrical	67561	Methanol	1.72E-03	3138
2401065000	Electronics and Other Electrical	108101	Methyl isobutyl ketone	1.25E-03	3138
2401065000	Electronics and Other Electrical	110543	N-hexane	9.40E-04	3138

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401065000	Electronics and Other Electrical	171	Glycol Ethers	6.27E-04	3138
2401070000	Motor Vehicles	1330207	Xylenes	1.95E-01	3131
2401070000	Motor Vehicles	108883	Toluene	1.47E-01	3131
2401070000	Motor Vehicles	100414	Ethylbenzene	2.81E-02	3131
2401070000	Motor Vehicles	108101	Methyl isobutyl ketone	2.53E-03	3131
2401075000	Aircraft	108883	Toluene	2.10E-01	2414
2401075000	Aircraft	108101	Methyl isobutyl ketone	8.77E-02	2414
2401075000	Aircraft	1330207	Xylenes	6.14E-02	2414
2401075000	Aircraft	171	Glycol Ethers	2.83E-02	2414
2401075000	Aircraft	107211	Ethylene glycol	4.83E-03	2414
2401080000	Marine	1330207	Xylenes	2.35E-01	2415
2401080000	Marine	108883	Toluene	1.36E-01	2415
2401080000	Marine	108101	Methyl isobutyl ketone	4.96E-02	2415
2401080000	Marine	171	Glycol Ethers	1.93E-02	2415
2401080000	Marine	107211	Ethylene glycol	3.50E-03	2415
2401085000	Railroad	108883	Toluene	2.54E-01	2416
2401085000	Railroad	1330207	Xylenes	1.19E-01	2416
2401085000	Railroad	108101	Methyl isobutyl ketone	7.46E-02	2416
2401085000	Railroad	171	Glycol Ethers	2.41E-02	2416
2401085000	Railroad	107211	Ethylene glycol	4.20E-03	2416
2401090000	Misc. Manufacturing	108883	Toluene	1.58E-01	3149
2401090000	Misc. Manufacturing	1330207	Xylenes	1.38E-01	3149
2401090000	Misc. Manufacturing	100414	Ethylbenzene	2.15E-02	3149
2401090000	Misc. Manufacturing	75092	Dichloromethane	9.66E-03	3149
2401090000	Misc. Manufacturing	108101	Methyl isobutyl ketone	5.97E-03	3149
2401090000	Misc. Manufacturing	110543	N-hexane	4.55E-03	3149
2401090000	Misc. Manufacturing	67561	Methanol	4.26E-04	3149
2401090000	Misc. Manufacturing	171	Glycol Ethers	2.84E-04	3149
2401090000	Misc. Manufacturing	91203	Naphthalene	2.84E-04	3149
2401090000	Misc. Manufacturing	107211	Ethylene glycol	1.42E-04	3149
2401090000	Misc. Manufacturing	98828	Cumene	1.42E-04	3149
2401090000	Misc. Manufacturing	108383	M-xylene	1.42E-04	3149
2401090000	Misc. Manufacturing	108054	Vinyl acetate	1.42E-04	3149
2401100000	Industrial Maintenance Coatings	108883	Toluene	5.22E-02	3138
2401100000	Industrial Maintenance Coatings	1330207	Xylenes	4.46E-02	3138
2401100000	Industrial Maintenance Coatings	75092	Dichloromethane	2.01E-02	3138
2401100000	Industrial Maintenance Coatings	100414	Ethylbenzene	6.11E-03	3138
2401100000	Industrial Maintenance Coatings	108054	Vinyl acetate	2.35E-03	3138
2401100000	Industrial Maintenance Coatings	67561	Methanol	1.72E-03	3138
2401100000	Industrial Maintenance Coatings	108101	Methyl isobutyl ketone	1.25E-03	3138

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2401100000	Industrial Maintenance Coatings	110543	N-hexane	9.40E-04	3138
2401100000	Industrial Maintenance Coatings	171	Glycol Ethers	6.27E-04	3138
2401200000	Other Special Purpose Coatings	108883	Toluene	5.22E-02	3138
2401200000	Other Special Purpose Coatings	1330207	Xylenes	4.46E-02	3138
2401200000	Other Special Purpose Coatings	75092	Dichloromethane	2.01E-02	3138
2401200000	Other Special Purpose Coatings	100414	Ethylbenzene	6.11E-03	3138
2401200000	Other Special Purpose Coatings	108054	Vinyl acetate	2.35E-03	3138
2401200000	Other Special Purpose Coatings	67561	Methanol	1.72E-03	3138
2401200000	Other Special Purpose Coatings	108101	Methyl isobutyl ketone	1.25E-03	3138
2401200000	Other Special Purpose Coatings	110543	N-hexane	9.40E-04	3138
2401200000	Other Special Purpose Coatings	171	Glycol Ethers	6.27E-04	3138
2415000000	Degreasing	108883	Toluene	2.35E-02	95817
2415000000	Degreasing	67561	Methanol	2.33E-02	95817
2415000000	Degreasing	110543	N-hexane	7.17E-03	95817
2415000000	Degreasing	100425	Styrene	6.46E-03	95817
2415000000	Degreasing	1330207	Xylenes	6.03E-03	95817
2415000000	Degreasing	171	Glycol Ethers	4.90E-03	95817
2415000000	Degreasing	127184	Perchloroethylene	2.13E-03	95817
2415000000	Degreasing	95476	O-xylene	1.17E-03	95817
2415000000	Degreasing	107211	Ethylene glycol	1.08E-03	95817
2415000000	Degreasing	108383	M-xylene	1.08E-03	95817
2415000000	Degreasing	79016	Trichloroethylene	9.79E-04	95817
2415000000	Degreasing	111422	Diethanolamine	7.82E-04	95817
2415000000	Degreasing	122996	Phenoxyethanol	7.49E-04	95817
2415000000	Degreasing	75092	Dichloromethane	5.58E-04	95817
2415000000	Degreasing	100414	Ethylbenzene	4.33E-04	95817
2415000000	Degreasing	106423	P-xylene	3.65E-04	95817
2415000000	Degreasing	N590	Polycyclic Organic Matter	1.68E-04	95817
2415000000	Degreasing	108101	Methyl isobutyl ketone	1.26E-04	95817
2415000000	Degreasing	80626	Methyl methacrylate	1.23E-04	95817
2420000000	Dry Cleaning	127184	Perchloroethylene	4.63E-01	2422
2420000000	Dry Cleaning	71556	1,1,1-trichloroethane	4.40E-02	2422
2425000000	Graphic Arts	84742	Dibutyl phthalate	9.99E-02	1191
2425000000	Graphic Arts	171	Glycol Ethers	4.00E-04	1191
2425000000	Graphic Arts	584849	2,4-toluene diisocyanate	3.00E-04	1191
2460100000	All Personal Care Products	108883	Toluene	1.57E-03	95823
2460100000	All Personal Care Products	111422	Diethanolamine	1.13E-03	95823
2460100000	All Personal Care Products	122996	Phenoxyethanol	1.03E-03	95823
2460100000	All Personal Care Products	171	Glycol Ethers	6.59E-04	95823
2460100000	All Personal Care Products	110543	N-hexane	5.40E-04	95823

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2460100000	All Personal Care Products	85449	Phthalic anhydride	2.70E-04	95823
2460200000	All Household Products	108883	Toluene	2.35E-02	95817
2460200000	All Household Products	67561	Methanol	2.33E-02	95817
2460200000	All Household Products	110543	N-hexane	7.17E-03	95817
2460200000	All Household Products	100425	Styrene	6.46E-03	95817
2460200000	All Household Products	1330207	Xylenes	6.03E-03	95817
2460200000	All Household Products	171	Glycol Ethers	4.90E-03	95817
2460200000	All Household Products	127184	Perchloroethylene	2.13E-03	95817
2460200000	All Household Products	95476	O-xylene	1.17E-03	95817
2460200000	All Household Products	107211	Ethylene glycol	1.08E-03	95817
2460200000	All Household Products	108383	M-xylene	1.08E-03	95817
2460200000	All Household Products	79016	Trichloroethylene	9.79E-04	95817
2460200000	All Household Products	111422	Diethanolamine	7.82E-04	95817
2460200000	All Household Products	122996	Phenoxyethanol	7.49E-04	95817
2460200000	All Household Products	75092	Dichloromethane	5.58E-04	95817
2460200000	All Household Products	100414	Ethylbenzene	4.33E-04	95817
2460200000	All Household Products	106423	P-xylene	3.65E-04	95817
2460200000	All Household Products	N590	Polycyclic Organic Matter	1.68E-04	95817
2460200000	All Household Products	108101	Methyl isobutyl ketone	1.26E-04	95817
2460200000	All Household Products	80626	Methyl methacrylate	1.23E-04	95817
2460400000	All Automotive Aftermarket Products	108883	Toluene	2.35E-02	95817
2460400000	All Automotive Aftermarket Products	67561	Methanol	2.33E-02	95817
2460400000	All Automotive Aftermarket Products	110543	N-hexane	7.17E-03	95817
2460400000	All Automotive Aftermarket Products	100425	Styrene	6.46E-03	95817
2460400000	All Automotive Aftermarket Products	1330207	Xylenes	6.03E-03	95817
2460400000	All Automotive Aftermarket Products	171	Glycol Ethers	4.90E-03	95817
2460400000	All Automotive Aftermarket Products	127184	Perchloroethylene	2.13E-03	95817
2460400000	All Automotive Aftermarket Products	95476	O-xylene	1.17E-03	95817
2460400000	All Automotive Aftermarket Products	107211	Ethylene glycol	1.08E-03	95817
2460400000	All Automotive Aftermarket Products	108383	M-xylene	1.08E-03	95817
2460400000	All Automotive Aftermarket Products	79016	Trichloroethylene	9.79E-04	95817
2460400000	All Automotive Aftermarket Products	111422	Diethanolamine	7.82E-04	95817
2460400000	All Automotive Aftermarket Products	122996	Phenoxyethanol	7.49E-04	95817
2460400000	All Automotive Aftermarket Products	75092	Dichloromethane	5.58E-04	95817
2460400000	All Automotive Aftermarket Products	100414	Ethylbenzene	4.33E-04	95817
2460400000	All Automotive Aftermarket Products	106423	P-xylene	3.65E-04	95817
2460400000	All Automotive Aftermarket Products	N590	Polycyclic Organic Matter	1.68E-04	95817
2460400000	All Automotive Aftermarket Products	108101	Methyl isobutyl ketone	1.26E-04	95817
2460400000	All Automotive Aftermarket Products	80626	Methyl methacrylate	1.23E-04	95817
2460600000	All Adhesives and Sealants	107211	Ethylene glycol	1.25E-01	95811

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2460600000	All Adhesives and Sealants	1330207	Xylenes	4.45E-02	95811
2460600000	All Adhesives and Sealants	108883	Toluene	3.57E-02	95811
2460600000	All Adhesives and Sealants	100425	Styrene	3.21E-02	95811
2460600000	All Adhesives and Sealants	100414	Ethylbenzene	1.62E-02	95811
2460600000	All Adhesives and Sealants	171	Glycol Ethers	1.22E-02	95811
2460600000	All Adhesives and Sealants	110543	N-hexane	1.09E-02	95811
2460600000	All Adhesives and Sealants	80626	Methyl methacrylate	1.01E-03	95811
2460600000	All Adhesives and Sealants	67561	Methanol	9.48E-04	95811
2460600000	All Adhesives and Sealants	108054	Vinyl acetate	7.39E-04	95811
2460600000	All Adhesives and Sealants	79107	Acrylic acid	4.96E-04	95811
2460600000	All Adhesives and Sealants	84742	Dibutyl phthalate	3.68E-04	95811
2460600000	All Adhesives and Sealants	75092	Dichloromethane	3.44E-04	95811
2460600000	All Adhesives and Sealants	111422	Diethanolamine	2.85E-04	95811
2460600000	All Adhesives and Sealants	108952	Phenol	2.06E-04	95811
2460600000	All Adhesives and Sealants	108101	Methyl isobutyl ketone	1.25E-04	95811
2460600000	All Adhesives and Sealants	108383	M-xylene	1.22E-04	95811
2460600000	All Adhesives and Sealants	98828	Cumene	1.14E-04	95811
2460600000	All Adhesives and Sealants	91203	Naphthalene	6.77E-05	95811
2460600000	All Adhesives and Sealants	131113	Dimethyl phthalate	6.21E-05	95811
2460600000	All Adhesives and Sealants	N590	Polycyclic Organic Matter	3.43E-05	95811
2460600000	All Adhesives and Sealants	50000	Formaldehyde	1.32E-05	95811
2460600000	All Adhesives and Sealants	79016	Trichloroethylene	5.29E-06	95811
2460600000	All Adhesives and Sealants	95476	O-xylene	4.68E-06	95811
2460600000	All Adhesives and Sealants	75070	Acetaldehyde	1.71E-06	95811
2460600000	All Adhesives and Sealants	106423	P-xylene	1.46E-06	95811
2460600000	All Adhesives and Sealants	71432	Benzene	1.21E-06	95811
2460800000	All FIFRA Related Products	171	Glycol Ethers	9.52E-03	95826
2460800000	All FIFRA Related Products	107211	Ethylene glycol	1.56E-03	95826
2460800000	All FIFRA Related Products	N590	Polycyclic Organic Matter	5.66E-04	95826
2460800000	All FIFRA Related Products	98828	Cumene	5.24E-04	95826
2460800000	All FIFRA Related Products	91203	Naphthalene	2.80E-04	95826
2460800000	All FIFRA Related Products	111422	Diethanolamine	2.07E-04	95826
2460800000	All FIFRA Related Products	108883	Toluene	1.21E-04	95826
2460800000	All FIFRA Related Products	1330207	Xylenes	1.12E-04	95826
2460800000	All FIFRA Related Products	121448	Triethylamine	3.60E-05	95826
2460800000	All FIFRA Related Products	108383	M-xylene	3.22E-05	95826
2460800000	All FIFRA Related Products	110543	N-hexane	1.52E-05	95826
2460800000	All FIFRA Related Products	67561	Methanol	1.53E-06	95826
2460900000	Misc. Products	107211	Ethylene glycol	1.69E-02	95822
2460900000	Misc. Products	110543	N-hexane	6.88E-03	95822

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2460900000	Misc. Products	122996	Phenoxyethanol	4.68E-04	95822
2460900000	Misc. Products	111422	Diethanolamine	3.84E-04	95822
2460900000	Misc. Products	79016	Trichloroethylene	1.93E-04	95822
2460900000	Misc. Products	1330207	Xylenes	9.71E-05	95822
2460900000	Misc. Products	98828	Cumene	8.59E-05	95822
2460900000	Misc. Products	100414	Ethylbenzene	6.87E-05	95822
2460900000	Misc. Products	108101	Methyl isobutyl ketone	3.81E-05	95822
2460900000	Misc. Products	171	Glycol Ethers	3.81E-05	95822
2460900000	Misc. Products	79107	Acrylic acid	3.40E-05	95822
2460900000	Misc. Products	108883	Toluene	2.72E-05	95822
2460900000	Misc. Products	91203	Naphthalene	7.48E-06	95822
2460900000	Misc. Products	108383	M-xylene	5.77E-06	95822
2460030999	Lighter Fluid, Fire Starter, Other Fuels	108883	Toluene	1.17E-03	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	N590	Polycyclic Organic Matter	7.79E-04	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	67561	Methanol	7.42E-04	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	108383	M-xylene	3.13E-04	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	75092	Dichloromethane	1.56E-04	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	110543	N-hexane	4.64E-05	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	91203	Naphthalene	1.70E-05	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	108101	Methyl isobutyl ketone	1.56E-05	95820
2460030999	Lighter Fluid, Fire Starter, Other Fuels	71432	Benzene	5.95E-06	95820
2461850000	Pesticide Application: Agricultural	542756	1,3-dichloropropene	2.00E-01	95828
2461850000	Pesticide Application: Agricultural	74839	Methyl bromide	2.67E-02	95828
2461850000	Pesticide Application: Agricultural	1582098	Trifluralin	5.59E-03	95828
2461850000	Pesticide Application: Agricultural	75569	Propylene oxide	3.39E-03	95828
2461850000	Pesticide Application: Agricultural	82688	Pentachloronitrobenzene	1.33E-03	95828
2461850000	Pesticide Application: Agricultural	50000	Formaldehyde	2.14E-05	95828
2461850000	Pesticide Application: Agricultural	1330207	Xylenes	2.54E-06	95828
2461850000	Pesticide Application: Agricultural	87865	Pentachlorophenol	4.30E-07	95828
2460500000	All Coatings and Related Products	108883	Toluene	1.28E-01	95812
2460500000	All Coatings and Related Products	95476	O-xylene	3.29E-02	95812
2460500000	All Coatings and Related Products	108383	M-xylene	2.70E-02	95812
2460500000	All Coatings and Related Products	100414	Ethylbenzene	1.20E-02	95812
2460500000	All Coatings and Related Products	106423	P-xylene	1.02E-02	95812
2460500000	All Coatings and Related Products	110543	N-hexane	6.11E-03	95812
2460500000	All Coatings and Related Products	108101	Methyl isobutyl ketone	5.01E-03	95812
2460500000	All Coatings and Related Products	171	Glycol Ethers	1.72E-03	95812
2460500000	All Coatings and Related Products	98828	Cumene	4.61E-04	95812
2460500000	All Coatings and Related Products	N590	Polycyclic Organic Matter	4.44E-04	95812
2460500000	All Coatings and Related Products	67561	Methanol	4.01E-04	95812

SCC	Description	Pollutant Code	Pollutant Description	Speciation Factor	SPECIATE 5.2 Reference Profile
2460500000	All Coatings and Related Products	107211	Ethylene glycol	3.94E-04	95812
2460500000	All Coatings and Related Products	91203	Naphthalene	2.16E-04	95812
2460500000	All Coatings and Related Products	84742	Dibutyl phthalate	1.27E-04	95812
2460500000	All Coatings and Related Products	121448	Triethylamine	3.42E-06	95812

Note: The Speciation Factor has been adjusted to reflect the HAP to VOC ratio for each SPECIATE profile. SPECIATE typically houses information normalized to TOG.

Table 10. Point-Nonpoint Crosswalk for Solvent Utilization

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
41100103	Chemical Evaporation	Aerosol Cans	Filling Facilities	Filling	2460500000	All Coatings and Related Products
41100104	Chemical Evaporation	Aerosol Cans	Filling Facilities	Leak Check	2460500000	All Coatings and Related Products
41100102	Chemical Evaporation	Aerosol Cans	Filling Facilities	Mixing	2460500000	All Coatings and Related Products
41100101	Chemical Evaporation	Aerosol Cans	Filling Facilities	Other Not Elsewhere Classified	2460500000	All Coatings and Related Products
41100105	Chemical Evaporation	Aerosol Cans	Filling Facilities	Washing	2460500000	All Coatings and Related Products
41000230	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer	2420000000	Dry Cleaning
41000233	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Cool Down Cycle	2420000000	Dry Cleaning
41000232	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Drying Cycle	2420000000	Dry Cleaning
41000231	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Loading/Unloading	2420000000	Dry Cleaning
41000240	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration	2420000000	Dry Cleaning
41000245	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, All Carbon, Batch Operation	2420000000	Dry Cleaning
41000247	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, All Carbon, Continuous Operation	2420000000	Dry Cleaning
41000244	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, Carbon Core, Batch Operation	2420000000	Dry Cleaning
41000246	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, Carbon Core, Continuous Operation	2420000000	Dry Cleaning
41000242	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Multiple Charge	2420000000	Dry Cleaning

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
41000243	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Regenerative	2420000000	Dry Cleaning
41000241	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Single Charge	2420000000	Dry Cleaning
41000225	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Solvent Settling Tank: Batch Flow	2420000000	Dry Cleaning
41000226	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Solvent Settling Tank: Continuous Flow	2420000000	Dry Cleaning
41000202	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Stoddard	2420000000	Dry Cleaning
41000215	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Washer/Extractor	2420000000	Dry Cleaning
41000260	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal	2420000000	Dry Cleaning
41000265	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Cartridge, All Carbon	2420000000	Dry Cleaning
41000266	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Cartridge, Carbon Core Only	2420000000	Dry Cleaning
41000262	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Filter Waste, Centrifuged	2420000000	Dry Cleaning
41000261	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Filter Waste, Drained	2420000000	Dry Cleaning
41000263	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Settling Tank Sludge	2420000000	Dry Cleaning
41000264	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Still Waste	2420000000	Dry Cleaning
41080001	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Equipment Leaks	Equipment Leaks	2420000000	Dry Cleaning
41000130	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer	2420000000	Dry Cleaning
41000133	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Cool Down Cycle	2420000000	Dry Cleaning
41000132	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Drying Cycle	2420000000	Dry Cleaning
41000131	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Loading/Unloading	2420000000	Dry Cleaning
41000140	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration	2420000000	Dry Cleaning
41000145	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, All Carbon, Batch Operation	2420000000	Dry Cleaning
41000147	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, All Carbon, Continuous Operation	2420000000	Dry Cleaning

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
41000144	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, Carbon Core, Batch Operation	2420000000	Dry Cleaning
41000146	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, Carbon Core, Continuous Operation	2420000000	Dry Cleaning
41000142	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Multiple Charge	2420000000	Dry Cleaning
41000143	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Regenerative	2420000000	Dry Cleaning
41000141	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Single Charge	2420000000	Dry Cleaning
41000125	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Solvent Settling Tank: Batch Flow	2420000000	Dry Cleaning
41000126	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Solvent Settling Tank: Continuous Flow	2420000000	Dry Cleaning
41000101	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Stoddard	2420000000	Dry Cleaning
41000115	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Washer/Extractor	2420000000	Dry Cleaning
41000160	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal	2420000000	Dry Cleaning
41000165	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Cartridge, All Carbon	2420000000	Dry Cleaning
41000166	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Cartridge, Carbon Core Only	2420000000	Dry Cleaning
41000162	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Filter Waste, Centrifuged	2420000000	Dry Cleaning
41000161	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Filter Waste, Drained	2420000000	Dry Cleaning
41000163	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Settling Tank Sludge	2420000000	Dry Cleaning
41000164	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Still Waste	2420000000	Dry Cleaning
41082001	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Aggregate	Process Area Drains	2420000000	Dry Cleaning
41082002	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Aggregate	Process Equipment Drains	2420000000	Dry Cleaning
41082599	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Points of Generation	Other Not Classified	2420000000	Dry Cleaning
49000503	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	1,1,1-Trichloroethane	2401090000	Misc. Manufacturing
49000504	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Chloroform	2401090000	Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
49000502	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Perchloroethylene	2401090000	Misc. Manufacturing
49000599	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Solvent	2401090000	Misc. Manufacturing
49000501	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Trichloroethylene	2401090000	Misc. Manufacturing
40100305	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	1,1,1-Trichloroethane (Methyl Chloroform)	2415000000	Degreasing
40100310	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Acetone	2415000000	Degreasing
40100336	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Degreaser: Entire Unit	2415000000	Degreasing
40100335	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Entire Unit	2415000000	Degreasing
40100309	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Freon	2415000000	Degreasing
40100311	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Glycol Ethers	2415000000	Degreasing
40100307	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Isopropyl Alcohol	2415000000	Degreasing
40100301	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methanol	2415000000	Degreasing
40100308	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methyl Ethyl Ketone	2415000000	Degreasing
40100302	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methylene Chloride	2415000000	Degreasing
40100399	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Other Not Classified	2415000000	Degreasing
40100304	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Perchloroethylene	2415000000	Degreasing
40100303	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Stoddard (Petroleum Solvent)	2415000000	Degreasing
40100306	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Trichloroethylene	2415000000	Degreasing
40100252	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): General Degreasing Units	2415000000	Degreasing
40100202	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): Open-top Vapor Degreasing	2415000000	Degreasing
40100222	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform):Conveyorized Vapor Degreaser	2415000000	Degreasing
40100209	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Butyl Acetate: Open-top Vapor Degreasing	2415000000	Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40100208	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Chlorosolve: Open-top Vapor Degreasing	2415000000	Degreasing
40100215	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: Open-top Vapor Degreasing	2415000000	Degreasing
40100236	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: with Non-boiling Solvent: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100235	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: with Vaporized Solvent: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100224	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100254	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: General Degreasing Units	2415000000	Degreasing
40100204	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: Open-top Vapor Degreasing	2415000000	Degreasing
40100298	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100296	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: General Degreasing Units	2415000000	Degreasing
40100299	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: Open-top Vapor Degreasing	2415000000	Degreasing
40100223	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100253	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: General Degreasing Units	2415000000	Degreasing
40100203	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: Open-top Vapor Degreasing	2415000000	Degreasing
40100221	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): Conveyorized Vapor Degreasing	2415000000	Degreasing
40100251	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): General Degreasing Units	2415000000	Degreasing
40100201	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): Open-top Vapor Degreasing	2415000000	Degreasing
40100256	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Toluene: General Degreasing Units	2415000000	Degreasing
40100206	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Toluene: Open-top Vapor Degreasing	2415000000	Degreasing
40100225	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100255	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: General Degreasing Units	2415000000	Degreasing
40100205	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: Open-top Vapor Degreasing	2415000000	Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40100258	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorofluoromethane: General Degreasing Units	2415000000	Degreasing
40100257	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorotrifluoroethane (Freon): General Degreasing Units	2415000000	Degreasing
40100207	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorotrifluoroethane (Freon): Open-top Vapor Degreasing	2415000000	Degreasing
40100107	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Ethylene Oxide: General	2420000000	Dry Cleaning
40100198	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Other Not Classified	2420000000	Dry Cleaning
40100101	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Perchloroethylene	2420000000	Dry Cleaning
40100102	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard (Petroleum Solvent) (Use 4-10-001-01 or 4-10-002-01)	2420000000	Dry Cleaning
40100104	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard (Petroleum Solvent) (Use 4-10-001-02 or 4-10-002-02)	2420000000	Dry Cleaning
40100147	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard:Filtr Disp/Cooked Muck (Centrif) (Use 4-10-001-62 or 002-62)	2420000000	Dry Cleaning
40100146	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard:Filtr Disp/Cooked Muck(Drained) (Use 4-10-001-61 or 002-61)	2420000000	Dry Cleaning
40100161	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Cartrige Filter Disposal	2420000000	Dry Cleaning
40100163	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Miscellaneous Fugitive	2420000000	Dry Cleaning
40100162	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Still Residue Disposal	2420000000	Dry Cleaning
40100160	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Washer/Dryer/Still	2420000000	Dry Cleaning
40100105	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorotrifluoroethane (Freon)	2420000000	Dry Cleaning
49000601	Chemical Evaporation	Organic Solvent Evaporation	Freon Recovery/Recycling Operations	CFC-12 Recovery - Auto Air Conditioning	2401090000	Misc. Manufacturing
40188898	Chemical Evaporation	Organic Solvent Evaporation	Fugitive Emissions	General	2401090000	Misc. Manufacturing
40100499	Chemical Evaporation	Organic Solvent Evaporation	Knit Fabric Scouring with Chlorinated Solvent	Other Not Classified	2401090000	Misc. Manufacturing
40100401	Chemical Evaporation	Organic Solvent Evaporation	Knit Fabric Scouring with Chlorinated Solvent	Perchloroethylene	2401090000	Misc. Manufacturing
49099998	Chemical Evaporation	Organic Solvent Evaporation	Miscellaneous Volatile Organic Compound Evaporation	Miscellaneous	2401090000	Misc. Manufacturing
49000302	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Chlorobenzene	2415000000	Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
49000304	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Creosote	2415000000	Degreasing
49000301	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Ethylene Glycol	2415000000	Degreasing
49000303	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	o-Dichlorobenzene	2415000000	Degreasing
49000399	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Other Not Classified	2415000000	Degreasing
49000104	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Furfural	2401090000	Misc. Manufacturing
49000102	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Methyl Ethyl Ketone	2401090000	Misc. Manufacturing
49000103	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Methyl Isobutyl Ketone	2401090000	Misc. Manufacturing
49000199	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Other Not Classified	2401090000	Misc. Manufacturing
49000101	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Petroleum Naphtha (Stoddard)	2401090000	Misc. Manufacturing
49000105	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Trichloroethylene	2401090000	Misc. Manufacturing
49000401	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Acetone	2415000000	Degreasing
49000403	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Methyl Methacrylate	2415000000	Degreasing
49000499	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Other Not Classified	2415000000	Degreasing
49000402	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Perchloroethylene	2415000000	Degreasing
49000404	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Phenol	2415000000	Degreasing
49000405	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Propylene Glycol	2415000000	Degreasing
49000202	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Condenser Vent	2401090000	Misc. Manufacturing
49000208	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Decanting	2401090000	Misc. Manufacturing
49000207	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Distillation Vent	2401090000	Misc. Manufacturing
49000206	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Fugitive Leaks	2401090000	Misc. Manufacturing
49000203	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Incinerator Stack	2401090000	Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
49000299	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Other Not Classified	2401090000	Misc. Manufacturing
49000209	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Salting	2401090000	Misc. Manufacturing
40500805	Chemical Evaporation	Printing/Publishing	Digital Printing	Dryer	2425000000	Graphic Arts
40500905	Chemical Evaporation	Printing/Publishing	Digital Printing	Dryer	2425000000	Graphic Arts
40500806	Chemical Evaporation	Printing/Publishing	Digital Printing	Other non-dryer printing	2425000000	Graphic Arts
40500906	Chemical Evaporation	Printing/Publishing	Digital Printing	Other non-dryer printing	2425000000	Graphic Arts
40500101	Chemical Evaporation	Printing/Publishing	Drying	Dryer	2425000000	Graphic Arts
40500308	Chemical Evaporation	Printing/Publishing	Flexographic	Dryer	2425000000	Graphic Arts
40500302	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Carbitol	2425000000	Graphic Arts
40500303	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Cellosolve	2425000000	Graphic Arts
40500304	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Ethyl Alcohol	2425000000	Graphic Arts
40500305	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Isopropyl Alcohol	2425000000	Graphic Arts
40500307	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, Naphtha	2425000000	Graphic Arts
40500306	Chemical Evaporation	Printing/Publishing	Flexographic	Ink Thinning Solvent, n-Propyl Alcohol	2425000000	Graphic Arts
40500309	Chemical Evaporation	Printing/Publishing	Flexographic	Other non-dryer printing	2425000000	Graphic Arts
40500301	Chemical Evaporation	Printing/Publishing	Flexographic	Printing	2425000000	Graphic Arts
40500314	Chemical Evaporation	Printing/Publishing	Flexographic	Propyl Alcohol Cleanup	2415000000	Degreasing
40500315	Chemical Evaporation	Printing/Publishing	Flexographic	Steam: Water-based	2425000000	Graphic Arts
40500318	Chemical Evaporation	Printing/Publishing	Flexographic	Steam: Water-based in Ink	2425000000	Graphic Arts
40500319	Chemical Evaporation	Printing/Publishing	Flexographic	Steam: Water-based Ink Storage	2425000000	Graphic Arts
40588801	Chemical Evaporation	Printing/Publishing	Fugitive Emissions	General	2425000000	Graphic Arts

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40500597	Chemical Evaporation	Printing/Publishing	General	Other Not Classified	2425000000	Graphic Arts
40500514	Chemical Evaporation	Printing/Publishing	Gravure	Cleanup Solvent	2415000000	Degreasing
40500502	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Dimethylformamide	2425000000	Graphic Arts
40500503	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Ethyl Acetate	2425000000	Graphic Arts
40500506	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Methyl Ethyl Ketone	2425000000	Graphic Arts
40500507	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Methyl Isobutyl Ketone	2425000000	Graphic Arts
40500510	Chemical Evaporation	Printing/Publishing	Gravure	Ink Thinning Solvent, Toluene	2425000000	Graphic Arts
40500511	Chemical Evaporation	Printing/Publishing	Gravure	Printing	2425000000	Graphic Arts
40500215	Chemical Evaporation	Printing/Publishing	Letterpress	Cleaning Solution	2415000000	Degreasing
40500204	Chemical Evaporation	Printing/Publishing	Letterpress	Dryer	2425000000	Graphic Arts
40500202	Chemical Evaporation	Printing/Publishing	Letterpress	Ink Thinning Solvent, Kerosene	2425000000	Graphic Arts
40500203	Chemical Evaporation	Printing/Publishing	Letterpress	Ink Thinning Solvents, Mineral Solvents	2425000000	Graphic Arts
40500205	Chemical Evaporation	Printing/Publishing	Letterpress	Other non-dryer printing	2425000000	Graphic Arts
40500201	Chemical Evaporation	Printing/Publishing	Letterpress	Printing	2425000000	Graphic Arts
40500402	Chemical Evaporation	Printing/Publishing	Lithographic	Dryer	2425000000	Graphic Arts
40500413	Chemical Evaporation	Printing/Publishing	Lithographic	Isopropyl Alcohol Cleanup	2415000000	Degreasing
40500403	Chemical Evaporation	Printing/Publishing	Lithographic	Other non-dryer printing	2425000000	Graphic Arts
40500401	Chemical Evaporation	Printing/Publishing	Lithographic	Printing	2425000000	Graphic Arts
40500417	Chemical Evaporation	Printing/Publishing	Offset Lithography	Cleaning Solution: Water-based	2415000000	Degreasing
40500415	Chemical Evaporation	Printing/Publishing	Offset Lithography	Dampening Solution with Alcohol Substitute	2425000000	Graphic Arts
40500416	Chemical Evaporation	Printing/Publishing	Offset Lithography	Dampening Solution with High Solvent Content	2425000000	Graphic Arts

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40500418	Chemical Evaporation	Printing/Publishing	Offset Lithography	Dampening Solution with Isopropyl Alcohol	2425000000	Graphic Arts
40500421	Chemical Evaporation	Printing/Publishing	Offset Lithography	Heatset Ink Mixing	2425000000	Graphic Arts
40500422	Chemical Evaporation	Printing/Publishing	Offset Lithography	Heatset Solvent Storage	2425000000	Graphic Arts
40500431	Chemical Evaporation	Printing/Publishing	Offset Lithography	Nonheated Lithographic Inks	2425000000	Graphic Arts
40500601	Chemical Evaporation	Printing/Publishing	Printing	Ink Mixing	2425000000	Graphic Arts
40500599	Chemical Evaporation	Printing/Publishing	Printing	Ink Thinning Solvent	2425000000	Graphic Arts
40500515	Chemical Evaporation	Printing/Publishing	Rotogravure	Dryer	2425000000	Graphic Arts
40500516	Chemical Evaporation	Printing/Publishing	Rotogravure	Other non-dryer printing	2425000000	Graphic Arts
40500803	Chemical Evaporation	Printing/Publishing	Screen Printing	Dryer	2425000000	Graphic Arts
40500802	Chemical Evaporation	Printing/Publishing	Screen Printing	Fugitive Emissions: Cleaning Rags	2415000000	Degreasing
40500804	Chemical Evaporation	Printing/Publishing	Screen Printing	Other non-dryer printing	2425000000	Graphic Arts
40500801	Chemical Evaporation	Printing/Publishing	Screen Printing	Screen Printing	2425000000	Graphic Arts
40202411	Chemical Evaporation	Surface Coating Operations	Aerospace	Chemical Depainting	2401075000	Aircraft
40202409	Chemical Evaporation	Surface Coating Operations	Aerospace	Chemical Milling	2401075000	Aircraft
40202408	Chemical Evaporation	Surface Coating Operations	Aerospace	Chemical Milling Maskant Application	2401075000	Aircraft
40202402	Chemical Evaporation	Surface Coating Operations	Aerospace	Cleaning/Pretreatment	2415000000	Degreasing
40202403	Chemical Evaporation	Surface Coating Operations	Aerospace	Coating Mixing	2401075000	Aircraft
40202404	Chemical Evaporation	Surface Coating Operations	Aerospace	Coating Storage	2401075000	Aircraft
40202405	Chemical Evaporation	Surface Coating Operations	Aerospace	Equipment Cleanup	2415000000	Degreasing
40202401	Chemical Evaporation	Surface Coating Operations	Aerospace	Primer Application	2401075000	Aircraft
40202407	Chemical Evaporation	Surface Coating Operations	Aerospace	Specialty Coating Application	2401075000	Aircraft

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202406	Chemical Evaporation	Surface Coating Operations	Aerospace	Topcoat Application	2401075000	Aircraft
40202410	Chemical Evaporation	Surface Coating Operations	Aerospace	Waste Storage and Handling	2401075000	Aircraft
40201609	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Anti-corrosion Priming	2401070000	Motor Vehicles
40201602	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Cleaning/Pretreatment	2415000000	Degreasing
40201603	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Coating Mixing	2401070000	Motor Vehicles
40201604	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Coating Storage	2401070000	Motor Vehicles
40201608	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Deadeners	2401070000	Motor Vehicles
40201605	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Equipment Cleanup	2415000000	Degreasing
40201623	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Solvent-borne - Automobiles	2401070000	Motor Vehicles
40201629	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Solvent-borne - Light Trucks	2401070000	Motor Vehicles
40201624	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Water-borne - Automobiles	2401070000	Motor Vehicles
40201630	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Water-borne - Light Trucks	2401070000	Motor Vehicles
40201699	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Other Not Classified	2401070000	Motor Vehicles
40201601	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Application/Electo-deposition/Dip/Spray	2401070000	Motor Vehicles
40201622	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Electro-deposition - Automobiles	2401070000	Motor Vehicles
40201628	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Electro-deposition - Light Trucks	2401070000	Motor Vehicles
40201621	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Solvent-borne - Automobiles	2401070000	Motor Vehicles
40201627	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Solvent-borne - Light Trucks	2401070000	Motor Vehicles
40201619	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Surfacing Operation	2401070000	Motor Vehicles
40201620	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Repair Topcoat Application Area	2401070000	Motor Vehicles
40201607	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Sealers	2401070000	Motor Vehicles

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201606	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat Operation	2401070000	Motor Vehicles
40201625	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Solvent-borne - Automobiles	2401070000	Motor Vehicles
40201631	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Solvent-borne - Light Trucks	2401070000	Motor Vehicles
40201626	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Water-borne - Automobiles	2401070000	Motor Vehicles
40201632	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Water-borne - Light Trucks	2401070000	Motor Vehicles
40200803	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Baked : 175F	2401055000	Machinery and Equipment
40200870	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Color Coat Oven	2401055000	Machinery and Equipment
40200802	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Dried < 175F	2401055000	Machinery and Equipment
40200872	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	EMI/RFI Shielding Coat Oven	2401055000	Machinery and Equipment
40200855	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Filler Oven	2401055000	Machinery and Equipment
40200801	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	General	2401055000	Machinery and Equipment
40200820	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Prime/Base Coat Oven	2401055000	Machinery and Equipment
40200856	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Sealer Oven	2401055000	Machinery and Equipment
40200861	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Single Coat Application: Oven	2401055000	Machinery and Equipment
40200845	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Curing Ovens (Includes Codes 46, 47, 48, and 49)	2401055000	Machinery and Equipment
40200849	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Interior Body Coat Oven	2401055000	Machinery and Equipment
40200847	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Base Coat (Exterior) Oven	2401055000	Machinery and Equipment
40200846	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Base Coat (Interior) Oven	2401055000	Machinery and Equipment
40200848	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Lithographic Coating Oven	2401055000	Machinery and Equipment
40200830	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Topcoat Oven	2401055000	Machinery and Equipment
40200871	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Topcoat/Texture Coat Oven	2401055000	Machinery and Equipment

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40200841	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Base Coat Oven	2401055000	Machinery and Equipment
40200840	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Curing Ovens: General (Includes Codes 41, 42, and 43)	2401055000	Machinery and Equipment
40200843	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Interior Body Coat Oven	2401055000	Machinery and Equipment
40200842	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Over Varnish Oven	2401055000	Machinery and Equipment
40280001	Chemical Evaporation	Surface Coating Operations	Equipment Leaks	Equipment Leaks	2401090000	Misc. Manufacturing
40204760	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup	2415000000	Degreasing
40204761	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204762	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204735	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Coagulation Baths and Solvent Separation	2401200000	Other Special Purpose Coatings
40204730	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204750	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Drying	2401200000	Other Special Purpose Coatings
40204721	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204740	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Solvent Recovery	2401200000	Other Special Purpose Coatings
40204770	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste	2401200000	Other Special Purpose Coatings
40204771	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204772	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204755	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Winding	2401200000	Other Special Purpose Coatings
40204350	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup	2415000000	Degreasing
40204351	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204352	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204330	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Coating Application	2401200000	Other Special Purpose Coatings

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204340	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Drying/Curing	2401200000	Other Special Purpose Coatings
40204321	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204360	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste	2401200000	Other Special Purpose Coatings
40204361	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204362	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204560	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup	2415000000	Degreasing
40204561	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204562	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204530	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204532	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application: Coating Die	2401200000	Other Special Purpose Coatings
40204531	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application: Extruder	2401200000	Other Special Purpose Coatings
40204550	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cooling Cylinder	2401200000	Other Special Purpose Coatings
40204521	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204570	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste	2401200000	Other Special Purpose Coatings
40204571	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204572	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204555	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Winding	2401200000	Other Special Purpose Coatings
40204150	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup	2415000000	Degreasing
40204151	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204152	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204130	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Coating Application	2401200000	Other Special Purpose Coatings

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204140	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Drying/Curing	2401200000	Other Special Purpose Coatings
40204121	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204160	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste	2401200000	Other Special Purpose Coatings
40204161	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204162	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204660	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup	2415000000	Degreasing
40204661	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204662	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204630	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204631	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application: Calendar Rolls	2401200000	Other Special Purpose Coatings
40204632	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application: Pick Up Roll	2401200000	Other Special Purpose Coatings
40204650	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cooling Rolls	2401200000	Other Special Purpose Coatings
40204621	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204670	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste	2401200000	Other Special Purpose Coatings
40204671	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204672	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204655	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Winding	2401200000	Other Special Purpose Coatings
40204250	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup	2415000000	Degreasing
40204251	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204252	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204230	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Coating Application	2401200000	Other Special Purpose Coatings

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204240	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Drying/Curing	2401200000	Other Special Purpose Coatings
40204221	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204260	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste	2401200000	Other Special Purpose Coatings
40204261	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204262	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings
40204460	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup	2415000000	Degreasing
40204461	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup: Coating Application Equipment	2415000000	Degreasing
40204462	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup: Empty Coating Drums	2415000000	Degreasing
40204430	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application	2401200000	Other Special Purpose Coatings
40204431	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application: First Roll Applicator	2401200000	Other Special Purpose Coatings
40204432	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application: Second Roll Applicator	2401200000	Other Special Purpose Coatings
40204450	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cooler	2401200000	Other Special Purpose Coatings
40204440	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing	2401200000	Other Special Purpose Coatings
40204441	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: First Predrier	2401200000	Other Special Purpose Coatings
40204443	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: Main Drying Tunnel	2401200000	Other Special Purpose Coatings
40204442	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: Second Predrier	2401200000	Other Special Purpose Coatings
40204435	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Lamination: Laminating Device	2401200000	Other Special Purpose Coatings
40204421	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Mixing Tanks	2401200000	Other Special Purpose Coatings
40204470	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste	2401200000	Other Special Purpose Coatings
40204471	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste: Cleaning Rags	2415000000	Degreasing
40204472	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste: Waste Ink Disposal	2401200000	Other Special Purpose Coatings

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204455	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Winding	2401200000	Other Special Purpose Coatings
40201103	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Mixing (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Graphic Arts
40201101	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Operation (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Graphic Arts
40201104	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Storage (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Graphic Arts
40201105	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Equipment Cleanup:Fabric Coating(Also Spec Coat Method Codes 4-02-04X)	2415000000	Degreasing
40201122	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Print:Dryer: Fuel-fired (Also See New Codes Under 4-02-040- XX)	2425000000	Graphic Arts
40201121	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Print:Dryer: Steam Coil (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40201116	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Flat Screen (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40201112	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Roller (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40201114	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Rotary Screen (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40201197	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Misc. Fugitives (Also New Codes 4-02-040-XX)	2425000000	Graphic Arts
40201199	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Other Not Classified (Also See New Codes Under 4-02-040-XX)	2425000000	Graphic Arts
40206030	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application	2401090000	Misc. Manufacturing
40206031	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Beam	2401090000	Misc. Manufacturing
40206032	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Beck	2401090000	Misc. Manufacturing
40206035	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Continuous	2401090000	Misc. Manufacturing
40201201	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: General (Also See New Codes Under 4-02-060-XX)	2401200000	Other Special Purpose Coatings
40206034	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Jet	2401090000	Misc. Manufacturing
40206033	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Jig	2401090000	Misc. Manufacturing
40206010	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Preparation	2401090000	Misc. Manufacturing
40206050	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Waste	2401090000	Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204021	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Application	2425000000	Graphic Arts
40204023	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Drying/Curing	2425000000	Graphic Arts
40204020	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Print Paste	2425000000	Graphic Arts
40204022	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Transfer	2425000000	Graphic Arts
40204002	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Application	2425000000	Graphic Arts
40204001	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Print Paste	2425000000	Graphic Arts
40204004	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Steam Cans/Drying	2425000000	Graphic Arts
40204003	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Transfer	2425000000	Graphic Arts
40204011	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Application	2425000000	Graphic Arts
40204013	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Drying/Curing	2425000000	Graphic Arts
40204010	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Print Paste	2425000000	Graphic Arts
40204012	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Transfer	2425000000	Graphic Arts
40202141	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Adhesive: Other Not Elsewhere Classified	2401015000	Factory Finished Wood
40202142	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Adhesive: Roll-on	2401015000	Factory Finished Wood
40202101	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Base Coat	2401015000	Factory Finished Wood
40202103	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Coating Mixing	2401015000	Factory Finished Wood
40202104	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Coating Storage	2401015000	Factory Finished Wood
40202137	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Enamel	2401015000	Factory Finished Wood
40202105	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Equipment Cleanup	2415000000	Degreasing
40202107	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Filler	2401015000	Factory Finished Wood
40202117	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Filler Sander	2401015000	Factory Finished Wood

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202110	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Grove Coat Application	2401015000	Factory Finished Wood
40202109	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Inks	2401015000	Factory Finished Wood
40202199	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Other Not Elsewhere Classified	2401015000	Factory Finished Wood
40202198	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Other Not Elsewhere Classified	2401015000	Factory Finished Wood
40202134	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Paint: Solvent-base	2401015000	Factory Finished Wood
40202135	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Paint: Water-base	2401015000	Factory Finished Wood
40202138	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Primer	2401015000	Factory Finished Wood
40202108	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Sealer	2401015000	Factory Finished Wood
40202118	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Sealer Sander	2401015000	Factory Finished Wood
40202132	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Solvent-borne Coating	2401015000	Factory Finished Wood
40202111	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Stain Application	2401015000	Factory Finished Wood
40202140	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Surface Preparation (Includes Tempering, Sanding, Brushing, Grove Cut)	2401015000	Factory Finished Wood
40202106	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Topcoat	2401015000	Factory Finished Wood
40202133	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Ultraviolet Coating	2401015000	Factory Finished Wood
40202136	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Varnish/Shellac	2401015000	Factory Finished Wood
40202131	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Water-borne Coating	2401015000	Factory Finished Wood
40288821	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Basecoat	2401055000	Machinery and Equipment
40288824	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Clean-up	2415000000	Degreasing
40288823	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Cleartop Coat	2401055000	Machinery and Equipment
40288822	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Coating	2401055000	Machinery and Equipment
40288801	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	General	2401055000	Machinery and Equipment

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202701	Chemical Evaporation	Surface Coating Operations	Glass Mirrors	Mirror Backing: Coating Operation	2401090000	Misc. Manufacturing
40202801	Chemical Evaporation	Surface Coating Operations	Glass Optical Fibers	Chemical Vapor Deposition of Preforms	2401065000	Electronic and Other Electrical
40202899	Chemical Evaporation	Surface Coating Operations	Glass Optical Fibers	Miscellaneous	2401065000	Electronic and Other Electrical
40202802	Chemical Evaporation	Surface Coating Operations	Glass Optical Fibers	Plasma Overcladding	2401065000	Electronic and Other Electrical
40202499	Chemical Evaporation	Surface Coating Operations	Large Aircraft	Other Not Classified	2401075000	Aircraft
40201402	Chemical Evaporation	Surface Coating Operations	Large Appliances	Cleaning/Pretreatment	2415000000	Degreasing
40201431	Chemical Evaporation	Surface Coating Operations	Large Appliances	Coating Line: General	2401060000	Large Appliances
40201403	Chemical Evaporation	Surface Coating Operations	Large Appliances	Coating Mixing	2401060000	Large Appliances
40201404	Chemical Evaporation	Surface Coating Operations	Large Appliances	Coating Storage	2401060000	Large Appliances
40201405	Chemical Evaporation	Surface Coating Operations	Large Appliances	Equipment Cleanup	2415000000	Degreasing
40201499	Chemical Evaporation	Surface Coating Operations	Large Appliances	Other Not Classified	2401060000	Large Appliances
40201432	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Air Spray	2401060000	Large Appliances
40201410	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Coat Flashoff	2401060000	Large Appliances
40201401	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Coating Operation	2401060000	Large Appliances
40201435	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Dip Coat	2401060000	Large Appliances
40201436	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Electro-deposition	2401060000	Large Appliances
40201433	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Electrostatic Spray	2401060000	Large Appliances
40201434	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Flow Coat	2401060000	Large Appliances
40201437	Chemical Evaporation	Surface Coating Operations	Large Appliances	Top Air Spray	2401060000	Large Appliances
40201438	Chemical Evaporation	Surface Coating Operations	Large Appliances	Top Electrostatic Spray	2401060000	Large Appliances
40201411	Chemical Evaporation	Surface Coating Operations	Large Appliances	Topcoat Flashoff	2401060000	Large Appliances

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201406	Chemical Evaporation	Surface Coating Operations	Large Appliances	Topcoat Spray	2401060000	Large Appliances
40202302	Chemical Evaporation	Surface Coating Operations	Large Ships	Cleaning/Pretreatment	2415000000	Degreasing
40202303	Chemical Evaporation	Surface Coating Operations	Large Ships	Coating Mixing	2401080000	Marine
40202304	Chemical Evaporation	Surface Coating Operations	Large Ships	Coating Storage	2401080000	Marine
40202305	Chemical Evaporation	Surface Coating Operations	Large Ships	Equipment Cleanup	2415000000	Degreasing
40202399	Chemical Evaporation	Surface Coating Operations	Large Ships	Other Not Classified	2401080000	Marine
40202301	Chemical Evaporation	Surface Coating Operations	Large Ships	Prime Coating Operation	2401080000	Marine
40202306	Chemical Evaporation	Surface Coating Operations	Large Ships	Topcoat Operation	2401080000	Marine
40201502	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Cleaning/Pretreatment	2415000000	Degreasing
40201531	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Coating Line: General	2401065000	Electronic and Other Electrical
40201503	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Coating Mixing	2401065000	Electronic and Other Electrical
40201504	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Coating Storage	2401065000	Electronic and Other Electrical
40201501	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Coating/Application/Curing	2401065000	Electronic and Other Electrical
40201505	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Equipment Cleanup	2415000000	Degreasing
40201599	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Other Not Classified	2401065000	Electronic and Other Electrical
40201702	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Cleaning/Pretreatment	2415000000	Degreasing
40201703	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Coating Mixing	2401040000	Metal Cans
40201704	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Coating Storage	2401040000	Metal Cans
40201726	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	End Sealing Compound (Also See 4-02-017-36 & -37)	2401040000	Metal Cans
40201705	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Equipment Cleanup	2415000000	Degreasing
40201729	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Exterior End Coating	2401040000	Metal Cans

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201722	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Interior Spray Coating	2401040000	Metal Cans
40201727	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Lithography	2401040000	Metal Cans
40201799	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Other Not Classified	2401040000	Metal Cans
40201728	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Over Varnish	2401040000	Metal Cans
40201724	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Sheet Base Coating (Exterior)	2401040000	Metal Cans
40201723	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Sheet Base Coating (Interior)	2401040000	Metal Cans
40201725	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Side Seam Spray Coating	2401040000	Metal Cans
40201706	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Solvent Storage	2401040000	Metal Cans
40201739	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three Piece Can Coating Line (All Coating Solvent Emission Points)	2401040000	Metal Cans
40201737	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three Piece Can End Sealing Compound	2401040000	Metal Cans
40201734	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three-piece Can Interior Body Spray Coat	2401040000	Metal Cans
40201731	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three-piece Can Sheet Base Coating	2401040000	Metal Cans
40201732	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three-piece Can Sheet Lithographic Coating Line	2401040000	Metal Cans
40201733	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three-piece Can-side Seam Spray Coating	2401040000	Metal Cans
40201738	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Two Piece Can Lithographic Coating Line	2401040000	Metal Cans
40201721	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Two Piece Exterior Base Coating	2401040000	Metal Cans
40201735	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Two-piece Can Coating Line	2401040000	Metal Cans
40201736	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Two-piece Can End Sealing Compound	2401040000	Metal Cans
40201802	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Cleaning/Pretreatment	2415000000	Degreasing
40201807	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Coating Storage	2401055000	Machinery and Equipment
40201805	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Equipment Cleanup	2415000000	Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201806	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Finish Coating	2401055000	Machinery and Equipment
40201899	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Other Not Classified	2401055000	Machinery and Equipment
40201801	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Prime Coating Application	2401055000	Machinery and Equipment
40201803	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Solvent Mixing	2401055000	Machinery and Equipment
40201804	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Solvent Storage (Use 4-07-004-01 thru 4-07-999-98 if possible)	2401055000	Machinery and Equipment
40202002	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Cleaning/Pretreatment	2415000000	Degreasing
40202003	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Mixing	2401025000	Metal Furniture
40202001	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Operation	2401025000	Metal Furniture
40202004	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Storage	2401025000	Metal Furniture
40202005	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Equipment Cleanup	2415000000	Degreasing
40202099	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Other Not Classified	2401025000	Metal Furniture
40202010	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application	2401025000	Metal Furniture
40202013	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Dip	2401025000	Metal Furniture
40202015	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Flashoff	2401025000	Metal Furniture
40202014	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Flow Coat	2401025000	Metal Furniture
40202011	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Spray, High Solids	2401025000	Metal Furniture
40202012	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Spray, Water-borne	2401025000	Metal Furniture
40202037	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Dip	2401025000	Metal Furniture
40202039	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Flashoff	2401025000	Metal Furniture
40202038	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Flow Coat	2401025000	Metal Furniture
40202035	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Spray, High Solids	2401025000	Metal Furniture

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202036	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Spray, Water-borne	2401025000	Metal Furniture
40202031	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Spray Line: General	2401025000	Metal Furniture
40202032	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray Dip Line: General (Use 4-02-020-37)	2401025000	Metal Furniture
40202033	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray High Solids Coating (Use 4-02-020-35)	2401025000	Metal Furniture
40202034	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray Water-borne Coating (Use 4-02-020-36)	2401025000	Metal Furniture
40202020	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application	2401025000	Metal Furniture
40202023	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Dip	2401025000	Metal Furniture
40202025	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Flashoff	2401025000	Metal Furniture
40202024	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Flow Coat	2401025000	Metal Furniture
40202021	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Spray, High Solids	2401025000	Metal Furniture
40202022	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Spray, Water-borne	2401025000	Metal Furniture
40299998	Chemical Evaporation	Surface Coating Operations	Miscellaneous	Miscellaneous	2401090000	Misc. Manufacturing
40202502	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Cleaning/Pretreatment	2415000000	Degreasing
40202503	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Mixing	2401055000	Machinery and Equipment
40202501	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Operation	2401055000	Machinery and Equipment
40202504	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Storage	2401055000	Machinery and Equipment
40202532	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Dip	2401055000	Machinery and Equipment
40202531	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Flow	2401055000	Machinery and Equipment
40202533	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Spray	2401055000	Machinery and Equipment
40202535	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Dip and Spray	2401055000	Machinery and Equipment
40202534	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Flow and Spray	2401055000	Machinery and Equipment

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202536	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Spray	2401055000	Machinery and Equipment
40202505	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Equipment Cleanup	2415000000	Degreasing
40202537	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Manual Two Coat, Spray and Air Dry	2401055000	Machinery and Equipment
40202599	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Other Not Classified	2401055000	Machinery and Equipment
40202510	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application	2401055000	Machinery and Equipment
40202515	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Flashoff	2401055000	Machinery and Equipment
40202511	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Spray, High Solids	2401055000	Machinery and Equipment
40202512	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Spray, Water-borne	2401055000	Machinery and Equipment
40202544	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Dip	2401055000	Machinery and Equipment
40202546	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Flashoff	2401055000	Machinery and Equipment
40202545	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Flow Coat	2401055000	Machinery and Equipment
40202542	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Spray, High Solids	2401055000	Machinery and Equipment
40202543	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Spray, Water-borne	2401055000	Machinery and Equipment
40202520	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application	2401055000	Machinery and Equipment
40202523	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Dip	2401055000	Machinery and Equipment
40202525	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Flashoff	2401055000	Machinery and Equipment
40202524	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Flow Coat	2401055000	Machinery and Equipment
40202521	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Spray, High Solids	2401055000	Machinery and Equipment
40202522	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Spray, Water-borne	2401055000	Machinery and Equipment
40201310	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Application: Knife Coater	2401030000	Paper
40201320	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Application: Reverse Roll Coater	2401030000	Paper

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201330	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Application: Rotogravure Printer	2401030000	Paper
40201303	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Mixing	2401030000	Paper
40201301	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Operation	2401030000	Paper
40201304	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Storage	2401030000	Paper
40201305	Chemical Evaporation	Surface Coating Operations	Paper Coating	Equipment Cleanup	2415000000	Degreasing
40201399	Chemical Evaporation	Surface Coating Operations	Paper Coating	Other Not Classified	2401030000	Paper
30700407	Industrial Processes	Pulp and Paper and Wood Products	Paper and Paperboard Manufacture	Coating Operations: On-Machine	2401030000	Paper
40202206	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Baseline Coating Mix	2401090000	Misc. Manufacturing
40202209	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: High Solids Coating (25% Efficiency)	2401090000	Misc. Manufacturing
40202210	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: High Solids Solvent-borne Coating (40% Efficiency)	2401090000	Misc. Manufacturing
40202213	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Higher Solids Solvent-borne EMI/RFI Shielding Coating	2401090000	Misc. Manufacturing
40202207	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Low Solids Solvent-borne Coating	2401090000	Misc. Manufacturing
40202212	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Low Solids Solvent-borne EMI/RFI Shielding Coating	2401090000	Misc. Manufacturing
40202208	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Medium Solids Solvent-borne Coating	2401090000	Misc. Manufacturing
40202211	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Water-borne Coating	2401090000	Misc. Manufacturing
40202214	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Water-borne EMI/RFI Shielding Coating	2401090000	Misc. Manufacturing
40202215	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Zinc Arc Spray	2401090000	Misc. Manufacturing
40202202	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Cleaning/Pretreatment	2415000000	Degreasing
40202203	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Mixing	2401090000	Misc. Manufacturing
40202201	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Operation	2401090000	Misc. Manufacturing
40202204	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Storage	2401090000	Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202230	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Color Coat Application	2401090000	Misc. Manufacturing
40202239	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Color Coat Flashoff	2401090000	Misc. Manufacturing
40202250	Chemical Evaporation	Surface Coating Operations	Plastic Parts	EMI/RFI Shielding Coat Application	2401090000	Misc. Manufacturing
40202259	Chemical Evaporation	Surface Coating Operations	Plastic Parts	EMI/RFI Shielding Coat Flashoff	2401090000	Misc. Manufacturing
40202205	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Equipment Cleanup	2415000000	Degreasing
40202280	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Maskant Application	2401090000	Misc. Manufacturing
40202299	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Other Not Classified	2401090000	Misc. Manufacturing
40202220	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Prime Coat Application	2401090000	Misc. Manufacturing
40202229	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Prime Coat Flashoff	2401090000	Misc. Manufacturing
40202270	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Sanding/Grit Blasting Prior to EMI/RFI Shielding Coat Application	2401090000	Misc. Manufacturing
40202240	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Topcoat/Texture Coat Application	2401090000	Misc. Manufacturing
40202249	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Topcoat/Texture Coat Flashoff	2401090000	Misc. Manufacturing
40203001	Chemical Evaporation	Surface Coating Operations	Semiconductors	Solvent	2401065000	Electronic and Other Electrical
40202602	Chemical Evaporation	Surface Coating Operations	Steel Drums	Cleaning/Pretreatment	2415000000	Degreasing
40202603	Chemical Evaporation	Surface Coating Operations	Steel Drums	Coating Mixing	2401055000	Machinery and Equipment
40202601	Chemical Evaporation	Surface Coating Operations	Steel Drums	Coating Operation	2401055000	Machinery and Equipment
40202605	Chemical Evaporation	Surface Coating Operations	Steel Drums	Equipment Cleanup	2415000000	Degreasing
40202607	Chemical Evaporation	Surface Coating Operations	Steel Drums	Exterior Coating	2401055000	Machinery and Equipment
40202606	Chemical Evaporation	Surface Coating Operations	Steel Drums	Interior Coating	2401055000	Machinery and Equipment
40202699	Chemical Evaporation	Surface Coating Operations	Steel Drums	Other Not Classified	2401055000	Machinery and Equipment
40200701	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Adhesive Application	2460600000	All Adhesives and Sealants

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40200710	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Adhesive: General	2460600000	All Adhesives and Sealants
40200712	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Adhesive: Roll-on	2460600000	All Adhesives and Sealants
40200706	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Adhesive: Solvent Mixing	2460600000	All Adhesives and Sealants
40200711	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Adhesive: Spray	2460600000	All Adhesives and Sealants
40200501	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Enamel	2401200000	Other Special Purpose Coatings
40200401	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Lacquer	2401200000	Other Special Purpose Coatings
40200101	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Paint: Solvent-base	2401200000	Other Special Purpose Coatings
40200201	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Paint: Water-base	2401200000	Other Special Purpose Coatings
40200601	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Primer	2401200000	Other Special Purpose Coatings
40200301	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Varnish/Shellac	2401200000	Other Special Purpose Coatings
40200929	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	1,1,1-Trichloroethane (Methyl Chloroform)	2401090000	Misc. Manufacturing
40200902	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Acetone	2401090000	Misc. Manufacturing
40200925	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Benzene	2401090000	Misc. Manufacturing
40200903	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Butyl Acetate	2401090000	Misc. Manufacturing
40200904	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Butyl Alcohol	2401090000	Misc. Manufacturing
40200905	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Carbitol	2401090000	Misc. Manufacturing
40200906	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Cellosolve	2401090000	Misc. Manufacturing
40200907	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Cellosolve Acetate	2401090000	Misc. Manufacturing
40200908	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Dimethyl Formamide	2401090000	Misc. Manufacturing
40200909	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethyl Acetate	2401090000	Misc. Manufacturing
40200910	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethyl Alcohol	2401090000	Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40200928	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethylene Oxide	2401090000	Misc. Manufacturing
40200911	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Gasoline	2401090000	Misc. Manufacturing
40200901	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	General	2401090000	Misc. Manufacturing
40200927	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Hexylene Glycol	2401090000	Misc. Manufacturing
40200913	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Isopropyl Acetate	2401090000	Misc. Manufacturing
40200912	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Isopropyl Alcohol	2401090000	Misc. Manufacturing
40200914	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Kerosene	2401090000	Misc. Manufacturing
40200915	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Lactol Spirits	2401090000	Misc. Manufacturing
40200916	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Acetate	2401090000	Misc. Manufacturing
40200917	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Alcohol	2401090000	Misc. Manufacturing
40200918	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Ethyl Ketone	2401090000	Misc. Manufacturing
40200919	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Isobutyl Ketone	2401090000	Misc. Manufacturing
40200930	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methylene Chloride	2401090000	Misc. Manufacturing
40200920	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Mineral Spirits	2401090000	Misc. Manufacturing
40200921	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Naphtha	2401090000	Misc. Manufacturing
40200931	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Perchloroethylene	2401090000	Misc. Manufacturing
40200922	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Toluene	2401090000	Misc. Manufacturing
40200926	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Turpentine	2401090000	Misc. Manufacturing
40200923	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Varsol	2401090000	Misc. Manufacturing
40200924	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Xylene	2401090000	Misc. Manufacturing
40282001	Chemical Evaporation	Surface Coating Operations	Wastewater, Aggregate	Process Area Drains	2401055000	Machinery and Equipment

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40282002	Chemical Evaporation	Surface Coating Operations	Wastewater, Aggregate	Process Equipment Drains	2401055000	Machinery and Equipment
40282599	Chemical Evaporation	Surface Coating Operations	Wastewater, Points of Generation	Other Not Classified	2401055000	Machinery and Equipment
40282501	Chemical Evaporation	Surface Coating Operations	Wastewater, Points of Generation	Printing Blanket, Rotary Screen	2401055000	Machinery and Equipment
40201903	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Mixing	2401020000	Wood Furniture
40201901	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Operation	2401020000	Wood Furniture
40201904	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Storage	2401020000	Wood Furniture
40201999	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Other Not Classified	2401020000	Wood Furniture
40600259	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels	Tanker/Barge Cleaning	2415000000	Degreasing
30101470	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning	2415000000	Degreasing
30101471	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning: Hand Wipe	2415000000	Degreasing
30101472	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning: Tanks, Vessels, etc.	2415000000	Degreasing
30102070	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning	2415000000	Degreasing
30102071	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning: Hand Wipe	2415000000	Degreasing
30102072	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning: Tanks, Vessels, etc.	2415000000	Degreasing
30102426	Industrial Processes	Chemical Manufacturing	Synthetic Organic Fiber	Equipment Cleanup	2415000000	Degreasing
31303502	Industrial Processes	Electrical Equipment	Manufacturing - General Processes	Cleaning	2415000000	Degreasing
31306502	Industrial Processes	Electrical Equipment	Semiconductor Manufacturing	Cleaning Process: Plasma Process: Specify Gas Used	2415000000	Degreasing
31306501	Industrial Processes	Electrical Equipment	Semiconductor Manufacturing	Cleaning Processes: Wet Chemical: Specify Aqueous Solution	2415000000	Degreasing
30900301	Industrial Processes	Fabricated Metal Products	Abrasive Cleaning of Metal Parts	Brush Cleaning	2415000000	Degreasing
30900302	Industrial Processes	Fabricated Metal Products	Abrasive Cleaning of Metal Parts	Tumble Cleaning	2415000000	Degreasing
30901102	Industrial Processes	Fabricated Metal Products	Conversion Coating of Metal Products	Acid Cleaning Bath (Pickling)	2415000000	Degreasing
30901101	Industrial Processes	Fabricated Metal Products	Conversion Coating of Metal Products	Alkaline Cleaning Bath	2415000000	Degreasing
30510005	Industrial Processes	Mineral Products	Bulk Materials Elevators	Cleaning	2415000000	Degreasing
30503701	Industrial Processes	Mineral Products	Coated Abrasives Manufacturing	Printing of Backing	2425000000	Graphic Arts
31612002	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	General Cleaning Operations	2415000000	Degreasing
31612003	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	Parts Cleaning Operations	2415000000	Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
31612001	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	Tank Cleaning Operations	2415000000	Degreasing
36000102	Industrial Processes	Printing/Publishing	Scrap Processes	Flexographic: Scrap Substrate Collection System	2425000000	Graphic Arts
36000104	Industrial Processes	Printing/Publishing	Scrap Processes	Lithographic: Scrap Substrate Collection System	2425000000	Graphic Arts
36000103	Industrial Processes	Printing/Publishing	Scrap Processes	Rotogravure: Scrap Substrate Collection System	2425000000	Graphic Arts
30701199	Industrial Processes	Pulp and Paper and Wood Products	Paper Coating and Glazing	Extrusion Coating Line with Solvent Free Resin/Wax	2401030000	Paper
30400342	Industrial Processes	Secondary Metal Production	Grey Iron Foundries	Casting Cleaning/Chippers	2415000000	Degreasing
30400340	Industrial Processes	Secondary Metal Production	Grey Iron Foundries	Grinding/Cleaning	2415000000	Degreasing
30400725	Industrial Processes	Secondary Metal Production	Steel Foundries	Casting Cleaning/Tumblers	2415000000	Degreasing
30400711	Industrial Processes	Secondary Metal Production	Steel Foundries	Cleaning	2415000000	Degreasing
33000102	Industrial Processes	Textile Products	Miscellaneous	Printing	2425000000	Graphic Arts
31401560	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup	2415000000	Degreasing
31401563	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Molds	2415000000	Degreasing
31401562	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Spray Guns	2415000000	Degreasing
31401561	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Tools (Other than Spray Guns)	2415000000	Degreasing
31401570	Industrial Processes	Transportation Equipment	Boat Manufacturing	Waste Disposal: Used Cleanup Solvents	2415000000	Degreasing
41000201	Petroleum and Solvent Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Stoddard	2420000000	Dry Cleaning
41000102	Petroleum and Solvent Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Stoddard	2420000000	Dry Cleaning
40100259	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): General Degreasing Units	2415000000	Degreasing
40100216	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	Degreaser: Entire Unit	2415000000	Degreasing
40100217	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit	2415000000	Degreasing
40100295	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: General Degreasing Units	2415000000	Degreasing
40100297	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: Open-top Vapor Degreasing	2415000000	Degreasing
40100103	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Dry Cleaning	Perchloroethylene	2420000000	Dry Cleaning
40100113	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Dry Cleaning	Perchloroethylene	2420000000	Dry Cleaning
40100199	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Dry Cleaning	See Comment	2420000000	Dry Cleaning
40100106	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorotrifluoroethane (Freon)	2420000000	Dry Cleaning

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40500199	Petroleum and Solvent Evaporation	Printing/Publishing	Drying	Dryer	2425000000	Graphic Arts
40500311	Petroleum and Solvent Evaporation	Printing/Publishing	Flexographic	Printing: Flexographic	2425000000	Graphic Arts
40500312	Petroleum and Solvent Evaporation	Printing/Publishing	Flexographic	Printing: Flexographic	2425000000	Graphic Arts
40500316	Petroleum and Solvent Evaporation	Printing/Publishing	Flexographic	Steam: Water-based	2425000000	Graphic Arts
40500317	Petroleum and Solvent Evaporation	Printing/Publishing	Flexographic	Steam: Water-based	2425000000	Graphic Arts
40588802	Petroleum and Solvent Evaporation	Printing/Publishing	Fugitive Emissions	Specify in Comments Field	2425000000	Graphic Arts
40588803	Petroleum and Solvent Evaporation	Printing/Publishing	Fugitive Emissions	Specify in Comments Field	2425000000	Graphic Arts
40588804	Petroleum and Solvent Evaporation	Printing/Publishing	Fugitive Emissions	Specify in Comments Field	2425000000	Graphic Arts
40588805	Petroleum and Solvent Evaporation	Printing/Publishing	Fugitive Emissions	Specify in Comments Field	2425000000	Graphic Arts
40500414	Petroleum and Solvent Evaporation	Printing/Publishing	General	Flexographic: Propyl Alcohol Cleanup	2415000000	Degreasing
40500598	Petroleum and Solvent Evaporation	Printing/Publishing	General	Ink Thinning Solvent: Other Not Specified	2425000000	Graphic Arts
40500501	Petroleum and Solvent Evaporation	Printing/Publishing	Gravure	Gravure: 2754	2425000000	Graphic Arts
40500512	Petroleum and Solvent Evaporation	Printing/Publishing	Gravure	Gravure: 2754	2425000000	Graphic Arts
40500513	Petroleum and Solvent Evaporation	Printing/Publishing	Gravure	Gravure: 2754	2425000000	Graphic Arts
40500211	Petroleum and Solvent Evaporation	Printing/Publishing	Letterpress	Letterpress: 2751	2425000000	Graphic Arts
40500212	Petroleum and Solvent Evaporation	Printing/Publishing	Letterpress	Printing: Letterpress	2425000000	Graphic Arts
40500411	Petroleum and Solvent Evaporation	Printing/Publishing	Lithographic	Lithographic: 2752	2425000000	Graphic Arts
40500412	Petroleum and Solvent Evaporation	Printing/Publishing	Lithographic	Lithographic: 2752	2425000000	Graphic Arts
40500432	Petroleum and Solvent Evaporation	Printing/Publishing	Offset Lithography	Nonheated Lithographic Inks	2425000000	Graphic Arts
40500433	Petroleum and Solvent Evaporation	Printing/Publishing	Offset Lithography	Nonheated Lithographic Inks	2425000000	Graphic Arts
40500811	Petroleum and Solvent Evaporation	Printing/Publishing	Screen Printing	Screen Printing	2425000000	Graphic Arts

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40500812	Petroleum and Solvent Evaporation	Printing/Publishing	Screen Printing	Screen Printing	2425000000	Graphic Arts
40200810	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven - General	General	2401055000	Machinery and Equipment
40200898	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven - General	General	2401055000	Machinery and Equipment
40202710	Petroleum and Solvent Evaporation	Surface Coating Operations	Glass Mirrors	Mirror Backing: Coating Operation	2401200000	Other Special Purpose Coatings
40200510	Petroleum and Solvent Evaporation	Surface Coating Operations	Surface Coating Application - General	Enamel	2401200000	Other Special Purpose Coatings
40200410	Petroleum and Solvent Evaporation	Surface Coating Operations	Surface Coating Application - General	Lacquer	2401200000	Other Special Purpose Coatings
40200110	Petroleum and Solvent Evaporation	Surface Coating Operations	Surface Coating Application - General	Paint: Solvent-base	2401200000	Other Special Purpose Coatings
40200210	Petroleum and Solvent Evaporation	Surface Coating Operations	Surface Coating Application - General	Paint: Water-base	2401200000	Other Special Purpose Coatings
40200610	Petroleum and Solvent Evaporation	Surface Coating Operations	Surface Coating Application - General	Primer	2401200000	Other Special Purpose Coatings
40200310	Petroleum and Solvent Evaporation	Surface Coating Operations	Surface Coating Application - General	Varnish/Shellac	2401200000	Other Special Purpose Coatings

STRUCTURE FIRES

A. Source Category Description

Accidental structure fires result from unintentional actions, arson, or natural events. This category includes emissions from the burning of residential or commercial structures and their contents. Building fires can produce short-term emissions of Volatile Organic Compounds (VOC), Nitrogen Oxides (Nox), Carbon Monoxide (CO), and Particulate Matter (PM).

Table 1: 2023 NEI Structure Fire SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified

B. Overview of Calculations

Structure Fire emissions in the 2023 NEI are estimated using total structure fires per county, a fuel loading factor, and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific county-level count of structure fires from the Maryland State Fire Marshal's office and a fuel loading factor. Structural materials such as insulation and wood, and the contents of structures such as furniture, carpets, clothing, paper and plastics, can burn in a structure fire. Not all of the contents and structural materials burn in a fire, rather, the fire burns a portion of the contents and structural material in the rooms where the fire originates and spreads. The average total material burned (i.e. fuel loading) in a residential fire is estimated to be 1.67 tons.[1] The total amount of material burned is estimated as the number of fires multiplied by the fuel loading factor. The 2023 NEI uses the total fuel burned, as shown in Table 2.

Table 2: 2023 County Structure Fire Activity

County	FIPS State and County Code	Number of Fires in 2023	Fuel Loading Factor (Tons/Fire)	Total Burned (Tons)
Allegany	24001	95	1.67	158.65
Anne Arundel	24003	504		841.68
Baltimore	24005	323		539.41
Calvert	24009	51		85.17
Caroline	24011	58		96.86
Carroll	24013	134		223.78
Cecil	24015	123		205.41
Charles	24017	243		405.81
Dorchester	24019	49		81.83

Frederick	24021	260		434.2
Garrett	24023	63		105.21
Harford	24025	154		257.18
Howard	24027	84		140.28
Kent	24029	40		66.8
Montgomery	24031	487		813.29
Prince George's	24033	856		1429.52
Queen Anne's	24035	43		71.81
St. Mary's	24037	125		208.75
Somerset	24039	15		25.05
Talbot	24041	56		93.52
Washington	24043	197		328.99
Wicomico	24045	157		262.19
Worcester	24047	68		113.56
Baltimore City	24510	1317		2199.39

D. Emissions Factors

Emission factors for structure fires are adopted from Holder's *Hazardous air pollutant emissions estimates from wildland urban interface*[2] Emission factors for structure fires are listed in Table 3 below.

Table 3. 2023 NEI emissions factors for Structure Fires

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2810030000	Structure Fires	VOC	116.4	lb/ton	2
2810030000	Structure Fires	Nox	0.662	lb/ton	
2810030000	Structure Fires	CO	138	lb/ton	
2810030000	Structure Fires	PM10-PRI	78.6	lb/ton	
2810030000	Structure Fires	PM2.5-PRI	78.6	lb/ton	
2810030000	Structure Fires	Lead	0.022	lb/ton	

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions from structure fires are calculated by multiplying the activity data for the source category by the emissions factor for that category.

$$\boldsymbol{E_{c,s} = A_{c,s} \times EF_s}$$

Where:

$E_{c,s}$ = Annual emissions in county c for source category s, in tons per year
$A_{c,s}$ = Activity data for county c associated with source category s (Table 2)
EF_s = Emissions factor for source category s (Table 3)

G. Point Source Subtraction

There are no point source-specific SCCs for structure fires; therefore, point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from structure fires in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for structure fires (SCC 2810030000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s}} = \boldsymbol{A_{c,s}} \times \boldsymbol{EF_{VOC,s}}$	$\left((841.68\ tons\ \times \frac{116.4\ lb}{ton}/2000\right)$	48.99 tons of VOC in 2023

I. References

1 U.S. Environmental Protection Agency. Wagon Wheel: 2023NEI_NEMO_Structure_MotorVehicle_Fires_16jul2024.

2 Holder, A.L., A. Ahmed, J.M. Vukovich, and V. Rao. Supplementary data Table S-2 PNAS Nexus, Volume 2, Issue 6, June 2023, pgad186. "Hazardous air pollutant emissions estimates from wildland urban interface", https://doi.org/10.1093/pnasnexus/pgad186.

VEHICLE FIRES

A. Source Category Description

Accidental vehicle fires result from unintentional actions, arson, or natural events. This category includes emissions from the burning of any commercial or private mode of transportation that is authorized for use on public roads. Vehicle fires can produce short-term emissions of Volatile Organic Compounds (VOC), Nitrogen Oxides (Nox), Carbon Monoxide (CO), and Particulate Matter (PM).

Table 1: 2023 NEI Vehicle Fires SCC.

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified

B. Overview of Calculations

Vehicle Fires emissions in the 2023 NEI are estimated using total vehicle fires per county, a fuel loading factor, and emission factors.

In the following sections, details are provided related to the collection of activity data (Section C), calculation of emissions factors (Section D), accounting for control programs (Section E), emissions (Section F), point source subtraction (Section G), and sample calculations (Section H).

C. Activity Data

Activity data is based on year-specific county-level count of vehicle fires from the Maryland State Fire Marshal's office and a fuel loading factor. Automobile components including upholstery, belts, hoses and tires can burn in a vehicle fire. Not all of the vehicle contents burn in a fire. The average total material burned (i.e. fuel loading) in a vehicle fire is estimated to be 1,016 lbs, or 0.508 tons.[1] The total amount of material burned is estimated as the number of fires multiplied by the fuel loading factor. The 2023 NEI uses the total fuel burned, as shown in Table 2.

Table 2: 2023 County Vehicle Fire Activity

County	FIPS State and County Code	Number of Fires in 2023	Fuel Loading Factor (Tons/Fire)	Total Burned (Tons)
Allegany	24001	54	0.508	27.432
Anne Arundel	24003	224		113.792
Baltimore	24005	321		163.068
Calvert	24009	24		12.192
Caroline	24011	22		11.176
Carroll	24013	57		28.956
Cecil	24015	70		35.56
Charles	24017	58		29.464
Dorchester	24019	15		7.62
Frederick	24021	108		54.864
Garrett	24023	19		9.652

Harford	24025	83		42.164
Howard	24027	70		35.56
Kent	24029	12		6.096
Montgomery	24031	193		98.044
Prince George's	24033	500		254
Queen Anne's	24035	21		10.668
St. Mary's	24037	41		20.828
Somerset	24039	10		5.08
Talbot	24041	23		11.684
Washington	24043	102		51.816
Wicomico	24045	63		32.004
Worcester	24047	28		14.224
Baltimore City	24510	205		104.14

D. Emissions Factors

Emission factors for vehicle fires are adopted from Holder's *Hazardous air pollutant emissions estimates from wildland urban interface* [2] and *Hazardous air pollutant emissions estimates from wildland urban interface* [2] and Holder's *Supplementary_Data_20240210.xlsx.* [3]

Emission factors for vehicle fires are listed in Table 3 below.

Table 3. 2023 NEI emissions factors for Vehicle Fires

SCC	Description	Pollutant Code	Emission Factor	Unit	Source
2810050000	Vehicle Fires	VOC	21.7	lb/ ton	3
2810050000	Vehicle Fires	NOx	8.6	lb/ ton	3
2810050000	Vehicle Fires	CO	96	lb/ ton	2
2810050000	Vehicle Fires	PM10-PRI	114.4	lb/ ton	2
2810050000	Vehicle Fires	PM2.5-PRI	114.4	lb/ ton	2
2810050000	Vehicle Fires	Lead	0.065	lb/ ton	2

E. Controls

There are no controls available for this source category.

F. Emissions

Emissions from vehicle fires are calculated by multiplying the activity data for the source category by the emissions factor for that category.

$$\boldsymbol{E_{c,s} = A_{c,s} \times EF_s}$$

Where:

$E_{,c,s}$ = Annual emissions in county c for source category s, in tons per year

$A_{c,s}$ = Activity data for county *c* associated with source category *s* (Table 2)
EF_s = Emissions factor for source category *s* (Table 3)

G. Point Source Subtraction

There are no point source-specific SCCs for structure fires; therefore, point source subtraction is not performed for this category.

H. Sample Calculations

Sample calculations for VOC emissions from vehicle fires in Anne Arundel County, Maryland are included in the table below.

Table 4. Sample Calculations of VOC emissions for vehicle fires (SCC 2810050000) in Anne Arundel County.

Eq. #	Equation	Values for Anne Arundel County	Result
1	$\boldsymbol{E_{VOCc,s} = A_{c,s} \times EF_{VOC,s}}$	$\left(113.792\ tons\ \times \frac{21.7\ lb}{ton} / 2000\right)$	1.23 tons of VOC in 2023

I. References

1 U.S. Environmental Protection Agency. Wagon Wheel: 2023NEI_NEMO_Structure_MotorVehicle_Fires_16jul2024.

2 Holder, A.L., A. Ahmed, J.M. Vukovich, and V. Rao. Supplementary data Table S-2 PNAS Nexus, Volume 2, Issue 6, June 2023, pgad186. "Hazardous air pollutant emissions estimates from wildland urban interface", https://doi.org/10.1093/pnasnexus/pgad186.

3 5. Holder, A.L., 2024. Correction to Table S2, "Supplementary_Data_20240210.xlsx"

Directorate of Public Works - U.S. Army Garrison, Aberdeen Proving Ground

2023 Air Emissions Inventory Summary

U.S. Army Garrison
Aberdeen Proving Ground

September 2024

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LIST OF ACRONYMS AND ABBREVIATIONS

AA	Aberdeen Area
AEI	Air Emissions Inventory
CO	Carbon Monoxide
COMAR	Code of Maryland Regulations
CY	Calendar Year
DPW	Directorate of Public Works
EA	Edgewood Area
EDMS	Emissions and Dispersion Modeling
System EF	Emission Factor
EIIP	Emission Inventory Improvement
Program FAA	Federal Aviation Administration
gal	gallon
GOV	Government Owned Vehicle
HP	Horsepower
k	Methane Generation Rate
l.f.	linear feet
LA	Low Approach
lb	pounds
lb/ft^3	pounds per cubic foot
Lo	Potential Methane Generation Capacity
LTO	Landing and Takeoff
MDE	Maryland Department of the Environment
NOx	Nitrogen Oxides
OB/OD	Open Burning/Open
Detonation P	Population, Residential
PM_{10}	Particulate matter 10 microns or less in diameter
$PM_{2.5}$	Particulate matter 2.5 microns or less in diameter
POV	Privately Owned Vehicle
RCRA	Resource Conservation and Recovery Act

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

RONA	Record of Non-Applicability
s.f.	square feet
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SUR	Solvent Usage Rate
SUV	Sport Utility Vehicle
T&G	Touch and Go
tpy	tons per year
TSDF	Treatment, Storage, and Disposal
Facility US	United States
USEPA	US Environmental Protection Agency
VOC	Volatile Organic Compounds
yr	year

EXECUTIVE SUMMARY

The United States Army Garrison, Aberdeen Proving Ground (APG) has two Title V Air Permits, issued by the State of Maryland, Department of the Environment, as Part 70 Operating Permit Numbers 24-025-0081 (Aberdeen Area) and 24-025-0082 (Edgewood Area), for their permitted emission sources. Each year, APG completes an Annual Emissions Certification Report and Annual Compliance Certification Report for each permit. The 2023 Emission Certification Reports for Aberdeen and Edgewood Areas are included in this report as **Appendices A and B**, respectively.

This report is a summary of APG's air emissions inventory of sources which do not require a construction permit (i.e., emission units that are not addressed by the Title V permits), including aircraft, watercraft, non-road vehicles, and insignificant stationary sources. This task was conducted in support of the Maryland State Implementation Plan (SIP) obligations.

The emissions for the criteria air pollutants were calculated using Emission Factors (EF) from published reports, predominantly from the United States Environmental Protection Agency (USEPA). The criteria air pollutants include carbon monoxide (CO), nitrogen oxides (NOx), particulate matter 10 microns or less in diameter (PM_{10}), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOC). The total estimated emissions in tons per year (tpy) from APG for Calendar Year (CY) 2023, from 20 different source categories, are provided on the following page in **Table ES-1**. The emissions calculations are presented in **Appendix C**. The population at APG is not expected to grow substantially through 2026; thus, APG does not anticipate a substantial increase in air emissions over the next three years.

Table ES-1. Estimated CY 2023 Emissions Summary from Sources Which Do Not Require a Construction Permit

Emissions Source	Criteria Pollutant Emissions, tons per year (tpy)					
	CO	**NO_X**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**VOC**
Aircraft Operations	9.09E+01	1.44E+01	2.49E-02	2.41E-02	3.27E+00	7.01E+01
Architectural Surface Coatings	--	--	--	--	--	4.46E+00
Asphalt Paving Operations	5.62E+00	1.69E+00	1.38E-01	1.17E-01	1.24E+00	4.50E-01
Chemical Usage	--	--	--	--	--	3.16E-02
Construction Operations	1.72E+01	3.59E+01	1.43E+01	4.67E+00	5.29E-01	7.32E+00
Consumer Products	--	--	--	--	--	3.27E+00
Fuel Spills	--	--	--	--	--	4.54E-03
Insignificant External Combustion Sources	1.63E+00	5.00E+00	7.65E-01	7.65E-01	1.56E+00	1.11E-01
Insignificant Internal Combustion Sources	4.16E+00	1.93E+01	1.37E+00	1.37E+00	1.28E+00	1.56E+00
Insignificant Storage Tanks	--	--	--	--	--	3.01E+00
Landfills	--	--	--	--	--	2.41E+00
Non-Road Vehicles	1.58E+02	6.53E+00	2.57E-01	2.39E-01	3.06E-01	2.83E+00
On-Road Vehicles	9.20E+01	1.06E+01	2.89E-01	2.63E-01	5.36E-02	8.46E+00
Open Burning/ Open Detonation of Explosives	1.45E-01	8.61E-02	8.88E+01	4.34E+01	3.16E-02	6.20E-03
Smoke Testing	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Solvent Degreasers	--	--	--	--	--	5.96E-01
Training Exercises	2.52E+00	8.04E-02	1.98E-01	1.17E-01	0.00E+00	3.28E-03
Watercraft	3.16E+01	5.60E+00	2.29E-01	2.29E-01	3.49E-01	7.16E+00
Welding	--	--	1.65E-01	1.65E-01	--	--
Miscellaneous Sources	--	--	--	--	--	--
Total	**4.04E+02**	**9.92E+01**	**1.06E+02**	**5.13E+01**	**8.62E+00**	**1.12E+02**

1.0 INTRODUCTION

Bluestone Environmental Group, Inc. was tasked under Contract Number W56ZTN-17-D-0006, by the United States Army Garrison, Aberdeen Proving Ground (APG) Directorate of Public Works (DPW), Environmental Division, to update the inventory of air emissions at the Aberdeen Area (AA) and Edgewood Area (EA) of APG from sources which do not require a construction permit.

Every three years, the State of Maryland is required by the U.S. Environmental Protection Agency (USEPA) to develop an inventory of air emissions in support of their State Implementation Plan. In a letter dated 18 March 2024, the Maryland Department of the Environment (MDE) requests the following information from APG in support of the State's air emissions inventory for calendar year (CY) 2023:

- Point Sources: Emission Certification Reports for registered sources.
- Insignificant Point Sources: Data including external combustion sources, internal combustion sources, and storage tanks.
- Nonpoint Area Sources: Data including commercial and consumer products, unpaved roads, fire training, degreasing, and other site-specific operations.
- Nonpoint Off-Road Sources: Data including watercraft, aircraft operations, and other site- specific operations.
- Mobile Sources: Data including on-base traffic activities and other site-specific operations.

APG has two Title V Air Permits, issued by MDE, as Part 70 Operating Permit Numbers 24-025-0081 (Aberdeen Area) and 24-025-0082 (Edgewood Area), for their registered emission sources. Each year, APG completes an Annual Emissions Certification Report for each permit. The CY 2023 Emission Certification Reports for Aberdeen and Edgewood Areas are included as **Appendices A and B**, respectively.

This report summarizes the air emissions data for the sources that are not addressed in the Annual Emissions Certification Reports, including the insignificant point sources, nonpoint area sources, nonpoint off-road sources, and mobile sources listed above. Data inputs for this inventory were based on the previous APG Air Emissions Inventory report (APG, 2020). The emissions for the criteria air pollutants were calculated using emission factors from published reports, predominantly from the USEPA. The criteria air pollutants include carbon monoxide (CO), nitrogen oxides (NOx), particulate matter 10 microns or less in diameter (PM_{10}), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOC). The total estimated emissions in tons per year from APG for CY 2023, from 20 different source categories, are provided in **Table 22-1**. The emissions calculations are presented in **Appendix C**. The population at APG is not expected to grow substantially through 2026; thus, APG does not anticipate a substantial increase in air emissions over the next three years.

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2.0 AIRCRAFT OPERATIONS

2.1 Background

Aircraft operations are conducted at APG at Philips Airfield in AA and at Weide Heliport in EA. Emissions originate from operations including landings and takeoffs (LTOs), touch and go's (T&Gs), and low approaches (LAs).

2.2 CY 2020 Data

2.2.1 Philips Airfield Aircraft Activity

Philips Airfield Aircraft activity for CY2023 was reported as an estimated 435 total number of aircraft operations. All aircraft activity was indicated to be military.

2.2.2 Weide Heliport Aircraft Activity

Weide Heliport Aircraft Activity information was not available from APG for CY 2023; therefore, CY 2020 data was used. From the 20 April 2021 telephone conversation with the Weide Airfield Manager: Total hours flown (3 aircraft) = 3529 hrs., 60% local traffic, 10 minutes per rotation at heliport.

LTOs = ((total hours * 60%)/ 10 minutes) * (60 minutes/1 hour) = ((3529 * 0.6)/ 10) * 60 = 12704

2.3 Emissions Calculations

APG records information on military and general aviation aircraft entering APG airspace and the types of aircraft. APG does not track the number of each aircraft type or individual operations (i.e., LTOs, T&Gs and LAs). In addition, APG records information as military or general aviation only. The following assumptions were used to estimate emissions at Philips Airfield:

- If an aircraft was recorded as entering airspace in CY 2023, military or general aviation, it was counted as an aircraft operation. It was assumed that 70% of recordings were LTOs, 20% were T&Gs, and 10% were LAs for all military aircraft. It was assumed that all general aviation was LTOs (APG, 2014).

- To determine the operation associated with an aircraft type, it was assumed that all aircraft types were used homogenously for each operation (i.e. the total number of individual operations were divided by the number of different aircraft types recorded).
- Aircraft activity associated with training is included in the above operations.

Weide Heliport data was provided as hours per year for three types of aircraft. The Airfield Manager indicated that to determine the yearly LTOs, the hours per year should be multiplied by 60%, then multiplied by 60 minutes per hour, and then divided by 10 minutes per rotation.

During a previous air emissions inventory (AEI) (APG, 2014), emissions from aircraft were estimated using the Federal Aviation Administration's (FAA) Emissions and Dispersion Modeling System (EDMS), Version 5.1.3. For the purposes of simplicity and comparability with CY 2014,

2017, and 2020 numbers, the CY 2023 emissions were estimated by pro-rating from the CY 2014 emissions, which were based on the EDMS model[1]. A ratio of the number of operations between CY 2023 and CY 2014 was created for each operation, the ratio was then multiplied by the 2014 emissions as shown below.

Ratio = operations conducted in CY 2023 / operations conducted in CY 2014

CY 2023 Emissions = Ratio * CY 2014 Emissions.

The estimated emissions from aircraft operations for CY 2023 are shown in **Table 2-1** and the emissions calculations are presented in **Appendix C**.

Table 2-1. Estimated Aircraft Operations Emissions

	CO (tpy)	NO_X (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_X (tpy)	VOC (tpy)
Philips Airfield Aircraft Emissions	6.65E+00	2.23E+00	2.49E-02	2.41E-02	3.70E-01	1.80E+00
Weide Heliport Aircraft Emissions	8.42E+01	1.22E+01	0.00E+00	0.00E+00	2.90E+00	6.83E+01
Total Aircraft Operations Emissions	**9.09E+01**	**1.44E+01**	**2.49E-02**	**2.41E-02**	**3.27E+00**	**7.01E+01**

[1] It is understood that the Aviation Environmental Design Tool (AEDT), Version 2b, is intended to replace the EDMS model. (https://aedt.faa.gov/ProductReleases.aspx).

3.0 ARCHITECTURAL SURFACE COATINGS

3.1 Background

Architectural surface coating operations involve the application of a thin layer of a coating such as paint, paint primer, varnish, or lacquer to an architectural surface. These operations also include the use of solvents and thinners for cleanup. Surface coatings are used for both interior and exterior surfaces. Surface coatings can be solvent-based or water-based.

The emissions from architectural surface coatings are likely to be scattered throughout an area and are treated as an area source of air emissions. Volatile organic compounds (VOCs) used in solvents are emitted during application and drying of surface coatings and are the primary concern for atmospheric emissions (USEPA, 1995a).

3.2 CY 2023 Data

3.2.1 Residential Emissions

The AA residential population provided is 925 and the EA residential population provided is 356.

3.2.2 Commercial Emissions

From the APG website, there are more than 17 million square feet of building space at APG.

3.2.3 Asphalt Striping Emissions

Three asphalt paving projects were completed in CY 2023 with a combined total of 56,750 linear feet.

3.3 Emissions Calculations

3.3.1 Residential Emissions

Emissions of VOCs from residential architectural surface coatings are determined by using VOC population-based emission factors (EFs). The procedure and EFs are presented in the USEPA's Emission Inventory Improvement Program (EIIP), Volume III, Chapter 3 (USEPA, 1995a). The per capita usage factor was determined by dividing the most recent United States (US) Census Bureau data on architectural surface coatings by the United States (US) population for that year (2010 was the most recent year for which both population and coating usage data was available). EFs for architectural surface coatings were presented in USEPA's EIIP, Volume III, Chapter 5, Table 5-2.

The per capita usage rate for water-based coatings is the gallons (gal) of water-based coatings used in the US divided by the US population = 515,679,000 gal / 308,745,539 = 1.67 gal per capita.

The per capita usage rate for solvent-based coatings is the gallons of solvent-based coatings used in the US divided by the US population = 93,571,000 gal / 308,745,539 = 0.30 gal per capita.

The emissions are calculated using the following equation: E=P*EF*SUR

Where:
E = Emissions, pounds (lb)/year (yr)
P = Residential Population for 2023 (956 and 356 for AA and EA, respectively)
EF = Emission Factor, lb/gal (3.87 and 0.74 for solvent-based and water-based coatings, respectively)
SUR = Solvent Usage Rate, gal per person

The estimated emissions from residential architectural surface coatings for CY 2023 is 1.54E+00 tpy of VOCs. The contribution from AA is 1.11E+00 tpy and from EA is 4.29E-01 tpy of VOCs.

3.3.2 Commercial Emissions

There are over 17 million square feet (s.f.) of building space at APG located in over 2,000 buildings (APG, 2019). In order to determine the VOC emissions from commercial architectural coatings, it is assumed that ten percent (10%) of building space is painted each year (i.e. building space is repainted once every ten years). The EF for building surface coating is 1.39 lb/gal of VOC and was adapted from the Code of Maryland Regulations (COMAR) 26.11.33.05, VOC Content Limits. A conversion factor was developed for APG based on historical paint use in order to convert building square feet to gallons of paint used; the conversion factor is 0.0017 gal per square foot.

The emissions from commercial architectural surface coatings for CY 2023 is 2.04E+00 tpy of VOCs.

3.3.3 Asphalt Striping Emissions

Emissions of VOCs from asphalt striping are estimated through several steps. First, APG Individual Job Order records are used to determine the area of asphalt paving. Next, assumptions are used to estimate the linear feet of asphalt striping performed on the paving. Looking at the three Job Orders for 2023, it is assumed that all asphalt paving is for roadways that need to be striped. It is assumed that each section of roadway will need three lines, one in the center of the roadway and one along each shoulder. The repaving at Phillips runway is estimated to be approximately equivalent to 750 linear feet based on the total area paved and the width of the runway.

The gallons of paint needed for this operation is estimated at 2,108 using the Parking Lot Paint Calculator[2]. It is assumed that the asphalt striping is performed with a water-based paint with a VOC content of 1.25 lbs VOCs per gallon.

The estimated emissions from asphalt striping architectural surface coatings for CY 2023 is 0.880 tpy of VOCs.

[2] https://www.asphaltkingdom.com/parking-lot-paint-calculator, Asphalt Kingdom, 2024

3.3.4 Architectural Surface Coatings Emissions

The estimated emissions from architectural surface coatings for CY 2023 are 4.46E+00 tpy of VOCs and the emissions calculations are presented in **Appendix C**.

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4.0 ASPHALT PAVING OPERATIONS

4.1 Background

Asphalt paving materials are mixtures of size-graded aggregate and liquid asphalt cement. Hot mix asphalt is heated. Hot mix asphalt emissions are from production and curing (USEPA, 1995b).

4.2 CY 2023 Data

Three asphalt paving projects were completed in CY 2023 with a combined total of 380,000 cubic feet.

4.3 Emissions Calculations

APG Individual Job Order records are used to determine the area of asphalt paving. Emissions estimates are based on conservative EFs taken from AP-42, Chapter 11, Hot Mix Asphalts, Tables 11.1-2, 11.1-5, and 11.1-8 (USEPA, 1995b). All of the listed paving operations occurred at AA. Estimates of total asphalt volumes were derived from the total linear feet assuming a conservative 15 foot wide, 4-inch-deep lane for the linear feet of road pavement and 8 inches thickness for the Philips Runway paving.

The estimated emissions from asphalt paving operations for CY 2023 are shown below in **Table 4-1** and the emissions calculations are presented in **Appendix C**.

Table 4-1. Estimated Asphalt Paving Operations Emissions

	CO (tpy)	NO_X (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_X (tpy)	VOC (tpy)
AA	5.62E+00	1.69E+00	1.38E-01	1.17E-01	1.24E+00	4.50E-01
EA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Asphalt Paving Operations Emissions	**5.62E+00**	**1.69E+00**	**1.38E-01**	**3.81E-01**	**1.24E+00**	**4.50E-01**

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5.0 CHEMICAL USAGE

5.1 Background

Chemicals containing volatile substances are utilized at APG for various activities including laboratory work, solvent cleaning, and use as adhesives and sealants. Surface coatings and solvent degreasers are not included in the Chemical Usage category as those two operations are separately accounted for in their own sections. Spent solvents are kept in closed containers, thus emissions are primarily produced during uses such as preparation and mixing in fume hoods. Used chemicals containing VOCs are then disposed as hazardous waste (APG, 2014). The gasoline received at the treatment, storage, and disposal facility (TSDF) is old or bad fuel drained from vehicles. The primary emission of concern is VOCs.

5.2 CY 2023 Data

Chemical usage data was not available from APG for CY 2023; therefore, CY 2020 chemical usage data is used.

2023 VOC-related Waste Generation Report from DPW-ED TSDF			
Category	**Weight AA (lb)**	**Weight EA (lb)**	**Total Weight (lb)**
Gasoline	292	85	377
Flammable Liquid	824	0	824
Total	**1116**	**85**	**1201**

5.3 Emissions Calculations

Neither the amount of chemical waste generated at APG nor the amount of chemicals used was available for CY2023. Therefore, CY2020 data was used. The amount of chemical waste generated at APG was recorded for the CY 2020. However, the amount of chemicals used was not available for CY 2020. There are two approaches to estimate emissions from chemical waste. A conservative approach to determine air emissions from chemical waste is to assume that 100% of the chemical used minus the waste chemical evaporates. A second approach is to assume that 95% of the total chemicals used is collected as waste and 5% evaporates. As the quantity of used chemicals is not available, the second approach is used for the CY 2020 waste chemical data. In the case of gasoline, it is assumed that 95% of the total drained from the vehicles was received at the TSDF, and 5% evaporated. The categories of chemical waste for APG include gasoline and flammable liquid.

The estimated emissions from chemical usage for CY 2023 are 3.16E-02 tpy of VOCs and the emissions calculations are presented in **Appendix C**.

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6.0 CONSTRUCTION OPERATIONS

6.1 Background

Heavy construction activities are a source of dust emissions (i.e., fugitive emissions). Building and road construction and demolition are examples of dust emitting construction operations. Due to the nature of construction activities, the overall emissions vary based on different construction activities and durations of projects. Emissions from construction operations can be broken down into several components based on activity, including: building construction and demolition, mobile construction equipment (for example rollers, cranes, trucks, excavators, etc.), and non-mobile construction equipment (for example light towers, portable power units, portable heating units, etc.) (USEPA, 1995b).

6.2 CY 2023 Data

Construction data was not available from APG for CY 2023; therefore, CY 2020 construction data is used.

Construction Activity Type	Quantity
Total Area of Disturbance (s.f.) - roof construction excluded due to no land disturbance	26000
Duration of Construction (days)	780
Total Area of Building Construction (s.f.)	810800
Total Volume of Building Demolition (c.f.)	2000

6.3 Emissions Calculations

EFs for construction operations were obtained from AP-42, Chapter 13, Section 13.2.3-1 (USEPA, 1995b). It is assumed that fugitive dust is created from construction traffic, land clearing (i.e. the use of scrapers), and material loading (for example the use of loaders and trucks). It is further assumed that the land is cleared to a depth of 2 feet below grade, the density of the soil is 80 pounds per cubic foot (lb/ft^3) and the material loading is equal to 25% of the total soil removed.

EFs for mobile and non-mobile heavy construction operations were obtained from USEPA's NONROAD 2008 model.

The DPW maintains an Excel spreadsheet tool to comply with Record of Non-Applicability (RONA) elements of the Clean Air Act. The tool estimates emissions from proposed APG activities. Construction operations emissions were estimated using this tool.

The estimated emissions from construction operations, including construction and demolition, mobile construction equipment, and non-mobile construction equipment, for CY 2023 are shown in **Table 6-1** and the emissions calculations are presented in **Appendix C**.

Table 6-1. Estimated Construction Operations Emissions

	CO (tpy)	NO_X (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_X (tpy)	VOC (tpy)
Total Construction Operations Emissions	1.72E+01	3.59E+01	1.43E+01	4.67E+00	5.29E-01	7.32E+00

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7.0 CONSUMER PRODUCTS

7.1 Background

Consumer products that contain VOCs are used in home, office, institution, and similar settings. VOCs in consumer products are commonly used for propellants, product drying aids, co-solvents, and cleaning agents. VOCs are typically released during product use. Consumer products include personal care products (hair care products, cologne, perfume, etc.), household products (cleaning and washing products), automotive aftermarket products (maintenance and repair products), adhesives and sealants, and miscellaneous products (arts and crafts supplies, pet care products, etc.) (USEPA, 1995a). Coatings and related products are not included in this section as those products are included in emissions from Architectural Surface Coatings.

7.2 CY 2023 Data

The AA residential population provided is 925 and the EA residential population provided is 356.

7.3 Emissions Calculations

EFs are from USEPA's EIIP, Volume III, Chapter 5, Table 5.4-1 (USEPA, 1995a). Yearly emissions for consumer products were determined by multiplying the EFs (lb VOC/person per year) by the residential population at AA and EA for CY 2023.

The estimated emissions from consumer products for CY 2023 are 3.27E+00 tpy of VOCs and the emissions calculations are presented in **Appendix C**.

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8.0 FUEL SPILLS

8.1 Background

VOCs can be emitted into the atmosphere if fuel is spilled.

8.2 CY 2023 Data

Fuel spill data was not available from APG for CY 2023; therefore, CY 2017 fuel spill data is used. The quantity of fuel spilled was 12,973 gallons during 35 spill events.

8.3 Emissions Calculations

Data on the quantity of fuel spills at APG for CY 2023 is unavailable; therefore, data from CY 2017 is used. It is conservatively assumed that all of the spilled fuel is gasoline. The emission factor from AP-42, Table 5.2-7 for spillage at a gasoline service station was used to estimate VOC emissions from fuel spills. The emissions were calculated by multiplying the EF (in units of pounds/ 1,000 gallons) by the quantity of fuel spilled (in units of thousand gallons).

The estimated emissions from fuel spills for CY 2023 are 4.54E-03 tpy of VOCs and the emissions calculations are presented in **Appendix C**.

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9.0 INSIGNIFICANT EXTERNAL COMBUSTION SOURCES

9.1 Background

Insignificant external combustion sources include small oil-fired, gas-fired and propane-fired boilers. Insignificant external combustion sources are those rated at less than 1 MMBtu/hr and are not listed on the APG Title V permits. DPW provided a list of 44 insignificant external combustion sources at AA and 28 at EA.

9.2 CY 2023 Data

	Rated Heat Input Capacity (MMBtu/hr)	CY 2023 Operating Hours (hr/yr)
AA Fuel Oil	19.351	2,027
AA NG	3.51	2,027
AA Propane	0.3	2,027
EA Fuel Oil	10.58	2,027
EA NG	2.9	2,027
EA Propane	0	2,027

9.3 Emissions Calculations

The rated heat input capacities for insignificant external combustion sources that burn fuel oil, natural gas, and propane were added together for AA and EA from the data supplied by DPW. These totals were used along with assumed CY 2023 operating hours and the heat values and EF of fuel oil, natural gas, and propane to estimate criteria pollutant emissions. It was assumed that all fuel oil is low sulfur content (0.05%).

The estimated emissions from insignificant external combustion sources for CY 2023 are shown in **Table 9-1** and the emissions calculations are presented in **Appendix C**.

Table 9-1. Estimated Insignificant External Combustion Sources Emissions

	CO (tpy)	NO_X (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_X (tpy)	VOC (tpy)
Total Insignificant External Combustion Sources Emissions	16.3E+00	5.00E+00	7.65E-01	7.65E-01	1.56E+00	1.11E-01

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10.0 INSIGNIFICANT INTERNAL COMBUSTION SOURCES

10.1 Background

Insignificant internal combustion sources include stationary engines in emergency generators. The major fuel source is diesel fuel. Insignificant internal combustion sources are those rated at less than 500 horsepower and are not listed on the APG Title V permits. DPW provided a list of 67 insignificant internal combustion sources at AA and 68 at EA. The majority of emissions from internal combustion engines are emitted through the exhaust of the unit, while a smaller portion is emitted from the crankcase, fuel tank, and carburetor (USEPA, 1995b).

10.2 CY 2023 Data

	Aggregated Ratings (HP)	**CY 2023 Operating Hours (hr/yr)**
AA Insignificant Internal Combustion Sources	11168.0	50
EA Insignificant Internal Combustion Sources	13748.0	50

10.3 Emissions Calculations

The horsepower ratings for insignificant internal combustion sources that burn diesel fuel were aggregated for AA and EA from the data supplied by DPW. It was assumed that each source was used for 50 hours in CY 2023. Emission factors for criteria pollutants are from AP-42, Section 3.3, Table 3.3-1 (USEPA, 1995b). Emissions are calculated by multiplying the EF with the assumed CY 2023 run time and the horsepower (HP) rating of the unit.

The estimated emissions from insignificant internal combustion sources for CY 2023 are shown in **Table 10-1** and the emissions calculations are presented in **Appendix C**.

Table 10-1. Estimated Insignificant Internal Combustion Sources Emissions

	CO (tpy)	NOX (tpy)	PM10 (tpy)	PM2.5 (tpy)	SOX (tpy)	VOC (tpy)
Total Insignificant Internal Combustion Sources Emissions	4.16E+00	1.93E+01	1.37E+00	1.37E+00	1.28E+00	1.56E+00

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11.0 INSIGNIFICANT STORAGE TANKS

11.1 Background

APG houses numerous small aboveground storage tanks (ASTs) and underground storage tanks (USTs) which contain fuels with a potential to emit VOCs. These fuels include gasoline, JP-8, kerosene, and F-24. VOCs can be emitted from gasoline storage tanks when refilling the tanks and due to tank breathing (USEPA, 1995b). Insignificant storage tanks are not listed on the APG Title V permits. DPW provided lists of ASTs and USTs and the tank capacities were aggregated for fuels with a potential to emit VOCs.

11.2 CY 2023 Data

The aggregated insignificant storage tank capacity is 1,939,130 gallons.

11.3 Emissions Calculations

Actual fuel throughputs are not available for CY 2023, so for the purpose of this inventory, it is assumed that all tanks have a CY 2023 fuel throughput equal to the tank capacity. The EF for Stage I/II tanks from AP-42, Chapter 5, Table 5.2-7 is used to estimate losses from insignificant storage tanks (USEPA, 1995b).

The estimated emissions from insignificant storage tanks for CY 2023 are 3.01E+00 tpy of VOCs and the emissions calculations are presented in **Appendix C**.

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12.0 LANDFILLS

12.1 Background

There are three closed landfills at APG. The Westwood and Philips Landfills were open until 2001 and were used to dispose of rubble. It is assumed that insignificant quantities of VOCs are emitted from these landfills due to the low organic content in rubble (APG, 2014). Michaelsville Landfill was used for municipal solid waste for eleven years from 1969 to 1980 (APG, 2014).

12.2 CY 2023 Data

The provided data is the Michaelsville Landfill annual waste acceptance rate of 76,266 tpy.

12.3 Emissions Calculations

Landfill VOC losses were calculated using USEPA's Landfill Gas Emissions Model (LandGEM) version 3.03. The "Inventory Defaults" embedded into the program are based on EFs from AP-42 (APG, 2014) and these default values were selected for this model. The main parameters chosen were a methane generation rate (k) of 0.04/year, a potential methane generation capacity (Lo) of 100 m^3/Mg, and a non-methane organic compound (NMOC) concentration of 600 parts per million by volume. The waste acceptance rate was 76,266 tpy for the years 1970 through 1979 and for 1969 and 1980 half of that rate was used, as was done for the 2014 AEI. It is conservatively assumed that VOC emissions are equal to NMOC emissions.

The estimated emissions from landfills for CY 2023 are 2.41E+00 tpy of VOCs and the emissions calculations are presented in **Appendix C**.

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13.0 NON-ROAD VEHICLES

13.1 Background

Non-road vehicles include industrial equipment (i.e. forklifts, sweepers, etc.), lawn and garden equipment (i.e. lawn mowers, leaf blowers, etc.), agricultural equipment (i.e. tractors, mowers, etc.), and miscellaneous vehicles (i.e. all-terrain vehicles, utility vehicles, etc.). This equipment is operated with gasoline or diesel fuel.

13.2 CY 2023 Data

Non-road vehicle usage data was not available from APG for CY 2023; therefore, CY 2020 non-road vehicle usage data is used.

13.2.1 Gasoline Non-Road Vehicles

Vehicle/ Equipment Type	# of Units	Engine Rating (Per Unit) (hp)	Model Year	Total Operating Time (hr/yr)
Forklift	2	150	Average	41
Forklift	11	150	Average	233
Toro Aerator	1	23	Average	35
Toro Workman Utility Vehicle	2	31	Average	1000
Salsco Greens Roller	1	11	Average	500
John Deere Sand Pro	1	45	Average	35
Golf Carts	110	11.5	Average	55000
Lawn Mowers	2	16	Average	1045.38
Toro Zero Turn Rotary Mower	1	23	Average	555
Toro Triplex Mower	2	18	Average	1110
Golf Cart (John Deere)	1	23	2009	228.5
ATV (Yamaha)	1	24	2005	0
ATV (Kawasaki)	1	18	2005	402.8
Golf Cart (Cub Cadet)	1	20	2008	109

13.2.2 Diesel Non-Road Vehicles

Vehicle/Equipment Type	# of Units or CY 2023 Mileage for Heavy, Medium, and Light Duty Vehicles	Average Engine Rating (Per Unit) (hp)	Average Model Year	Total Operating Time (hr/yr)
Forklift	17	150	Average	514
ATV, John Deere Gator	3	20	Average	80
Fairway and Approach Mowers	3	35	Average	1,665
Ford New Holland Tractor	3	65	2000	312
Kubota Tractor	1	85.3	2000	312
Rough Mowers	3	55	Average	1,665
Boomlift Aerial	1	150	2008	72
Forklift	21	150	1995	1,188
Forklift Reach Telehandler	1	150	2008	98
Heavy duty	522004.6	N/A	N/A	N/A
Medium duty	116903.2	N/A	N/A	N/A
Light duty	219386.2	N/A	N/A	N/A

13.3 Emissions Calculations

For the purposes of simplicity and comparability with earlier estimates numbers, the CY 2023 emissions were estimated in a manner similar to that used for the CY 2020 and 2017 emissions. EFs for diesel engines were obtained from Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling—Compression-Ignition (USEPA, 2010a)[3]. EFs for gasoline engines were obtained from Exhaust Emission Factors for Nonroad Engine Modeling—Spark-Ignition (USEPA, 2010b). Emission factors are characterized by engine size in HP.

Information was gathered from APG on the number of vehicles, type of vehicles, horsepower rating, fuel type, and estimated operating hours for CY 2023. If data was not available for CY 2023, the equipment and necessary information was assumed to be the same as in the previous AEI Report (APG, 2017).

The estimated emissions from non-road vehicles for CY 2023 are shown in **Table 13-1** and the emissions calculations are presented in **Appendix C**.

Table 13-1. Estimated Non-Road Vehicles Emissions

	CO (tpy)	NO_X (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_X (tpy)	VOC (tpy)
Total Gasoline Non-Road Vehicles Emissions	1.55E+02	1.20E+00	2.60E-02	2.39E-02	1.01E-01	2.27E+00
Total Diesel Non-Road Vehicles Emissions	3.13E+00	5.32E+00	2.31E-01	2.15E-01	2.06E-01	5.53E-01
Total Non-Road Vehicles Emissions	1.58E+02	6.53E+00	2.57E-01	2.39E-01	3.06E-01	2.83E+00

[3] The MOVES model, which includes the NONROAD model, may be used to estimate emissions from non-road equipment.

14.0 ON-ROAD VEHICLES

14.1 Background

On-road vehicles at APG include privately owned vehicles (POVs) as well as government owned vehicles (GOVs). POVs include vehicles owned by contractor employees, visitors, and military personnel (APG, 2014). GOVs include vehicles such as those used by police and emergency services. Emissions are for estimated miles driven on-base only.

14.2 CY 2023 Data

On-road vehicle usage data was not available from APG for CY 2023; therefore, CY 2020 On-road vehicle usage data is used.

14.2.1 On-Road POVs

Vehicle Category	POVs	Annual On-base Mileage
HDDBT	27	29,337
HDGV	26	34,597
LDDT	151	205,089
LDGT12	4,897	6,631,222
LDGV	7,573	10,254,467
Totals	**12,675**	**17,154,712**

14.2.2 On-Road GOVs

Vehicle Category	Annual On-Base Mileage
HDDBT	4,769
HDDV	205,818
HDGV	71,991
LDDT	43,766
LDGT12	884,335
LDGV	526,712
TOTALS	**1,737,391**

14.3 Emissions Calculations

For the purposes of simplicity and comparability with earlier estimates numbers, the CY 2023 emissions were estimated in a manner similar to that used for the CY 2017 emissions. Emissions are calculated using a three-step process. First, vehicle types, numbers of vehicles, and vehicle mileage traveled on the base are obtained. Next, all vehicles are categorized based on vehicle type, fuel, and duty rating. Lastly, the emissions are calculated using emissions factors taken from the APG RONA spreadsheet which is based on Mobile Emissions from “Guide to Air Force Mobile Sources”, the emission factors which in turn are based on the EPA MOVES model.

Information pertaining to the number of POVs is taken from a traffic study conducted at APG in

CY 2018. Privately owned vehicle counts were collected at each gate at APG on a single day, 24 April 2018. The traffic study counted single occupancy vehicles and carpool vehicles, but it did not distinguish between cars, sport utility vehicles (SUVs), or personal trucks. The traffic study did separate out vans and buses as heavy-duty vehicles. To categorize the POVs, it is assumed that 60 % of single occupancy and carpool vehicles are passenger cars and 40 % are SUVs or light pickup trucks. Motorcycles are not included in the emissions calculations because they accounted for less than 0.2 % of the POVs. The vehicle mileage traveled on the base is not included in the traffic study; therefore, the on-base vehicle mileage is estimated. The daily vehicle miles per POV are estimated as the distance from each gate to a central location on the base, then doubling the miles assuming each POV enters and leaves the base. The annual vehicle miles are estimated as the daily vehicle miles multiplied by five working days per week, multiplied by 50 working weeks per year (APG, 2014). It is assumed that all buses and 3 % of SUVs/light pickup trucks are diesel. All passenger cars, all vans, and 97 % of the SUVs/light pickup trucks are assumed to run on gasoline (APG, 2014).

Information on GOVs was provided as vehicle type, fuel type, and total miles driven per year. The GOVs are categorized based on vehicle type, fuel, and duty rating. CY2023 total milage was not available from APG; therefore, CY 2020 total mileage is used directly with the EFs to determine emissions.

The estimated emissions from on-road vehicles for CY 2023 are shown in **Table 14-1** and the emissions calculations are presented in **Appendix C**.

Table 14-1. Estimated On-Road Vehicles Emissions

	CO (tpy)	NO_X (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_X (tpy)	VOC (tpy)
On-road POV Emissions	8.24E+01	8.29E+00	2.11E-01	1.92E-01	4.60E-02	7.59E+00
On-road GOV Emissions	9.61E+00	2.30E+00	7.79E-02	7.14E-02	7.68E-03	8.79E-01
Total On-road Vehicles Emissions	9.20E+01	1.06E+01	2.89E-01	2.63E-01	5.36E-02	8.46E+00

15.0 OPEN BURNING/OPEN DETONATION OF EXPLOSIVES

15.1 Background

Open burning/open detonation (OB/OD) is a method to dispose of weapons/munitions, explosives, and propellants. APG has a Resource Conservation and Recovery Act (RCRA) permit for OB/OD operations. APG determined an EF for OB/OD operations which include emissions from particulates generated from the soil during OB/OD and from the weapons/munitions, explosives, and propellants. The EF does not include the additional explosive material added to the weapons/munitions, explosives, and propellants to initiate the burning or detonation (APG, 2014).

15.2 CY 2023 Data

OB/OD data was not available from APG for CY 2023; therefore, CY 2020 OB/OD data is used. No change in the requested or permitted open burns has been made during this time frame.

Disposal Method	Quantity (lbs/yr)
Open Burning	2103
Open Detonation	9322

15.3 Emissions Calculations

Records of the quantity of OB/OD, in pounds, for CY 2023 could not be obtained from APG. Therefore, CY 2020 amounts were used. Emissions were determined by multiplying the quantity of OB/OD by the EF established for APG in previous AEI Reports.

The estimated emissions from open burning/open detonation of explosives for CY 2023 are shown in **Table 15-1** and the emissions calculations are presented in **Appendix C**.

Table 15-1. Estimated Open Burning/Open Detonation of Explosives Emissions

	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC
Open Burning Emissions (lb/yr)	1.63E+01	1.46E+01	4.21E+02	2.31E+01	1.46E+00	2.86E-01
Open Detonation Emissions (lb/yr)	2.73E+02	1.58E+02	1.77E+05	8.67E+04	6.17E+01	1.21E+01
Total OB/OD of Explosives Emissions (lb/yr)	2.89E+02	1.72E+02	1.78E+05	8.67E+04	6.32E+01	1.24E+01
Total OB/OD of Explosives Emissions (tpy)	1.45E-01	8.61E-02	8.88E+01	4.34E+01	3.16E-02	6.20E-03

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16.0 SMOKE TESTING

16.1 Background

Tests are conducted with smoke grenades which can add pollutants to the air.

16.2 CY 2023 Data

Smoke testing data was not available from APG for CY 2023; therefore, CY 2020 smoke testing data is used. APG indicated that zero smoke grenades were used in CY 2023. Accordingly, no emission estimates are presented for this category.

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17.0 SOLVENT DEGREASERS

17.1 Background

Solvent degreasers are used to clean parts at APG. Typically, parts are cleaned by manually spraying or soaking the parts in a tank. Once the parts are cleaned, the parts are suspended over the tank to drain (APG, 2014). The pollutant of interest in solvent degreasers is VOCs.

17.2 CY 2023 Data

Smoke testing data was not available from APG for CY 2023; therefore, CY 2020 smoke testing data is used.

Location	Volume (gal)	Density (lb/gal)	Solvent Removed as Waste (lb/yr)
AA	32	6.43	205.6208
AA	128	6.43	822.4832
AA	5	6.43	32.12825
AA	256	6.43	1644.9664
AA	120	6.43	771.078
AA	120	6.43	771.078
AA	98	6.43	629.7137
AA	32	6.43	205.6208
AA	385	6.43	2473.87525
AA	45	6.43	289.15425
AA	74	6.43	472.285275
AA	74	6.43	472.285275
AA	23	6.43	147.78995
AA	96	6.43	616.8624
AA	74	6.43	472.285275
AA	64	6.43	411.2416
EA	49	6.43	314.85685
AA	1,136	7	7952
EA	503	7	3521
AA	42	8.804	369.76695
AA	5	8.078	40.3898
Totals APG	**3,359.5**		**22,636.5**

17.3 Emissions Calculations

A mass balance approach can be used to determine emissions from solvent degreasers. The amount of solvent degreaser removed from APG in CY 2020 was obtained from Safety-Kleen Inc, CY 2023 data was not available. It is assumed that 95% of the total solvent degreaser supplied is removed by the supplier as waste and 5% evaporates. This is a conservative approach (APG, 2014).

The estimated emissions from solvent degreasers for CY 2023 is 5.96E-01 tpy of VOCs and the emissions calculations are presented in **Appendix C**.

18.0 TRAINING EXERCISES

18.1 Background

Training exercises with ammunition occur at APG on land and from watercraft. This section includes emissions from ammunition used for training.

18.2 CY 2023 Data

Training exercise data was not available from APG for CY 2023; therefore, CY 2020 training exercise data is used.

Item	Items fired
60 mm mortar	34
5.56 mm	1600
7.62 mm	335422
40 mm	10754
.50 Caliber	140500

18.3 Emissions Calculations

APG provided data on the type of ammunition used and the number of rounds fired for CY 2020, this data was not available for CY 2023. EFs for ammunition were obtained from AP-42, Chapter 15 (USEPA, 1995b). The EFs are in units of pollutant emitted in pounds per round fired. Emissions are calculated by multiplying the number of rounds fired by the EF.

The estimated emissions from training exercises for CY 2023 are shown in **Table 18-1** and the emissions calculations are presented in **Appendix C**.

Table 18-1. Estimated Training Exercises Emissions

	CO (tpy)	NO_X (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_X (tpy)	VOC (tpy)
Total Training Exercises Emissions	2.52E+00	8.04E-02	1.98E-01	1.17E-01	0.00E+00	3.28E-03

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19.0 WATERCRAFT

19.1 Background

Watercraft are used at APG for training exercises and for patrols. Privately owned boats are also used in waters within the APG boundary.

19.2 CY 2023 Data

Watercraft usage data was not available from APG for CY 2023; therefore, CY 2020 watercraft usage data is used.

Description	Number of Units	Size, HP	Inboard or Outboard	Fuel Type	On-Site Estimated Usage (hours/yr)
Rohr MOD1 Landing Craft, LCM8522	1	800	Inboard	Diesel	30
Patrol Boat, Utility 41	1	900	Inboard	Diesel	85
Evans Boat, Patrol 42	1	900	Inboard	Diesel	18
Evans Boat, Patrol 43	7	900	Inboard	Diesel	828
Watercraft	0	350	Outboard	Gasoline	0
Watercraft	0	250	Outboard	Gasoline	0
Watercraft	0	150	Outboard	Gasoline	0
Watercraft	0	50	Outboard	Gasoline	0
AA privately owned watercraft at marina	12		Outboard	Gasoline	120
EA privately owned watercraft at marina	17	62.5	Inboard	Gasoline	174
	70	62.5	Outboard	Gasoline	696
Drop-in privately owned watercraft	30	62.5	Inboard	Gasoline	300
	120	62.5	Outboard	Gasoline	1200
Rental outboard motors	11	25	Outboard	Gasoline	1320

19.3 Emissions Calculations

For the purposes of simplicity and comparability with earlier estimates numbers, the CY 2023 emissions were estimated in a manner similar to that used for the CY 2017 emissions. The EFs for diesel engines were based on USEPA (2010a). EFs in USEPA (2010a) are based on the size (HP) of the engine. A single EF for each engine size was created by averaging the EFs in USEPA (2010a). EFs for gasoline engines were based on from USEPA (2010b) in the same manner as diesel engines[4]. The EFs for SO_2 were calculated using equations in USEPA (2010a) and USEPA (2010b).

Watercraft operations originate from several organizations at APG. Watercraft information was not provided as boat type, engine type (inboard or out-board), fuel type, and hours of operation for CY 2023. As data was not available for CY 2023, the equipment and necessary information was extracted from the previous AEI Reports (APG, 2020). Emissions are calculated by multiplying the hours of operation, the size of the engine and the EF.

[4] The MOVES model, which includes the NONROAD model, may be used to estimate emissions from certain watercraft engines.

The estimated emissions from watercraft for CY 2023 are shown in **Table 19-1** and the emissions calculations are presented in **Appendix C**. It is assumed that $PM_{2.5}$ emissions are equal to PM_{10} emissions.

Table 19-1. Estimated Watercraft Emissions

	CO (tpy)	NO_X (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_X (tpy)	VOC (tpy)
Total Watercraft Emissions	3.16E+01	5.60E+00	2.29E-01	2.29E-01	3.49E-01	7.16E+00

20.0 WELDING

20.1 Background

Welding operations are conducted at APG; such operations include brazing and soldering, and electric arc welding, which is the most common. Particulate emissions are the primary concern from welding processes (USEPA, 1995b).

20.2 CY 2023 Data

Welding data was not available from APG for CY 2023; therefore, CY 2020 welding usage data is used.

Source	Type	Weight (lb/yr)
Welding Wire	Mig wire 100S-1	2000
Welding Wire	Mig wire 70S-6	4000
Welding Wire	Mig wire Alum.4043	300
Welding Wire	Mig Wire Alum. 5356	300
Stick Electrodes	1/8"1018	2000
Stick Electrodes	5/32" 1018	2000
Stick Electrodes	5/32"7018	2000
Stick Electrodes	5/32" 6011	200
Stick Electrodes	308 S.S.	75
Stick Electrodes	Carbon Rods	500
Welding Wire	Lincoln Electrical UltraCore 71A85 .045"	330
Welding Rod	Lincoln Electrical E7018	10
Totals		**13715**

20.3 Emissions Calculations

EFs were taken from AP-42, Chapter 12, Table 12.19-1 (USEPA, 1995b). Data was provided by APG on the amount and type of welding material used; based on the type of welding material used at APG, it is assumed that all welding is gas metal arc welding (GMAW). The maximum EF for GMAW is used to create a conservative estimate of emissions.

The estimated emissions from welding for CY 2023 is 1.65E-01 tpy of PM_{10} and 1.65E-01 tpy of $PM_{2.5}$ and the emissions calculations are presented in **Appendix C**. It is assumed that $PM_{2.5}$ emissions are equal to PM_{10} emissions.

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21.0 MISCELLANEOUS SOURCES

21.1 Background

There are miscellaneous sources at APG that were investigated to determine if criteria pollutants were emitted from these sources.

21.2 Sources

Building 6004 contains a room with two powder coat devices that is listed as an insignificant source in the AA Title V permit. Overspray runs through six filters enclosed within the powder coat room. The room does not have a vent stack and painters hook up to an external air supply while using the powder coat devices. The CY 2023 emissions from this powder coat room are insignificant.

Methane flares used at the EA wastewater treatment plant were evaluated in 2002 and deemed insignificant (APG, 2014).

Wet cooling towers at APG used for air conditioning are closed-loop systems and have no significant emissions (APG, 2014).

Dry cleaning at APG was done offsite in CY 2023; therefore, there are no emissions from dry cleaning operations.

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22.0 SUMMARY

This report documents air emissions sources at APG which do not require a construction permit, as requested by the DPW. Data was collected from APG personnel to estimate emissions of criteria pollutants for 20 source categories not included in the Title V permits for AA or EA shown below:

- Aircraft Operations
- Architectural Surface Coatings
- Asphalt Paving Operations
- Chemical Usage
- Construction Operations
- Consumer Products
- Fuel Spills
- Insignificant External Combustion Sources
- Insignificant Internal Combustion Sources
- Insignificant Storage Tanks
- Landfills
- Non-Road Vehicles
- On-Road Vehicles
- Open Burning/Open Detonation of Explosives
- Smoke Testing
- Solvent Degreasers
- Training Exercises
- Watercraft
- Welding
- Miscellaneous Sources

Emissions were calculated using emission factors from documented references and applied to data obtained from APG (**Table 22-1**).

Table 22-1. Estimated CY 2023 Emissions Summary from Sources Which Do Not Require a Construction Permit

Emissions Source	Criteria Pollutant Emissions, tons per year (tpy)					
	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC
Aircraft Operations	9.09E+01	1.44E+01	2.49E-02	2.41E-02	3.27E+00	7.01E+01
Architectural Surface Coatings	--	--	--	--	--	4.46E+00
Asphalt Paving Operations	5.62E+00	1.69E+00	1.38E-01	1.17E-01	1.24E+00	4.50E-01
Chemical Usage	--	--	--	--	--	3.16E-02
Construction Operations	1.72E+01	3.59E+01	1.43E+01	4.67E+00	5.29E-01	7.32E+00
Consumer Products	--	--	--	--	--	3.27E+00
Fuel Spills	--	--	--	--	--	4.54E-03
Insignificant External Combustion Sources	1.63E+00	5.00E+00	7.65E-01	7.65E-01	1.56E+00	1.11E-01
Insignificant Internal Combustion Sources	4.16E+00	1.93E+01	1.37E+00	1.37E+00	1.28E+00	1.56E+00
Insignificant Storage Tanks	--	--	--	--	--	3.01E+00
Landfills	--	--	--	--	--	2.41E+00
Non-Road Vehicles	1.58E+02	6.53E+00	2.57E-01	2.39E-01	3.06E-01	2.83E+00
On-Road Vehicles	9.20E+01	1.06E+01	2.89E-01	2.63E-01	5.36E-02	8.46E+00
Open Burning/ Open Detonation of Explosives	1.45E-01	8.61E-02	8.88E+01	4.34E+01	3.16E-02	6.20E-03
Smoke Testing	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Solvent Degreasers	--	--	--	--	--	5.96E-01
Training Exercises	2.52E+00	8.04E-02	1.98E-01	1.17E-01	0.00E+00	3.28E-03
Watercraft	3.16E+01	5.60E+00	2.29E-01	2.29E-01	3.49E-01	7.16E+00
Welding	--	--	1.65E-01	1.65E-01	--	--
Miscellaneous Sources	--	--	--	--	--	--
Total	4.04E+02	9.92E+01	1.06E+02	5.13E+01	8.62E+00	1.12E+02

23.0 EMISSIONS GROWTH

APG does not anticipate that there will be a significant increase in air emissions in the foreseeable future. Estimates of APG population for FY 2020 through FY 2026 were obtained from DPW Master Planning. The population is expected to remain fairly consistent. It is assumed that emissions will be generally proportional to APG population. The emissions estimated for CY 2020 were multiplied by the percent change in population from the FY 2020 base year to estimate future trends in emissions. The calculated estimate for CY 2023 emissions presented in this report are below the projected emissions growth using the FY 2020 data. Although emissions are expected to be generally proportional to the population, future estimates will also depend on changes in the type and number of emission sources on site and emission estimation methodologies (e.g., AEDT, MOVES3).

The estimated population projections are shown in **Table 23-1** and the emissions growth calculations are presented in **Appendix C**.

Table 23-1. Estimated Population Projections

Fiscal Year	Population	Growth Rate (%) over base year 2020
2020	20,862	--
2021	21,149	1.38%
2022	21,162	1.44%
2023	21,180	1.52%
2024	21,082	1.05%
2025	20,924	0.30%
2026	20,924	0.30%

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24.0 REFERENCES

Aberdeen Proving Ground (APG), 2019. *Aberdeen Proving Ground. Home of Innovation. Home. My Aberdeen Proving Ground.* https://home.army.mil/apg/index.php/my-fort . Accessed 21 April 2021.

APG, 2010. *2008 Air Emissions Inventory Summary, Aberdeen Proving Ground, Maryland* July, 2010.

APG, 2014. *Air Emissions Inventory Summary Aberdeen Proving Ground, Maryland*, July 31, 2024.

APG, 2018. *2017 Air Emissions Inventory Summary U.S. Army Garrison, Aberdeen Proving Ground, Maryland*, April 2018.

APG, 2021. *2020 Air Emissions Inventory Summary U.S. Army Garrison, Aberdeen Proving Ground, Maryland*, June 2021.

Asphalt Kingdom, 2024. https://www.asphaltkingdom.com/parking-lot-paint-calculator. Accessed August 2024.

USEPA, 1995a. *Emission Inventory Improvement Program, Volume III.* November 1995.

USEPA, 1995b. *AP-42: Compilation of Air Pollutant Emission Factors, Volume 1, Fifth Edition* (individual chapters are updated).

USEPA, 2010a. *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling—Compression-Ignition. NR-009d*. EPA-420-R-10-018. July 2010.

USEPA, 2010b. *Exhaust Emission Factors for Nonroad Engine Modeling—Spark-Ignition. NR- 010f*. EPA-420-R-10-019. July 2010.

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APPENDIX A

2023 AIR EMISSIONS CERTIFICATION REPORT FOR ABERDEEN AREA OF ABERDEEN PROVING GROUND

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DEPARTMENT OF THE ARMY
U.S. ARMY INSTALLATION MANAGEMENT COMMAND
U.S. ARMY GARRISON ABERDEEN PROVING GROUND
DPW ENVIRONMENTAL DIVISION BUILDING 4304, 6504 RODMAN RD
ABERDEEN PROVING GROUND MARYLAND 21005-1946

March 26, 2024

Mr. Alexander Holt
Air Quality Compliance Program
Air and Radiation Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 715
Baltimore, Maryland 21230-1720

Dear Mr. Holt:

As required by Code of Maryland Regulation 26.11.01.05-1, enclosed is a digital file in '.pdf' format of the Annual Emissions Certification Report for the Aberdeen Area of Aberdeen Proving Ground, for calendar year 2023. The report includes the completed Maryland Department of the Environment emission reporting forms (Forms 1 through 6) and supporting calculations.

In accordance with the Title V Permit Section VI – State Only Enforceable Condition No. 2, Aberdeen Proving Ground performed a compliance demonstration for the emissions of toxic air pollutants in 2017. This demonstration showed that Aberdeen Proving Ground is compliant with respect to Maryland Air Toxic regulation COMAR 26.11.15 and is considered to be valid for calendar year 2023. There have been no significant changes at Aberdeen Proving Ground Aberdeen Area in 2023 that would invalidate this demonstration. In September 2023, Aberdeen Proving Ground completed an updated compliance demonstration for the emissions of toxic air pollutants in Aberdeen Area.

The point of contact for this matter in the Directorate of Public Works, Environmental Compliance Branch is Dr. Hazoor Khan at 410-306-2278, hazoor.b.khan.civ@army.mil.

Sincerely,

KRYSTON.SARAH.LISA.1298181980 Digitally signed by KRYSTON.SARAH.LISA.1298181980 Date: 2024.03.26 09:07:17 -04'00'

Sarah Kryston
Chief Environmental Compliance Branch
Directorate of Public Works

Enclosure

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MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard, Suite 715 Baltimore Maryland 21230-1720
(410) 537-3000 1-800-633-6101 http://www.mde.state.md.us
Air and Radiation Administration
Air Quality Compliance Program
(410) 537-3220

FORM 1

GENERAL FACILITY INFORMATION
EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

A. FACILITY IDENTIFICATION			Do Not Write in This Space
Facility Name Aberdeen Proving Ground - Aberdeen Area 24-025-00081			Date Received Regional
Address DPW Environmental Division Building 4304, 6504 Rodman Rd. ATTN: AMIM-APP-E			Date Received State
City Aberdeen Proving Ground	County Harford	Zip Code 21005-1946	AIRS Code
B. Briefly describe the major function of the facility Research/Development and Test/Evaluation of U.S. Army Material.			FINDS Code SIC Code
			Facility Number:
			TEMPO ID:
C. SEASONAL PRODUCTION (%, if applicable)			Reviewed by:
Winter *(Dec.-Feb)*	Spring *(Mar-May)*	Summer *(Jun-Aug)* / Fall *(Sept-Nov)*	Name Date

D. Explain any increases or decreases in emissions from the previous calendar year for each registration at this facility.

The Fire Test Lab and ECO Mobile Incinerator had no reportable emissions this year
There are no other significant increases or decreases in emissions from the previous calendar year.

E. CONTROL DEVICE INFORMATION (for NO_x and VOC sources only)

Control Device	Capture Efficiency	Removal Efficiency
All information regarding control devices are		
included in the calculations section		

I am familiar with the facility and the installations and sources for which this report is submitted. I have personally examined the information in this report, which consists of 102 pages (including attachments), and certify that the information is correct to the best of my knowledge.

Sarah Kryston	Chief, Environmental Compliance Branch	3/26/24
Name (Print/type)	Title	Date
Sarah Kryston	(410) 306-2270	
Signature	Telephone Number	

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Nitrogen Oxides (NOx) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0619	Various	10300503	No. 2 Oil	s	1.69E+00	1.86E+01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0689	26-0642-A01	10300503	No. 2 Oil	s	4.33E-02	4.76E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Atmospheric Burner 4-0692	Atmospheric Burner #1	40290012	F-24	s	0.00E+00	0.00E+00	0.00	0	0	0	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0707	26-0445-A01	10300503	No. 2 Oil	s	2.45E-02	2.69E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0708	26-0394-A01	10300503	No. 2 Oil	s	1.01E-01	1.11E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0709	26-0392-A01	10300503	No. 2 Oil	s	2.97E-02	1.63E-01	24.00	7	52	365	0.16	24.00	NA	NA	C3
				f											
Fuel Oil Boiler 5-0710	0339-A01	10300503	NG	s	3.93E-02	4.32E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0719	26-0670-A01	10300503	No. 2 Oil	s	3.24E-02	3.56E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0720	26-0688-A01	10300503	No. 2 Oil	s	7.11E-03	7.81E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0722	26-0449-A01	10300503	No. 2 Oil	s	2.77E-02	3.05E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0724	Bldg 906C - pending	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0079	26-0345-A01	10200603 10300503	NG	s	2.82E+00	1.54E+01	24.00	7	52	365	15.44	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0080	26-0345-A02	10200603 10300503	NG	s	2.82E+00	1.54E+01	24.00	7	52	365	15.44	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0081	26-0345-A03	10200603 10300503	NG	s	2.82E+00	1.54E+01	24.00	7	52	365	15.44	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0085	26-4600-A06	10200603 10300503	NG	s	1.26E+00	6.90E+00	24.00	7	52	365	6.90	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0087	26-4600-A08	10200603 10300503	NG	s	1.26E+00	6.90E+00	24.00	7	52	365	6.90	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0152	Various	10200603 10300503	NG	s	6.02E+00	6.61E+01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0167	26-03062-A02	10200603 10300503	NG	s	1.77E-01	9.72E-01	24.00	7	52	365	0.97	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0298	26-C2CNT West-A01 thru A04	10200603 10300503	NG	s	2.35E-01	2.58E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0299	26-GMS Tower-A01 thru A03	10200603 10300503	NG	s	7.34E-02	8.06E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0300	26-HQ Building-A01 thru A05	10200603 10300503	NG	s	3.07E-01	3.37E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0301	26-GMS Lab-A01 thru A03	10200603 10300503	NG	s	2.55E-01	2.80E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Nitrogen Oxides (NOx) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Dual Fuel Boiler 5-0308	26-04219-A03	10200603 10300503	NG	s	6.90E-02	3.78E-01	24.00	7	52	365	0.38	24.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0309	26-5100-A02	10200603	NG	s	2.51E-01	2.76E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0310	26-5100-A01	10200603	NG	s	2.51E-01	2.76E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0315	26-0525-A02	10200603 10300503	NG	s	1.97E-01	2.17E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0322	Various	10200603	NG	s	2.86E-01	3.14E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0334	26-0525-A03	10200603 10300503	NG	s	1.97E-01	2.17E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0335	26-0525-A01	10200603 10300503	NG	s	1.97E-01	2.17E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0336	26-04119-A03	10200603	NG	s	1.22E-01	1.34E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0337	26-0459-A02	10200603	NG	s	5.47E-02	6.02E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Propane Boiler 5-0352	0367-A01	10301002	Propane	s	1.18E-02	1.30E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0364	26-4312-A01	10200603 10300503	NG	s	1.50E-01	8.23E-01	24.00	7	52	365	0.82	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0364	26-4312-A02	10200603 10300503	NG	s	1.50E-01	8.23E-01	24.00	7	52	365	0.82	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0367	26-2485-A01	10200603	NG	s	5.98E-02	6.57E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0370	26-4600-A09	10200603 10300503	NG	s	1.26E+00	6.90E+00	24.00	7	52	365	6.90	24.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0371	26-3660-A01	10200603	NG	s	5.61E-02	6.16E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0376	0383A-A01 & A02	10200603	NG	s	2.13E-01	2.34E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0384	26-0400-A02	10200603	NG	s	5.17E-02	5.68E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0384	26-0400-A03	10200603	NG	s	5.17E-02	5.68E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0552	26-04219-A02	10200603 10300503	NG	s	6.90E-02	3.78E-01	24.00	7	52	365	0.38	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0710	0339-A01	10200603	NG	s	3.93E-02	4.32E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Paint Spray Booth 6-0159	07-00525-A06	40202501	NA	s	0.00E+00	0.00E+00	1.06	1.6	22	36	0.00	4.00	NA	NA	C2
				f											
Paint Spray Booth 6-0162	07-00525-A04	40202501	NA	s	0.00E+00	0.00E+00	1.13	2.3	37	84	0.00	1.13	NA	NA	C2
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Nitrogen Oxides (NOx) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	40400340	NA	s	0.00E+00	0.00E+00	8.00	7	52	365	0.00	8.00	NA	NA	C3
				f											
Fire Test Lab (IFEL) 9-0216	07-0525-A01	N/A	N/A	s	0.00E+00	0.00E+00	8.00	NA	NA	0	0.00	8.00	NA	NA	C2
				f											
Emergency Generator 9-0227	03-0394-A01	20200401	No. 2 Oil	s	7.57E-01	1.26E+02	4.08	1	12	12	126.16	4.08	NA	NA	C3
				f											
Emergency Generator 9-0228	03-0394-A02	20200401	No. 2 Oil	s	8.65E-01	1.44E+02	4.67	1	12	12	144.18	4.67	NA	NA	C3
				f											
Emergency Generator 9-0229	03-0328-A01	20200401	No. 2 Oil	s	5.43E-01	9.06E+01	3.67	1	12	12	90.56	3.67	NA	NA	C3
				f											
Emergency Generator 9-0276	03-4600-A04	20100101	No. 2 Oil	s	5.90E-01	9.84E+01	2.28	1	12	12	98.38	2.28	NA	NA	C3
				f											
Emergency Generator 9-0277	03-4600-A05	20100101	No. 2 Oil	s	5.95E-01	9.91E+01	2.29	1	12	12	99.11	2.29	NA	NA	C3
				f											
Emergency Generator 9-0386	03-0394-A03	20200401	No. 2 Oil	s	5.18E-01	8.64E+01	5.00	1	12	12	86.40	5.00	NA	NA	C3
				f											
Emergency Generator 9-0387	03-0394-A04	20200401	No. 2 Oil	s	3.72E-01	6.19E+01	3.58	1	12	12	61.92	3.58	NA	NA	C3
				f											
Emergency Generator 9-0388	03-0394-A05	20200401	No. 2 Oil	s	1.73E-02	2.88E+00	0.17	1	12	12	2.88	0.17	NA	NA	C3
				f											
Emergency Generator 9-0389	03-0394-A06	20200401	No. 2 Oil	s	5.18E-01	8.64E+01	5.00	1	12	12	86.40	5.00	NA	NA	C3
				f											
Emergency Generator 9-0390	03-0394-A07	20200401	No. 2 Oil	s	4.06E-01	6.77E+01	3.92	1	12	12	67.68	3.92	NA	NA	C3
				f											
Emergency Generator 9-0393	26-GMS-Lab-A04	20200401	No. 2 Oil	s	2.90E-01	4.84E+01	0.67	1	12	12	48.36	0.67	NA	NA	C3
				f											
Emergency Generator 9-0394	26-C2CNTWest-A05	20200401	No. 2 Oil	s	3.17E-02	5.28E+00	0.17	1	12	12	5.28	0.17	NA	NA	C3
				f											
Emergency Generator 9-0395	26-GMS Tower-A04	20200401	No. 2 Oil	s	3.17E-02	5.28E+00	0.17	1	12	12	5.28	0.17	NA	NA	C3
				f											
Emergency Generator 9-0396	26-HQBuilding-A06	20200401	No. 2 Oil	s	7.85E-02	1.31E+01	0.33	1	12	12	13.09	0.33	NA	NA	C3
				f											
Emergency Generator 9-0408	0316-01	20200401	No. 2 Oil	s	4.04E-01	6.73E+01	1.00	1	12	12	67.32	1.00	NA	NA	C3
				f											
Emergency Generator 9-0409	0120-01	20200401	No. 2 Oil	s	4.71E-01	7.85E+01	1.17	1	12	12	78.54	1.17	NA	NA	C3
				f											
Emergency Generator 9-0410	3090-01	20200401	No. 2 Oil	s	1.20E+00	1.99E+02	2.96	1	12	12	199.23	2.96	NA	NA	C3
				f											
Emergency Generator 9-0411	6010-01 & 6010-A02	20200401	No. 2 Oil	s	6.09E-01	5.08E+01	1.50	2	12	24	50.75	1.50	NA	NA	C3
				f											
Emergency Generator 9-0412	6009-01	20200401	No. 2 Oil	s	1.64E-01	2.74E+01	0.79	1	12	12	27.40	0.79	NA	NA	C3
				f											
Emergency Generator 9-0414	03-0328-A02	20200401	No. 2 Oil	s	1.08E-01	1.80E+01	1.17	1	12	12	18.02	1.17	NA	NA	C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Nitrogen Oxides (NOx) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0418	03-0328-A03	20200401	No. 2 Oil	s	1.02E-01	1.70E+01	0.92	1	12	12	16.99	0.92	NA	NA	C3
				f											
Emergency Generator 9-0419	0311-01	20200401	No. 2 Oil	s	7.26E-02	1.21E+01	0.88	1	12	12	12.10	0.88	NA	NA	C3
				f											
Emergency Generator 9-0433	0120-02	20200401	No. 2 Oil	s	6.26E-01	1.04E+02	1.55	1	12	12	104.35	1.55	NA	NA	C3
				f											
Emergency Generator 9-0434	0120-03	20200401	No. 2 Oil	s	4.38E-01	7.29E+01	1.08	1	12	12	72.93	1.08	NA	NA	C3
				f											
Emergency Generator 9-0435	BSS-01	20200401	No. 2 Oil	s	4.97E+00	1.31E+02	9.45	3.5	22	76	130.69	9.45	NA	NA	C3
				f											
Emergency Generator 9-0436	LWE-01 thru 05	20200401	No. 2 Oil	s	3.25E+00	4.64E+01	18.32	12.7	11	140	46.43	18.32	NA	NA	C3
				f											
Emergency Generator 9-0437	UTF-01	20200401	No. 2 Oil	s	1.42E-01	2.02E+01	1.76	1	14	14	20.22	1.76	NA	NA	C3
				f											
Emergency Generator 9-0491	3147-A01	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
				f											
Emergency Generator 9-0499	2202-01	20200401	No. 2 Oil	s	1.17E-01	1.96E+01	1.13	1	12	12	19.57	1.13	NA	NA	C3
				f											
Emergency Generator 9-0500	3660-01	20200401	No. 2 Oil	s	1.13E-01	1.89E+01	1.28	1	12	12	18.89	1.28	NA	NA	C3
				f											
Emergency Generator 9-0503	Bldg 120 - Gen. #1	20200401	No. 2 Oil	s	4.61E-01	7.69E+01	1.14	1	12	12	76.86	1.14	NA	NA	C3
				f											
Emergency Generator 9-0504	Bldg 120 - Gen. #2	20200401	No. 2 Oil	s	4.41E-01	7.35E+01	1.09	1	12	12	73.49	1.09	NA	NA	C3
				f											
Emergency Generator 9-0510	Bldg 5016 - pending	20200401	No. 2 Oil	s	1.54E-01	2.57E+01	0.48	1	12	12	25.67	0.48	NA	NA	C3
				f											
Emergency Generator 9-0511	Bldg 5046 - pending	20200401	No. 2 Oil	s	4.76E-02	7.94E+00	0.56	1	12	12	7.94	0.56	NA	NA	C3
				f											
ECO Mobile Incinerator N/A	N/A	50100107	Diesel	s	0.00E+00	0.00E+00	0.00	0	0	0	0.00	0.00	NA	NA	C3
Total					43.27	2193.37					2073.68				

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are mo
favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fu

Emission Estimation Method
A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balance using engineering knowledge of the process
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Sulfur Oxides (as SO_2) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0619	Various	10300503	No. 2 Oil	s	5.34E-01	5.87E+00	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0689	26-0642-A01	10300503	No. 2 Oil	s	1.56E-02	1.71E-01	24.00	7	26	182					C3
				f											
Atmospheric Burner 4-0692	Atmospheric Burner #1	40290012	F-24	s	0.00E+00	0.00E+00	0.00	0	0	0					C3
				f											
Fuel Oil Boiler 4-0707	26-0445-A01	10300503	No. 2 Oil	s	8.82E-03	9.70E-02	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0708	26-0394-A01	10300503	No. 2 Oil	s	3.63E-02	3.98E-01	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0709	26-0392-A01	10300503	No. 2 Oil	s	1.07E-02	5.86E-02	24.00	7	52	365					C3
				f											
Fuel Oil Boiler 5-0710	0339-A01	10300503	NG	s	2.36E-04	2.59E-03	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0719	26-0670-A01	10300503	No. 2 Oil	s	1.17E-02	1.28E-01	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0720	26-0688-A01	10300503	No. 2 Oil	s	2.56E-03	2.81E-02	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0722	26-0449-A01	10300503	No. 2 Oil	s	9.98E-03	1.10E-01	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0724	Bldg 906C - pending	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0079	26-0345-A01	10200603 10300503	NG	s	6.29E-01	3.44E+00	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0080	26-0345-A02	10200603 10300503	NG	s	6.29E-01	3.44E+00	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0081	26-0345-A03	10200603 10300503	NG	s	6.29E-01	3.44E+00	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0085	26-4600-A06	10200603 10300503	NG	s	7.56E-03	4.14E-02	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0087	26-4600-A08	10200603 10300503	NG	s	7.56E-03	4.14E-02	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0152	Various	10200603 10300503	NG	s	6.18E-02	6.79E-01	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0167	26-03062-A02	10200603 10300503	NG	s	1.06E-03	5.83E-03	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0298	26-C2CNT West-A01 thru A04	10200603 10300503	NG	s	3.92E-03	4.31E-02	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0299	26-GMS Tower-A01 thru A03	10200603 10300503	NG	s	1.22E-03	1.34E-02	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0300	26-HQ Building-A01 thru A05	10200603 10300503	NG	s	5.34E-03	5.86E-02	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0301	26-GMS Lab-A01 thru A03	10200603 10300503	NG	s	4.25E-03	4.67E-02	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0308	26-04219-A03	10200603 10300503	NG	s	4.14E-04	2.27E-03	24.00	7	52	365					C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Sulfur Oxides (as SO_2) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Natural Gas Boiler 5-0309	26-5100-A02	10200603	NG	s	1.51E-03	1.66E-02	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0310	26-5100-A01	10200603	NG	s	1.51E-03	1.66E-02	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0315	26-0525-A02	10200603 10300503	NG	s	1.18E-03	1.30E-02	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0322	Various	10200603	NG	s	1.71E-03	1.88E-02	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0334	26-0525-A03	10200603 10300503	NG	s	1.18E-03	1.30E-02	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0335	26-0525-A01	10200603 10300503	NG	s	1.18E-03	1.30E-02	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0336	26-04119-A03	10200603	NG	s	7.34E-04	8.06E-03	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0337	26-0459-A02	10200603	NG	s	3.28E-04	3.61E-03	24.00	7	26	182					C3
				f											
Propane Boiler 5-0352	0367-A01	10301002	Propane	s	4.90E-05	5.39E-04	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0364	26-4312-A01	10200603 10300503	NG	s	9.01E-04	4.94E-03	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0364	26-4312-A02	10200603 10300503	NG	s	9.01E-04	4.94E-03	24.00	7	52	365					C3
				f											
Natural Gas Boiler 5-0367	26-2485-A01	10200603	NG	s	3.59E-04	3.94E-03	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0370	26-4600-A09	10200603 10300503	NG	s	7.56E-03	4.14E-02	24.00	7	52	365					C3
				f											
Natural Gas Boiler 5-0371	26-3660-A01	10200603	NG	s	3.36E-04	3.70E-03	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0376	0383A-A01 & A02	10200603	NG	s	1.28E-03	1.40E-02	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0384	26-0400-A02	10200603	NG	s	3.10E-04	3.41E-03	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0384	26-0400-A03	10200603	NG	s	3.10E-04	3.41E-03	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0552	26-04219-A02	10200603 10300503	NG	s	4.14E-04	2.27E-03	24.00	7	52	365					C3
				f											
Natural Gas Boiler 5-0710	0339-A01	10200603	NG	s	2.36E-04	2.59E-03	24.00	7	26	182					C3
				f											
Paint Spray Booth 6-0159	07-00525-A06	40202501	NA	s	0.00E+00	0.00E+00	1.06	1.6	22	36					C2
				f											
Paint Spray Booth 6-0162	07-00525-A04	40202501	NA	s	0.00E+00	0.00E+00	1.13	2.3	37	84					C2
				f											
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	40400340	NA	s	0.00E+00	0.00E+00	8.00	7	52	365					C3
				f											
Fire Test Lab (IFEL) 9-0216	07-0525-A01	N/A	N/A	s	0.00E+00	0.00E+00	8.00	NA	NA	0					C3
				f											
Emergency Generator 9-0227	03-0394-A01	20200401	No. 2 Oil	s	3.58E-04	5.97E-02	4.08	1	12	12					C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Sulfur Oxides (as SO_2) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0228	03-0394-A02	20200401	No. 2 Oil	s	4.10E-04	6.83E-02	4.67	1	12	12					C3
				f											
Emergency Generator 9-0229	03-0328-A01	20200401	No. 2 Oil	s	2.57E-04	4.29E-02	3.67	1	12	12					C3
				f											
Emergency Generator 9-0276	03-4600-A04	20100101	No. 2 Oil	s	2.79E-04	4.66E-02	2.28	1	12	12					C3
				f											
Emergency Generator 9-0277	03-4600-A05	20100101	No. 2 Oil	s	2.82E-04	4.69E-02	2.29	1	12	12					C3
				f											
Emergency Generator 9-0386	03-0394-A03	20200401	No. 2 Oil	s	2.45E-04	4.09E-02	5.00	1	12	12					C3
				f											
Emergency Generator 9-0387	03-0394-A04	20200401	No. 2 Oil	s	1.76E-04	2.93E-02	3.58	1	12	12					C3
				f											
Emergency Generator 9-0388	03-0394-A05	20200401	No. 2 Oil	s	8.18E-06	1.36E-03	0.17	1	12	12					C3
				f											
Emergency Generator 9-0389	03-0394-A06	20200401	No. 2 Oil	s	2.45E-04	4.09E-02	5.00	1	12	12					C3
				f											
Emergency Generator 9-0390	03-0394-A07	20200401	No. 2 Oil	s	1.92E-04	3.20E-02	3.92	1	12	12					C3
				f											
Emergency Generator 9-0393	26-GMS-Lab-A04	20200401	No. 2 Oil	s	1.65E-04	2.75E-02	0.67	1	12	12					C3
				f											
Emergency Generator 9-0394	26-C2CNTWest-A05	20200401	No. 2 Oil	s	2.40E-05	4.00E-03	0.17	1	12	12					C3
				f											
Emergency Generator 9-0395	26-GMS Tower-A04	20200401	No. 2 Oil	s	2.40E-05	4.00E-03	0.17	1	12	12					C3
				f											
Emergency Generator 9-0396	26-HQBuilding-A06	20200401	No. 2 Oil	s	6.37E-05	1.06E-02	0.33	1	12	12					C3
				f											
Emergency Generator 9-0408	0316-01	20200401	No. 2 Oil	s	1.91E-04	3.19E-02	1.00	1	12	12					C3
				f											
Emergency Generator 9-0409	0120-01	20200401	No. 2 Oil	s	2.23E-04	3.72E-02	1.17	1	12	12					C3
				f											
Emergency Generator 9-0410	3090-01	20200401	No. 2 Oil	s	5.66E-04	9.43E-02	2.96	1	12	12					C3
				f											
Emergency Generator 9-0411	6010-01 & 6010-A02	20200401	No. 2 Oil	s	2.88E-04	2.40E-02	1.50	2	12	24					C3
				f											
Emergency Generator 9-0412	6009-01	20200401	No. 2 Oil	s	7.78E-05	1.30E-02	0.79	1	12	12					C3
				f											
Emergency Generator 9-0414	03-0328-A02	20200401	No. 2 Oil	s	5.12E-05	8.53E-03	1.17	1	12	12					C3
				f											
Emergency Generator 9-0418	03-0328-A03	20200401	No. 2 Oil	s	4.83E-05	8.05E-03	0.92	1	12	12					C3
				f											
Emergency Generator 9-0419	0311-01	20200401	No. 2 Oil	s	3.44E-05	5.73E-03	0.88	1	12	12					C3
				f											
Emergency Generator 9-0433	0120-02	20200401	No. 2 Oil	s	2.96E-04	4.94E-02	1.55	1	12	12					C3
				f											
Emergency Generator 9-0434	0120-03	20200401	No. 2 Oil	s	2.07E-04	3.45E-02	1.08	1	12	12					C3
				f											
Emergency Generator 9-0435	BSS-01	20200401	No. 2 Oil	s	2.35E-03	6.19E-02	9.45	3.5	22	76					C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Sulfur Oxides (as SO_2) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0436	LWE-01 thru 05	20200401	No. 2 Oil	s	1.54E-03	2.20E-02	18.32	12.7	11	140					C3
				f											
Emergency Generator 9-0437	UTF-01	20200401	No. 2 Oil	s	6.70E-05	9.57E-03	1.76	1	14	14					C3
				f											
Emergency Generator 9-0491	3147-A01	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
				f											
Emergency Generator 9-0499	2202-01	20200401	No. 2 Oil	s	5.56E-05	9.26E-03	1.13	1	12	12					C3
				f											
Emergency Generator 9-0500	3660-01	20200401	No. 2 Oil	s	5.37E-05	8.94E-03	1.28	1	12	12					C3
				f											
Emergency Generator 9-0503	Bldg 120 - Gen. #1	20200401	No. 2 Oil	s	2.18E-04	3.64E-02	1.14	1	12	12					C3
				f											
Emergency Generator 9-0504	Bldg 120 - Gen. #2	20200401	No. 2 Oil	s	2.09E-04	3.48E-02	1.09	1	12	12					C3
				f											
Emergency Generator 9-0510	Bldg 5016 - pending	20200401	No. 2 Oil	s	7.29E-05	1.22E-02	0.48	1	12	12					C3
				f											
Emergency Generator 9-0511	Bldg 5046 - pending	20200401	No. 2 Oil	s	2.25E-05	3.76E-03	0.56	1	12	12					C3
				f											
ECO Mobile Incinerator N/A	N/A	50100107	Diesel	s	0.00E+00	0.00E+00	0.00	0	0	0					C3
Total					2.64	19.28									

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are mos favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel

Emission Estimation Method
A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique

C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balan using engineering knowledge of the proc
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Volatile Organic Compounds (VOC) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0619	Various	10300503	No. 2 Oil	s	3.67E-02	4.03E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0689	26-0642-A01	10300503	No. 2 Oil	s	7.36E-04	8.09E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Atmospheric Burner 4-0692	Atmospheric Burner #1	40290012	F-24	s	0.00E+00	0.00E+00	0.00	0	0	0	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0707	26-0445-A01	10300503	No. 2 Oil	s	4.17E-04	4.58E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0708	26-0394-A01	10300503	No. 2 Oil	s	1.71E-03	1.88E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0709	26-0392-A01	10300503	No. 2 Oil	s	5.05E-04	2.77E-03	24.00	7	52	365	0.00	24.00	NA	NA	C3
				f											
Fuel Oil Boiler 5-0710	0339-A01	10300503	NG	s	2.16E-03	2.38E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0719	26-0670-A01	10300503	No. 2 Oil	s	5.50E-04	6.05E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0720	26-0688-A01	10300503	No. 2 Oil	s	1.21E-04	1.33E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0722	26-0449-A01	10300503	No. 2 Oil	s	4.71E-04	5.18E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Fuel Oil Boiler 4-0724	Bldg 906C - pending	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0079	26-0345-A01	10200603 10300503	NG	s	8.94E-02	4.90E-01	24.00	7	52	365	0.49	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0080	26-0345-A02	10200603 10300503	NG	s	8.94E-02	4.90E-01	24.00	7	52	365	0.49	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0081	26-0345-A03	10200603 10300503	NG	s	8.94E-02	4.90E-01	24.00	7	52	365	0.49	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0085	26-4600-A06	10200603 10300503	NG	s	6.93E-02	3.80E-01	24.00	7	52	365	0.38	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0087	26-4600-A08	10200603 10300503	NG	s	6.93E-02	3.80E-01	24.00	7	52	365	0.38	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0152	Various	10200603 10300503	NG	s	3.28E-01	3.61E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0167	26-03062-A02	10200603 10300503	NG	s	9.75E-03	5.34E-02	24.00	7	52	365	0.05	24.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0298	26-C2CNT West-A01 thru A04	10200603 10300503	NG	s	3.59E-02	3.95E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0299	26-GMS Tower-A01 thru A03	10200603 10300503	NG	s	1.12E-02	1.23E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0300	26-HQ Building-A01 thru A05	10200603 10300503	NG	s	4.68E-02	5.14E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0301	26-GMS Lab-A01 thru A03	10200603 10300503	NG	s	3.90E-02	4.28E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0308	26-04219-A03	10200603 10300503	NG	s	3.80E-03	2.08E-02	24.00	7	52	365	0.02	24.00	NA	NA	C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Volatile Organic Compounds (VOC) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Natural Gas Boiler 5-0309	26-5100-A02	10200603	NG	s	1.38E-02	1.52E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0310	26-5100-A01	10200603	NG	s	1.38E-02	1.52E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0315	26-0525-A02	10200603 10300503	NG	s	1.08E-02	1.19E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0322	Various	10200603	NG	s	1.57E-02	1.73E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0334	26-0525-A03	10200603 10300503	NG	s	1.08E-02	1.19E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0335	26-0525-A01	10200603 10300503	NG	s	1.08E-02	1.19E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0336	26-04119-A03	10200603	NG	s	6.73E-03	7.39E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0337	26-0459-A02	10200603	NG	s	3.01E-03	3.31E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Propane Boiler 5-0352	0367-A01	10301002	Propane	s	7.26E-04	7.98E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0364	26-4312-A01	10200603 10300503	NG	s	8.26E-03	4.53E-02	24.00	7	52	365	0.05	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0364	26-4312-A02	10200603 10300503	NG	s	8.26E-03	4.53E-02	24.00	7	52	365	0.05	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0367	26-2485-A01	10200603	NG	s	3.29E-03	3.61E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0370	26-4600-A09	10200603 10300503	NG	s	6.93E-02	3.80E-01	24.00	7	52	365	0.38	24.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0371	26-3660-A01	10200603	NG	s	3.08E-03	3.39E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0376	0383A-A01 & A02	10200603	NG	s	1.17E-02	1.29E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0384	26-0400-A02	10200603	NG	s	2.84E-03	3.13E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0384	26-0400-A03	10200603	NG	s	2.84E-03	3.13E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Dual Fuel Boiler 5-0552	26-04219-A02	10200603 10300503	NG	s	3.80E-03	2.08E-02	24.00	7	52	365	0.02	0.00	NA	NA	C3
				f											
Natural Gas Boiler 5-0710	0339-A01	10200603	NG	s	2.16E-03	2.38E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
				f											
Paint Spray Booth 6-0159	07-00525-A06	40202501	NA	s	1.39E-02	7.71E-01	1.06	1.6	22	36	0.77	4.00	NA	NA	C2
				f											
Paint Spray Booth 6-0162	07-00525-A04	40202501	NA	s	4.37E-02	1.04E+00	1.13	2.3	37	84	1.04	4.00	NA	NA	C2
				f											
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	40400340	NA	s	8.43E-01	4.62E+00	8.00	7	52	365	4.62	24.00	NA	NA	C3
				f											
Fire Test Lab (IFEL) 9-0216	07-0525-A04	N/A	N/A	s	0.00E+00	0.00E+00	8.00	NA	NA	0	0.00	8.00	NA	NA	C2
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Volatile Organic Compounds (VOC) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0227	03-0394-A01	20200401	No. 2 Oil	s	1.94E-02	3.23E+00	4.08	1	12	12	3.23	4.08	NA	NA	C3
				f											
Emergency Generator 9-0228	03-0394-A02	20200401	No. 2 Oil	s	2.21E-02	3.69E+00	4.67	1	12	12	3.69	4.67	NA	NA	C3
				f											
Emergency Generator 9-0229	03-0328-A01	20200401	No. 2 Oil	s	1.39E-02	2.32E+00	3.67	1	12	12	2.32	3.67	NA	NA	C3
				f											
Emergency Generator 9-0276	03-4600-A04	20100101	No. 2 Oil	s	1.51E-02	2.52E+00	2.28	1	12	12	2.52	2.28	NA	NA	C3
				f											
Emergency Generator 9-0277	03-4600-A05	20100101	No. 2 Oil	s	1.52E-02	2.54E+00	2.29	1	12	12	2.54	2.29	NA	NA	C3
				f											
Emergency Generator 9-0386	03-0394-A03	20200401	No. 2 Oil	s	1.33E-02	2.21E+00	5.00	1	12	12	2.21	5.00	NA	NA	C3
				f											
Emergency Generator 9-0387	03-0394-A04	20200401	No. 2 Oil	s	9.51E-03	1.58E+00	3.58	1	12	12	1.58	3.58	NA	NA	C3
				f											
Emergency Generator 9-0388	03-0394-A05	20200401	No. 2 Oil	s	4.42E-04	7.37E-02	0.17	1	12	12	0.07	0.17	NA	NA	C3
				f											
Emergency Generator 9-0389	03-0394-A06	20200401	No. 2 Oil	s	1.33E-02	2.21E+00	5.00	1	12	12	2.21	5.00	NA	NA	C3
				f											
Emergency Generator 9-0390	03-0394-A07	20200401	No. 2 Oil	s	1.04E-02	1.73E+00	3.92	1	12	12	1.73	3.92	NA	NA	C3
				f											
Emergency Generator 9-0393	26-GMS-Lab-A04	20200401	No. 2 Oil	s	5.30E-03	8.83E-01	0.67	1	12	12	0.88	0.67	NA	NA	C3
				f											
Emergency Generator 9-0394	26-C2CNTWest-A05	20200401	No. 2 Oil	s	5.69E-04	9.48E-02	0.17	1	12	12	0.09	0.17	NA	NA	C3
				f											
Emergency Generator 9-0395	26-GMS Tower-A04	20200401	No. 2 Oil	s	5.69E-04	9.48E-02	0.17	1	12	12	0.09	0.17	NA	NA	C3
				f											
Emergency Generator 9-0396	26-HQBuilding-A06	20200401	No. 2 Oil	s	2.05E-03	3.41E-01	0.33	1	12	12	0.34	0.33	NA	NA	C3
				f											
Emergency Generator 9-0408	0316-01	20200401	No. 2 Oil	s	1.03E-02	1.72E+00	1.00	1	12	12	1.72	1.00	NA	NA	C3
				f											
Emergency Generator 9-0409	0120-01	20200401	No. 2 Oil	s	1.21E-02	2.01E+00	1.17	1	12	12	2.01	1.17	NA	NA	C3
				f											
Emergency Generator 9-0410	3090-01	20200401	No. 2 Oil	s	3.06E-02	5.10E+00	2.96	1	12	12	5.10	2.96	NA	NA	C3
				f											
Emergency Generator 9-0411	6010-01 & 6010-A02	20200401	No. 2 Oil	s	1.56E-02	1.30E+00	1.50	2	12	24	1.30	1.50	NA	NA	C3
				f											
Emergency Generator 9-0412	6009-01	20200401	No. 2 Oil	s	4.21E-03	7.01E-01	0.79	1	12	12	0.70	0.79	NA	NA	C3
				f											
Emergency Generator 9-0414	03-0328-A02	20200401	No. 2 Oil	s	2.77E-03	4.61E-01	1.17	1	12	12	0.46	1.17	NA	NA	C3
				f											
Emergency Generator 9-0418	03-0328-A03	20200401	No. 2 Oil	s	2.61E-03	4.35E-01	0.92	1	12	12	0.43	0.92	NA	NA	C3
				f											
Emergency Generator 9-0419	0311-01	20200401	No. 2 Oil	s	1.86E-03	3.10E-01	0.88	1	12	12	0.31	0.88	NA	NA	C3
				f											
Emergency Generator 9-0433	0120-02	20200401	No. 2 Oil	s	1.60E-02	2.67E+00	1.55	1	12	12	2.67	1.55	NA	NA	C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Volatile Organic Compounds (VOC) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0434	0120-03	20200401	No. 2 Oil	s	1.12E-02	1.87E+00	1.08	1	12	12	1.87	1.08	NA	NA	C3
				f											
Emergency Generator 9-0435	BSS-01	20200401	No. 2 Oil	s	1.27E-01	3.34E+00	9.45	3.5	22	76	3.34	9.45	NA	NA	C3
				f											
Emergency Generator 9-0436	LWE-01 thru 05	20200401	No. 2 Oil	s	8.32E-02	1.19E+00	18.32	12.7	11	140	1.19	18.32	NA	NA	C3
				f											
Emergency Generator 9-0437	UTF-01	20200401	No. 2 Oil	s	3.62E-03	5.17E-01	1.76	1	14	14	0.52	1.76	NA	NA	C3
				f											
Emergency Generator 9-0491	3147-A01	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
				f											
Emergency Generator 9-0499	2202-01	20200401	No. 2 Oil	s	3.01E-03	5.01E-01	1.13	1	12	12	0.50	1.13	NA	NA	C3
				f											
Emergency Generator 9-0500	3660-01	20200401	No. 2 Oil	s	2.90E-03	4.83E-01	1.28	1	12	12	0.48	1.28	NA	NA	C3
				f											
Emergency Generator 9-0503	Bldg 120 - Gen. #1	20200401	No. 2 Oil	s	1.18E-02	1.97E+00	1.14	1	12	12	1.97	1.14	NA	NA	C3
				f											
Emergency Generator 9-0504	Bldg 120 - Gen. #2	20200401	No. 2 Oil	s	1.13E-02	1.88E+00	1.09	1	12	12	1.88	1.09	NA	NA	C3
				f											
Emergency Generator 9-0510	Bldg 5016 - pending	20200401	No. 2 Oil	s	3.94E-03	6.57E-01	0.48	1	12	12	0.66	0.48	NA	NA	C3
				f											
Emergency Generator 9-0511	Bldg 5046 - pending	20200401	No. 2 Oil	s	1.22E-03	2.03E-01	0.56	1	12	12	0.20	0.56	NA	NA	C3
				f											
ECO Mobile Incinerator N/A	N/A	50100107	Diesel	s	0.00E+00	0.00E+00	0.00	0	0	0	0.00	0.00	NA	NA	C3
Total					2.52	66.84					60.06				

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are mos favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel.

Emission Estimation Method
A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balance using engineering knowledge of the proces
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Carbon Monoxide (CO) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0619	Various	10300503	No. 2 Oil	s	5.45E-01	5.99E+00	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0689	26-0642-A01	10300503	No. 2 Oil	s	1.08E-02	1.19E-01	24.00	7	26	182					C3
				f											
Atmospheric Burner 4-0692	Atmospheric Burner #1	40290012	F-24	s	0.00E+00	0.00E+00	0.00	0	0	0					C3
				f											
Fuel Oil Boiler 4-0707	26-0445-A01	10300503	No. 2 Oil	s	6.13E-03	6.73E-02	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0708	26-0394-A01	10300503	No. 2 Oil	s	2.52E-02	2.77E-01	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0709	26-0392-A01	10300503	No. 2 Oil	s	7.42E-03	4.07E-02	24.00	7	52	365					C3
				f											
Fuel Oil Boiler 5-0710	0339-A01	10300503	NG	s	3.30E-02	3.63E-01	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0719	26-0670-A01	10300503	No. 2 Oil	s	8.09E-03	8.89E-02	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0720	26-0688-A01	10300503	No. 2 Oil	s	1.78E-03	1.95E-02	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0722	26-0449-A01	10300503	No. 2 Oil	s	6.93E-03	7.62E-02	24.00	7	26	182					C3
				f											
Fuel Oil Boiler 4-0724	Bldg 906C - pending	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0079	26-0345-A01	10200603 10300503	NG	s	1.35E+00	7.39E+00	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0080	26-0345-A02	10200603 10300503	NG	s	1.35E+00	7.39E+00	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0081	26-0345-A03	10200603 10300503	NG	s	1.35E+00	7.39E+00	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0085	26-4600-A06	10200603 10300503	NG	s	1.06E+00	5.80E+00	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0087	26-4600-A08	10200603 10300503	NG	s	1.06E+00	5.80E+00	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0152	Various	10200603 10300503	NG	s	5.01E+00	5.51E+01	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0167	26-03062-A02	10200603 10300503	NG	s	1.49E-01	8.16E-01	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0298	26-C2CNT West-A01 thru A04	10200603 10300503	NG	s	5.49E-01	6.03E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0299	26-GMS Tower-A01 thru A03	10200603 10300503	NG	s	1.71E-01	1.88E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0300	26-HQ Building-A01 thru A05	10200603 10300503	NG	s	7.14E-01	7.85E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0301	26-GMS Lab-A01 thru A03	10200603 10300503	NG	s	5.95E-01	6.54E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0308	26-04219-A03	10200603 10300503	NG	s	5.80E-02	3.18E-01	24.00	7	52	365					C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Carbon Monoxide (CO) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Natural Gas Boiler 5-0309	26-5100-A02	10200603	NG	s	2.11E-01	2.32E+00	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0310	26-5100-A01	10200603	NG	s	2.11E-01	2.32E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0315	26-0525-A02	10200603 10300503	NG	s	1.66E-01	1.82E+00	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0322	Various	10200603	NG	s	2.40E-01	2.64E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0334	26-0525-A03	10200603 10300503	NG	s	1.66E-01	1.82E+00	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0335	26-0525-A01	10200603 10300503	NG	s	1.66E-01	1.82E+00	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0336	26-04119-A03	10200603	NG	s	1.03E-01	1.13E+00	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0337	26-0459-A02	10200603	NG	s	4.60E-02	5.05E-01	24.00	7	26	182					C3
				f											
Propane Boiler 5-0352	0367-A01	10301002	Propane	s	6.81E-03	7.48E-02	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0364	26-4312-A01	10200603 10300503	NG	s	1.26E-01	6.91E-01	24.00	7	52	365					C3
				f											
Dual Fuel Boiler 5-0364	26-4312-A02	10200603 10300503	NG	s	1.26E-01	6.91E-01	24.00	7	52	365					C3
				f											
Natural Gas Boiler 5-0367	26-2485-A01	10200603	NG	s	5.02E-02	5.52E-01	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0370	26-4600-A09	10200603 10300503	NG	s	1.06E+00	5.80E+00	24.00	7	52	365					C3
				f											
Natural Gas Boiler 5-0371	26-3660-A01	10200603	NG	s	4.71E-02	5.18E-01	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0376	0383A-A01 & A02	10200603	NG	s	1.79E-01	1.97E+00	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0384	26-0400-A02	10200603	NG	s	4.34E-02	4.77E-01	24.00	7	26	182					C3
				f											
Natural Gas Boiler 5-0384	26-0400-A03	10200603	NG	s	4.34E-02	4.77E-01	24.00	7	26	182					C3
				f											
Dual Fuel Boiler 5-0552	26-04219-A02	10200603 10300503	NG	s	5.80E-02	3.18E-01	24.00	7	52	365					C3
				f											
Natural Gas Boiler 5-0710	0339-A01	10200603	NG	s	3.30E-02	3.63E-01	24.00	7	26	182					C3
				f											
Paint Spray Booth 6-0159	07-00525-A06	40202501	NA	s	0.00E+00	0.00E+00	1.06	1.6	22	36					C2
				f											
Paint Spray Booth 6-0162	07-00525-A04	40202501	NA	s	0.00E+00	0.00E+00	1.13	2.3	37	84					C2
				f											
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	40400340	NA	s	0.00E+00	0.00E+00	8.00	NA	NA	0					C3
				f											
Fire Test Lab (IFEL) 9-0216	07-0525-A01	N/A	N/A	s	0.00E+00	0.00E+00	8.00	NA	NA	0					C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Carbon Monoxide (CO) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0227	03-0394-A01	20200401	No. 2 Oil	s	2.01E-01	3.35E+01	4.08	1	12	12					C3
				f											
Emergency Generator 9-0228	03-0394-A02	20200401	No. 2 Oil	s	2.30E-01	3.83E+01	4.67	1	12	12					C3
				f											
Emergency Generator 9-0229	03-0328-A01	20200401	No. 2 Oil	s	1.44E-01	2.41E+01	3.67	1	12	12					C3
				f											
Emergency Generator 9-0276	03-4600-A04	20100101	No. 2 Oil	s	1.57E-01	2.61E+01	2.28	1	12	12					C3
				f											
Emergency Generator 9-0277	03-4600-A05	20100101	No. 2 Oil	s	1.58E-01	2.63E+01	2.29	1	12	12					C3
				f											
Emergency Generator 9-0386	03-0394-A03	20200401	No. 2 Oil	s	1.38E-01	2.30E+01	5.00	1	12	12					C3
				f											
Emergency Generator 9-0387	03-0394-A04	20200401	No. 2 Oil	s	9.87E-02	1.64E+01	3.58	1	12	12					C3
				f											
Emergency Generator 9-0388	03-0394-A05	20200401	No. 2 Oil	s	4.59E-03	7.65E-01	0.17	1	12	12					C3
				f											
Emergency Generator 9-0389	03-0394-A06	20200401	No. 2 Oil	s	1.38E-01	2.30E+01	5.00	1	12	12					C3
				f											
Emergency Generator 9-0390	03-0394-A07	20200401	No. 2 Oil	s	1.08E-01	1.80E+01	3.92	1	12	12					C3
				f											
Emergency Generator 9-0393	26-GMS-Lab-A04	20200401	No. 2 Oil	s	3.01E-02	5.02E+00	0.67	1	12	12					C3
				f											
Emergency Generator 9-0394	26-C2CNTWest-A05	20200401	No. 2 Oil	s	1.29E-03	2.16E-01	0.17	1	12	12					C3
				f											
Emergency Generator 9-0395	26-GMS Tower-A04	20200401	No. 2 Oil	s	1.29E-03	2.16E-01	0.17	1	12	12					C3
				f											
Emergency Generator 9-0396	26-HQBuilding-A06	20200401	No. 2 Oil	s	5.16E-03	8.61E-01	0.33	1	12	12					C3
				f											
Emergency Generator 9-0408	0316-01	20200401	No. 2 Oil	s	1.07E-01	1.79E+01	1.00	1	12	12					C3
				f											
Emergency Generator 9-0409	0120-01	20200401	No. 2 Oil	s	1.25E-01	2.09E+01	1.17	1	12	12					C3
				f											
Emergency Generator 9-0410	3090-01	20200401	No. 2 Oil	s	3.18E-01	5.29E+01	2.96	1	12	12					C3
				f											
Emergency Generator 9-0411	6010-01 & 6010-A02	20200401	No. 2 Oil	s	1.62E-01	1.35E+01	1.50	2	12	24					C3
				f											
Emergency Generator 9-0412	6009-01	20200401	No. 2 Oil	s	4.37E-02	7.28E+00	0.79	1	12	12					C3
				f											
Emergency Generator 9-0414	03-0328-A02	20200401	No. 2 Oil	s	2.87E-02	4.79E+00	1.17	1	12	12					C3
				f											
Emergency Generator 9-0418	03-0328-A03	20200401	No. 2 Oil	s	2.71E-02	4.51E+00	0.92	1	12	12					C3
				f											
Emergency Generator 9-0419	0311-01	20200401	No. 2 Oil	s	1.93E-02	3.21E+00	0.88	1	12	12					C3
				f											
Emergency Generator 9-0433	0120-02	20200401	No. 2 Oil	s	1.66E-01	2.77E+01	1.55	1	12	12					C3
				f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** Carbon Monoxide (CO) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
					Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0434	0120-03	20200401	No. 2 Oil	s	1.16E-01	1.94E+01	1.08	1	12	12					C3
				f											
Emergency Generator 9-0435	BSS-01	20200401	No. 2 Oil	s	1.32E+00	3.47E+01	9.45	3.5	22	76					C3
				f											
Emergency Generator 9-0436	LWE-01 thru 05	20200401	No. 2 Oil	s	8.63E-01	1.23E+01	18.32	12.7	11	140					C3
				f											
Emergency Generator 9-0437	UTF-01	20200401	No. 2 Oil	s	3.76E-02	5.37E+00	1.76	1	14	14					C3
				f											
Emergency Generator 9-0491	3147-A01	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
				f											
Emergency Generator 9-0499	2202-01	20200401	No. 2 Oil	s	3.12E-02	5.20E+00	1.13	1	12	12					C3
				f											
Emergency Generator 9-0500	3660-01	20200401	No. 2 Oil	s	3.01E-02	5.02E+00	1.28	1	12	12					C3
				f											
Emergency Generator 9-0503	Bldg 120 - Gen. #1	20200401	No. 2 Oil	s	1.22E-01	2.04E+01	1.14	1	12	12					C3
				f											
Emergency Generator 9-0504	Bldg 120 - Gen. #2	20200401	No. 2 Oil	s	1.17E-01	1.95E+01	1.09	1	12	12					C3
				f											
Emergency Generator 9-0510	Bldg 5016 - pending	20200401	No. 2 Oil	s	4.09E-02	6.82E+00	0.48	1	12	12					C3
				f											
Emergency Generator 9-0511	Bldg 5046 - pending	20200401	No. 2 Oil	s	1.26E-02	2.11E+00	0.56	1	12	12					C3
				f											
ECO Mobile Incinerator N/A	N/A	50100107	Diesel	s	0.00E+00	0.00E+00	0.00	0	0	0					C3
Total					22.23	664.86									

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel.

Emission Estimation Method
A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balar using engineering knowledge of the proc
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 3: PM

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** **Particulate Matter** (PM) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		PM - Filterable		PM 10 - Filterable		PM 2.5 - Filterable		PM Condensable		Operation	Estimation Method
					Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Days/yr	
Fuel Oil Boiler 4-0619	Various	10300503	No. 2 Oil	s	1.88E-02	2.06E-01	1.20E-02	1.31E-01	1.01E-02	1.11E-01	2.15E-02	2.37E-01	182	C3
				f										
Fuel Oil Boiler 4-0689	26-0642-A01	10300503	No. 2 Oil	s	4.33E-04	4.76E-03	2.34E-04	2.57E-03	1.80E-04	1.97E-03	2.81E-04	3.09E-03	182	C3
				f										
Atmospheric Burner 4-0692	Atmospheric Burner #1	40290012	F-24	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	C3
				f										
Fuel Oil Boiler 4-0707	26-0445-A01	10300503	No. 2 Oil	s	2.45E-04	2.69E-03	1.32E-04	1.45E-03	1.02E-04	1.12E-03	1.59E-04	1.75E-03	182	C3
				f										
Fuel Oil Boiler 4-0708	26-0394-A01	10300503	No. 2 Oil	s	1.01E-03	1.11E-02	5.44E-04	5.98E-03	4.18E-04	4.59E-03	6.55E-04	7.19E-03	182	C3
				f										
Fuel Oil Boiler 4-0709	26-0392-A01	10300503	No. 2 Oil	s	2.97E-04	1.63E-03	1.60E-04	8.78E-04	1.23E-04	6.75E-04	1.93E-04	1.06E-03	365	C3
				f										
Fuel Oil Boiler 5-0710	0339-A01	10300503	NG	s	7.47E-04	8.21E-03	7.47E-04	8.21E-03	7.47E-04	8.21E-03	2.24E-03	2.46E-02	182	C3
				f										
Fuel Oil Boiler 4-0719	26-0670-A01	10300503	No. 2 Oil	s	3.24E-04	3.56E-03	1.75E-04	1.92E-03	1.34E-04	1.48E-03	2.10E-04	2.31E-03	182	C3
				f										
Fuel Oil Boiler 4-0720	26-0688-A01	10300503	No. 2 Oil	s	7.11E-05	7.81E-04	3.84E-05	4.22E-04	2.95E-05	3.24E-04	4.62E-05	5.08E-04	182	C3
				f										
Fuel Oil Boiler 4-0722	26-0449-A01	10300503	No. 2 Oil	s	2.77E-04	3.05E-03	1.50E-04	1.64E-03	1.15E-04	1.26E-03	1.80E-04	1.98E-03	182	C3
				f										
Fuel Oil Boiler 4-0724	Bldg 906C - pending	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	182	C3
				f										
Dual Fuel Boiler 5-0079	26-0345-A01	10200603 10300503	NG	s	1.94E-01	1.06E+00	1.14E-01	6.25E-01	9.24E-02	5.06E-01	1.74E-01	9.56E-01	365	C3
				f										
Dual Fuel Boiler 5-0080	26-0345-A02	10200603 10300503	NG	s	1.94E-01	1.06E+00	1.14E-01	6.25E-01	9.24E-02	5.06E-01	1.74E-01	9.56E-01	365	C3
				f										
Dual Fuel Boiler 5-0081	26-0345-A03	10200603 10300503	NG	s	1.94E-01	1.06E+00	1.14E-01	6.25E-01	9.24E-02	5.06E-01	1.74E-01	9.56E-01	365	C3
				f										
Dual Fuel Boiler 5-0085	26-4600-A06	10200603 10300503	NG	s	2.39E-02	1.31E-01	2.39E-02	1.31E-01	2.39E-02	1.31E-01	7.18E-02	3.93E-01	365	C3
				f										
Dual Fuel Boiler 5-0087	26-4600-A08	10200603 10300503	NG	s	2.39E-02	1.31E-01	2.39E-02	1.31E-01	2.39E-02	1.31E-01	7.18E-02	3.93E-01	365	C3
				f										
Dual Fuel Boiler 5-0152	Various	10200603 10300503	NG	s	1.20E-01	1.32E+00	1.17E-01	1.28E+00	1.16E-01	1.27E+00	3.44E-01	3.78E+00	182	C3
				f										
Dual Fuel Boiler 5-0167	26-03062-A02	10200603 10300503	NG	s	3.37E-03	1.85E-02	3.37E-03	1.85E-02	3.37E-03	1.85E-02	1.01E-02	5.54E-02	365	C3
				f										
Dual Fuel Boiler 5-0298	26-C2CNT West-A01 thru A04	10200603 10300503	NG	s	1.24E-02	1.36E-01	1.24E-02	1.36E-01	1.24E-02	1.36E-01	3.72E-02	4.09E-01	182	C3
				f										
Dual Fuel Boiler 5-0299	26-GMS Tower-A01 thru A03	10200603 10300503	NG	s	3.87E-03	4.26E-02	3.87E-03	4.26E-02	3.87E-03	4.26E-02	1.16E-02	1.28E-01	182	C3
				f										
Dual Fuel Boiler 5-0300	26-HQ Building-A01 thru A05	10200603 10300503	NG	s	1.62E-02	1.78E-01	1.62E-02	1.78E-01	1.62E-02	1.78E-01	4.85E-02	5.33E-01	182	C3
				f										
Dual Fuel Boiler 5-0301	26-GMS Lab-A01 thru A03	10200603 10300503	NG	s	1.35E-02	1.48E-01	1.35E-02	1.48E-01	1.35E-02	1.48E-01	4.04E-02	4.44E-01	182	C3
				f										
Dual Fuel Boiler 5-0308	26-04219-A03	10200603 10300503	NG	s	1.31E-03	7.18E-03	1.31E-03	7.18E-03	1.31E-03	7.18E-03	3.93E-03	2.16E-02	365	C3
				f										

FORM 3: PM

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** **Particulate Matter** (PM) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		PM - Filterable		PM 10 - Filterable		PM 2.5 - Filterable		PM Condensable		Operation	Estimation Method
					Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Days/yr	
Natural Gas Boiler 5-0309	26-5100-A02	10200603	NG	s	4.78E-03	5.25E-02	4.78E-03	5.25E-02	4.78E-03	5.25E-02	1.43E-02	1.58E-01	182	C3
				f										
Natural Gas Boiler 5-0310	26-5100-A01	10200603	NG	s	4.78E-03	5.25E-02	4.78E-03	5.25E-02	4.78E-03	5.25E-02	1.43E-02	1.58E-01	182	C3
				f										
Dual Fuel Boiler 5-0315	26-0525-A02	10200603 10300503	NG	s	3.75E-03	4.12E-02	3.75E-03	4.12E-02	3.75E-03	4.12E-02	1.12E-02	1.23E-01	182	C3
				f										
Natural Gas Boiler 5-0322	Various	10200603	NG	s	5.43E-03	5.97E-02	5.43E-03	5.97E-02	5.43E-03	5.97E-02	1.63E-02	1.79E-01	182	C3
				f										
Dual Fuel Boiler 5-0334	26-0525-A03	10200603 10300503	NG	s	3.75E-03	4.12E-02	3.75E-03	4.12E-02	3.75E-03	4.12E-02	1.12E-02	1.23E-01	182	C3
				f										
Dual Fuel Boiler 5-0335	26-0525-A01	10200603 10300503	NG	s	3.75E-03	4.12E-02	3.75E-03	4.12E-02	3.75E-03	4.12E-02	1.12E-02	1.23E-01	182	C3
				f										
Natural Gas Boiler 5-0336	26-04119-A03	10200603	NG	s	2.32E-03	2.55E-02	2.32E-03	2.55E-02	2.32E-03	2.55E-02	6.97E-03	7.66E-02	182	C3
				f										
Natural Gas Boiler 5-0337	26-0459-A02	10200603	NG	s	1.04E-03	1.14E-02	1.04E-03	1.14E-02	1.04E-03	1.14E-02	3.12E-03	3.43E-02	182	C3
				f										
Propane Boiler 5-0352	0367-A01	10301002	Propane	s	1.82E-04	2.00E-03	9.81E-05	1.08E-03	7.54E-05	8.28E-04	1.18E-04	1.30E-03	182	C3
				f										
Dual Fuel Boiler 5-0364	26-4312-A01	10200603 10300503	NG	s	2.85E-03	1.56E-02	2.85E-03	1.56E-02	2.85E-03	1.56E-02	8.56E-03	4.69E-02	365	C3
				f										
Dual Fuel Boiler 5-0364	26-4312-A02	10200603 10300503	NG	s	2.85E-03	1.56E-02	2.85E-03	1.56E-02	2.85E-03	1.56E-02	8.56E-03	4.69E-02	365	C3
				f										
Natural Gas Boiler 5-0367	26-2485-A01	10200603	NG	s	1.14E-03	1.25E-02	1.14E-03	1.25E-02	1.14E-03	1.25E-02	3.41E-03	3.74E-02	182	C3
				f										
Dual Fuel Boiler 5-0370	26-4600-A09	10200603 10300503	NG	s	2.39E-02	1.31E-01	2.39E-02	1.31E-01	2.39E-02	1.31E-01	7.18E-02	3.93E-01	365	C3
				f										
Natural Gas Boiler 5-0371	26-3660-A01	10200603	NG	s	1.07E-03	1.17E-02	1.07E-03	1.17E-02	1.07E-03	1.17E-02	3.20E-03	3.51E-02	182	C3
				f										
Natural Gas Boiler 5-0376	0383A-A01 & A02	10200603	NG	s	4.05E-03	4.45E-02	4.05E-03	4.45E-02	4.05E-03	4.45E-02	1.21E-02	1.33E-01	182	C3
				f										
Natural Gas Boiler 5-0384	26-0400-A02	10200603	NG	s	9.83E-04	1.08E-02	9.83E-04	1.08E-02	9.83E-04	1.08E-02	2.95E-03	3.24E-02	182	C3
				f										
Natural Gas Boiler 5-0384	26-0400-A03	10200603	NG	s	9.83E-04	1.08E-02	9.83E-04	1.08E-02	9.83E-04	1.08E-02	2.95E-03	3.24E-02	182	C3
				f										
Dual Fuel Boiler 5-0552	26-04219-A02	10200603 10300503	NG	s	1.31E-03	7.18E-03	1.31E-03	7.18E-03	1.31E-03	7.18E-03	3.93E-03	2.16E-02	365	C3
				f										
Natural Gas Boiler 5-0710	0339-A01	10200603	NG	s	7.47E-04	8.21E-03	7.47E-04	8.21E-03	7.47E-04	8.21E-03	2.24E-03	2.46E-02	182	C3
				f										
Paint Spray Booth 6-0159	07-00525-A06	40202501	NA	s	5.13E-03	2.85E-01	NA	NA	NA	NA	NA	NA	36	C2
				f										
Paint Spray Booth 6-0162	07-00525-A04	40202501	NA	s	1.32E-02	3.13E-01	NA	NA	NA	NA	NA	NA	84	C2
				f										
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	40400340	NA	s	0.00E+00	0.00E+00	NA	NA	NA	NA	NA	NA	0	C3
				f										
Fire Test Lab (IFEL) 9-0216	07-0525-A04	N/A	N/A	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	C3
				f										

FORM 3: PM

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** **Particulate Matter** (PM) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		PM - Filterable		PM 10 - Filterable		PM 2.5 - Filterable		PM Condensable		Operation	Estimation Method
					Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Days/yr	
Emergency Generator 9-0227	03-0394-A01	20200401	No. 2 Oil	s	1.47E-02	2.44E+00	1.17E-02	1.96E+00	1.13E-02	1.89E+00	1.82E-03	3.04E-01	12	C3
				f										
Emergency Generator 9-0228	03-0394-A02	20200401	No. 2 Oil	s	1.68E-02	2.79E+00	1.34E-02	2.23E+00	1.29E-02	2.16E+00	2.08E-03	3.47E-01	12	C3
				f										
Emergency Generator 9-0229	03-0328-A01	20200401	No. 2 Oil	s	1.05E-02	1.75E+00	8.42E-03	1.40E+00	8.13E-03	1.36E+00	1.31E-03	2.18E-01	12	C3
				f										
Emergency Generator 9-0276	03-4600-A04	20100101	No. 2 Oil	s	1.14E-02	1.91E+00	9.15E-03	1.52E+00	8.84E-03	1.47E+00	1.42E-03	2.37E-01	12	C3
				f										
Emergency Generator 9-0277	03-4600-A05	20100101	No. 2 Oil	s	1.15E-02	1.92E+00	9.22E-03	1.54E+00	8.90E-03	1.48E+00	1.43E-03	2.38E-01	12	C3
				f										
Emergency Generator 9-0386	03-0394-A03	20200401	No. 2 Oil	s	1.00E-02	1.67E+00	8.04E-03	1.34E+00	7.76E-03	1.29E+00	1.25E-03	2.08E-01	12	C3
				f										
Emergency Generator 9-0387	03-0394-A04	20200401	No. 2 Oil	s	7.20E-03	1.20E+00	5.76E-03	9.60E-01	5.56E-03	9.27E-01	8.94E-04	1.49E-01	12	C3
				f										
Emergency Generator 9-0388	03-0394-A05	20200401	No. 2 Oil	s	3.35E-04	5.58E-02	2.68E-04	4.46E-02	2.59E-04	4.31E-02	4.16E-05	6.93E-03	12	C3
				f										
Emergency Generator 9-0389	03-0394-A06	20200401	No. 2 Oil	s	1.00E-02	1.67E+00	8.04E-03	1.34E+00	7.76E-03	1.29E+00	1.25E-03	2.08E-01	12	C3
				f										
Emergency Generator 9-0390	03-0394-A07	20200401	No. 2 Oil	s	7.87E-03	1.31E+00	6.29E-03	1.05E+00	6.08E-03	1.01E+00	9.77E-04	1.63E-01	12	C3
				f										
Emergency Generator 9-0393	26-GMS-Lab-A04	20200401	No. 2 Oil	s	6.75E-03	1.12E+00	5.40E-03	8.99E-01	5.21E-03	8.69E-01	8.38E-04	1.40E-01	12	C3
				f										
Emergency Generator 9-0394	26-C2CNTWest-A05	20200401	No. 2 Oil	s	9.82E-04	1.64E-01	7.86E-04	1.31E-01	7.59E-04	1.26E-01	1.22E-04	2.03E-02	12	C3
				f										
Emergency Generator 9-0395	26-GMS Tower-A04	20200401	No. 2 Oil	s	9.82E-04	1.64E-01	7.86E-04	1.31E-01	7.59E-04	1.26E-01	1.22E-04	2.03E-02	12	C3
				f										
Emergency Generator 9-0396	26-HQBuilding-A06	20200401	No. 2 Oil	s	2.61E-03	4.35E-01	2.09E-03	3.48E-01	2.02E-03	3.36E-01	3.24E-04	5.40E-02	12	C3
				f										
Emergency Generator 9-0408	0316-01	20200401	No. 2 Oil	s	7.83E-03	1.30E+00	6.26E-03	1.04E+00	6.05E-03	1.01E+00	9.72E-04	1.62E-01	12	C3
				f										
Emergency Generator 9-0409	0120-01	20200401	No. 2 Oil	s	9.13E-03	1.52E+00	7.30E-03	1.22E+00	7.05E-03	1.18E+00	1.13E-03	1.89E-01	12	C3
				f										
Emergency Generator 9-0410	3090-01	20200401	No. 2 Oil	s	2.32E-02	3.86E+00	1.85E-02	3.09E+00	1.79E-02	2.98E+00	2.88E-03	4.79E-01	12	C3
				f										
Emergency Generator 9-0411	6010-01 & 6010-A02	20200401	No. 2 Oil	s	1.18E-02	1.97E+00	9.44E-03	1.57E+00	9.12E-03	1.52E+00	1.47E-03	2.44E-01	12	C3
				f										
Emergency Generator 9-0412	6009-01	20200401	No. 2 Oil	s	3.18E-03	5.31E-01	2.55E-03	4.25E-01	2.46E-03	4.10E-01	3.96E-04	6.59E-02	12	C3
				f										
Emergency Generator 9-0414	03-0328-A02	20200401	No. 2 Oil	s	2.10E-03	3.49E-01	1.68E-03	2.79E-01	1.62E-03	2.70E-01	2.60E-04	4.34E-02	12	C3
				f										
Emergency Generator 9-0418	03-0328-A03	20200401	No. 2 Oil	s	1.98E-03	3.29E-01	1.58E-03	2.63E-01	1.53E-03	2.54E-01	2.45E-04	4.09E-02	12	C3
				f										
Emergency Generator 9-0419	0311-01	20200401	No. 2 Oil	s	1.41E-03	2.34E-01	1.12E-03	1.87E-01	1.09E-03	1.81E-01	1.75E-04	2.91E-02	12	C3
				f										
Emergency Generator 9-0433	0120-02	20200401	No. 2 Oil	s	1.21E-02	2.02E+00	9.70E-03	1.62E+00	9.37E-03	1.56E+00	1.51E-03	2.51E-01	12	C3
				f										

FORM 3: PM

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Aberdeen Area

Facility ID #: 24-25-00081 **Pollutant:** **Particulate Matter** (PM) **Calendar Year:** 2023

Equipment Description/ Registration No.	Emission Unit No.	SCC No.	Fuel		PM - Filterable		PM 10 - Filterable		PM 2.5 - Filterable		PM Condensable		Operation	Estimation Method
					Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Days/yr	
Emergency Generator 9-0434	0120-03	20200401	No. 2 Oil	s	8.48E-03	1.41E+00	6.78E-03	1.13E+00	6.55E-03	1.09E+00	1.05E-03	1.75E-01	12	C3
				f										
Emergency Generator 9-0435	BSS-01	20200401	No. 2 Oil	s	9.62E-02	1.60E+01	7.70E-02	1.28E+01	7.43E-02	1.24E+01	1.20E-02	1.99E+00	12	C3
				f										
Emergency Generator 9-0436	LWE-01 thru 05	20200401	No. 2 Oil	s	6.30E-02	1.05E+01	5.04E-02	8.40E+00	4.87E-02	8.11E+00	7.82E-03	1.30E+00	12	C3
				f										
Emergency Generator 9-0437	UTF-01	20200401	No. 2 Oil	s	2.74E-03	4.57E-01	2.19E-03	3.66E-01	2.12E-03	3.53E-01	3.41E-04	5.68E-02	12	C3
				f										
Emergency Generator 9-0499	2202-01	20200401	No. 2 Oil	s	2.27E-03	3.79E-01	1.82E-03	3.03E-01	1.76E-03	2.93E-01	2.83E-04	4.71E-02	12	C3
				f										
Emergency Generator 9-0500	3660-01	20200401	No. 2 Oil	s	2.20E-03	3.66E-01	1.76E-03	2.93E-01	1.70E-03	2.83E-01	2.73E-04	4.55E-02	12	C3
				f										
Emergency Generator 9-0503	Bldg 120 - Gen. #1	20200401	No. 2 Oil	s	8.94E-03	1.49E+00	7.15E-03	1.19E+00	6.90E-03	1.15E+00	1.11E-03	1.85E-01	12	C3
				f										
Emergency Generator 9-0504	Bldg 120 - Gen. #2	20200401	No. 2 Oil	s	8.54E-03	1.42E+00	6.83E-03	1.14E+00	6.60E-03	1.10E+00	1.06E-03	1.77E-01	12	C3
				f										
Emergency Generator 9-0510	Bldg 5016 - pending	20200401	No. 2 Oil	s	2.98E-03	4.97E-01	2.39E-03	3.98E-01	2.31E-03	3.84E-01	3.71E-04	6.18E-02	12	C3
				f										
Emergency Generator 9-0511	Bldg 5046 - pending	20200401	No. 2 Oil	s	9.23E-04	1.54E-01	7.38E-04	1.23E-01	7.13E-04	1.19E-01	1.15E-04	1.91E-02	12	C3
				f										
ECO Mobile Incinerator N/A	N/A	50100107	Diesel	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Total					1.29	70.18	0.95	55.46	0.87	53.33	1.44	18.96		

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel.

Emission Estimation Method
A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balan using engineering knowledge of the proc
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 4

TOXIC AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Benzene **Calendar Year: 2023**

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
ECO Mobile Incinerator N/A	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	3.37E-02	1.85E-01	2.31E-02
Total	**3.37E-02**	**1.85E-01**	**2.31E-02**

Pollutant: Chromium Metal & Cr III Compounds **Calendar Year: 2023**

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Paint Spray Booth 6-0159	7.28E-04	1.48E-01	1.40E-01
Paint Spray Booth 6-0162	2.20E-03	1.01E-01	9.01E-02
ECO Mobile Incinerator N/A	0.00E+00	0.00E+00	0.00E+00
Total	**2.93E-03**	**2.49E-01**	**2.30E-01**

Pollutant: Cobalt & Compounds **Calendar Year: 2023**

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Paint Spray Booth 6-0159	3.64E-04	7.38E-02	6.99E-02
Paint Spray Booth 6-0162	1.12E-03	7.80E-02	6.93E-02
Total	**1.48E-03**	**1.52E-01**	**1.39E-01**

Pollutant: Hexamethylene Diisocyanate Monomer **Calendar Year: 2023**

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Paint Spray Booth 6-0159	2.18E-02	7.06E+00	6.68E+00
Paint Spray Booth 6-0162	8.83E-02	7.20E+00	6.40E+00
Total	**1.10E-01**	**1.43E+01**	**1.31E+01**

Pollutant: Toluene **Calendar Year: 2023**

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
ECO Mobile Incinerator N/A	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	1.85E-01	1.02E+00	1.27E-01
Total	**1.85E-01**	**1.02E+00**	**1.27E-01**

FORM 4

TOXIC AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Xylenes **Calendar Year: 2023**

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Paint Spray Booth 6-0159	5.14E-04	1.31E+00	1.24E+00
Paint Spray Booth 6-0162	1.05E-03	1.22E-01	1.09E-01
Gasoline Storage Tanks 9-0152	8.43E-02	4.62E-01	5.77E-02
ECO Mobile Incinerator N/A	0.00E+00	0.00E+00	0.00E+00
Total	**8.59E-02**	**1.89E+00**	**1.41E+00**

Pollutant: Zinc Compounds **Calendar Year: 2023**

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Paint Spray Booth 6-0159	8.11E-06	6.67E-03	6.32E-03
Paint Spray Booth 6-0162	2.36E-05	8.11E-03	7.21E-03
Total	**3.17E-05**	**1.48E-02**	**1.35E-02**

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Acetaldehyde **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	2.55E-02	2.81E-01	1.17E-02
Fuel Oil Boiler 4-0689	26-0642-A01	7.59E-04	8.34E-03	3.48E-04
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	4.30E-04	4.72E-03	1.97E-04
Fuel Oil Boiler 4-0708	26-0394-A01	1.77E-03	1.94E-02	8.08E-04
Fuel Oil Boiler 4-0709	26-0392-A01	5.20E-04	2.85E-03	1.19E-04
Fuel Oil Boiler 5-0710	0339-A01	1.66E-06	1.82E-05	7.59E-07
Fuel Oil Boiler 4-0719	26-0670-A01	5.67E-04	6.24E-03	2.60E-04
Fuel Oil Boiler 4-0720	26-0688-A01	1.25E-04	1.37E-03	5.71E-05
Fuel Oil Boiler 4-0722	26-0449-A01	4.86E-04	5.34E-03	2.22E-04
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	3.03E-02	1.66E-01	6.93E-03
Dual Fuel Boiler 5-0080	26-0345-A02	3.03E-02	1.66E-01	6.93E-03
Dual Fuel Boiler 5-0081	26-0345-A03	3.03E-02	1.66E-01	6.93E-03
Dual Fuel Boiler 5-0085	26-4600-A06	5.31E-05	2.91E-04	1.21E-05
Dual Fuel Boiler 5-0087	26-4600-A08	4.38E-03	2.40E-02	1.00E-03
Dual Fuel Boiler 5-0152	26-3326-A02	1.52E-03	1.67E-02	6.98E-04
Dual Fuel Boiler 5-0167	26-03062-A02	7.48E-06	4.10E-05	1.71E-06
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	2.75E-05	3.03E-04	1.26E-05
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	8.59E-06	9.44E-05	3.94E-06
Dual Fuel Boiler 5-0300	26-HQ Building-A01	4.74E-05	5.21E-04	2.17E-05
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	2.99E-05	3.28E-04	1.37E-05
Dual Fuel Boiler 5-0308	26-04219-A03	2.91E-06	1.59E-05	6.64E-07
Natural Gas Boiler 5-0309	26-5100-A02	1.06E-05	1.16E-04	4.85E-06
Natural Gas Boiler 5-0310	26-5100-A01	1.06E-05	1.16E-04	4.85E-06
Dual Fuel Boiler 5-0315	26-0525-A02	8.31E-06	9.13E-05	3.81E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Acetaldehyde **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0322	26-2202-A01	1.20E-05	1.32E-04	5.52E-06
Dual Fuel Boiler 5-0334	26-0525-A03	8.31E-06	9.13E-05	3.81E-06
Dual Fuel Boiler 5-0335	26-0525-A01	8.31E-06	9.13E-05	3.81E-06
Natural Gas Boiler 5-0336	26-04119-A03	5.16E-06	5.67E-05	2.36E-06
Natural Gas Boiler 5-0337	26-0459-A02	2.31E-06	2.54E-05	1.06E-06
Propane Boiler 5-0352	0367-A01	3.18E-04	3.50E-03	1.46E-04
Dual Fuel Boiler 5-0364	26-4312-A01	6.33E-06	3.47E-05	1.45E-06
Dual Fuel Boiler 5-0364	26-4312-A02	6.33E-06	3.47E-05	1.45E-06
Natural Gas Boiler 5-0367	26-2485-A01	2.52E-06	2.77E-05	1.15E-06
Dual Fuel Boiler 5-0370	26-4600-A09	5.31E-05	2.91E-04	1.21E-05
Natural Gas Boiler 5-0371	26-3660-A01	2.36E-06	2.60E-05	1.08E-06
Natural Gas Boiler 5-0376	0383A-A01 & A02	8.98E-06	9.87E-05	4.11E-06
Dual Fuel Boiler 5-0552	26-04219-A02	2.91E-06	1.59E-05	6.64E-07
Natural Gas Boiler 5-0710	0339-A01	1.66E-06	1.82E-05	7.59E-07
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	5.96E-06	9.94E-04	2.43E-04
Emergency Generator 9-0228	03-0394-A02	6.81E-06	1.14E-03	2.43E-04
Emergency Generator 9-0229	03-0328-A01	4.28E-06	7.13E-04	1.95E-04
Emergency Generator 9-0276	03-4600-A04	4.65E-06	7.75E-04	3.41E-04
Emergency Generator 9-0277	03-4600-A05	4.68E-06	7.80E-04	3.41E-04
Emergency Generator 9-0386	03-0394-A03	4.08E-06	6.80E-04	1.36E-04
Emergency Generator 9-0387	03-0394-A04	2.93E-06	4.88E-04	1.36E-04

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Acetaldehyde **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0388	03-0394-A05	1.36E-07	2.27E-05	1.36E-04
Emergency Generator 9-0389	03-0394-A06	4.08E-06	6.80E-04	1.36E-04
Emergency Generator 9-0390	03-0394-A07	3.20E-06	5.33E-04	1.36E-04
Emergency Generator 9-0393	26-GMS-Lab-A04	2.74E-06	4.57E-04	6.85E-04
Emergency Generator 9-0394	26-C2CNTWest-A05	3.99E-07	6.65E-05	3.99E-04
Emergency Generator 9-0395	26-GMS Tower-A04	3.99E-07	6.65E-05	3.99E-04
Emergency Generator 9-0396	26-HQBuilding-A06	1.06E-06	1.77E-04	5.30E-04
Emergency Generator 9-0408	0316-01	3.18E-06	5.30E-04	5.30E-04
Emergency Generator 9-0409	0120-01	3.71E-06	6.19E-04	5.30E-04
Emergency Generator 9-0410	3090-01	9.41E-06	1.57E-03	5.30E-04
Emergency Generator 9-0411	6010-01	4.80E-06	7.99E-04	8.72E-04
Emergency Generator 9-0412	6009-01	1.29E-06	2.16E-04	2.73E-04
Emergency Generator 9-0414	03-0328-A02	8.52E-07	1.42E-04	1.22E-04
Emergency Generator 9-0418	03-0328-A03	8.03E-07	1.34E-04	1.46E-04
Emergency Generator 9-0419	0311-01	1.74E-05	2.90E-03	3.31E-03
Emergency Generator 9-0433	0120-02	4.93E-06	8.22E-04	5.30E-04
Emergency Generator 9-0434	0120-03	3.45E-06	5.74E-04	5.30E-04
Emergency Generator 9-0435	BSS-01	1.19E-03	3.13E-02	3.31E-03
Emergency Generator 9-0436	LWE-01	7.79E-04	5.56E-02	1.53E-02
Emergency Generator 9-0437	UTF-01	3.39E-05	4.85E-03	2.76E-03
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	9.25E-07	1.54E-04	1.37E-04
Emergency Generator 9-0500	3660-01	8.92E-07	1.49E-04	1.17E-04
Emergency Generator 9-0503	Bldg 120 - Gen. #1	3.63E-06	6.05E-04	5.30E-04
Emergency Generator 9-0504	Bldg 120 - Gen. #2	3.47E-06	5.79E-04	5.30E-04
Emergency Generator 9-0510	Bldg 5016 - pending	1.21E-06	2.02E-04	4.26E-04

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Acetaldehyde **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0511	Bldg 5046 - pending	3.75E-07	6.25E-05	1.12E-04
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**1.30E-01**	**9.84E-01**	**7.11E-02**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Acrolein **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	2.55E-02	2.81E-01	1.17E-02
Fuel Oil Boiler 4-0689	26-0642-A01	7.59E-04	8.34E-03	3.48E-04
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	4.30E-04	4.72E-03	1.97E-04
Fuel Oil Boiler 4-0708	26-0394-A01	1.77E-03	1.94E-02	8.08E-04
Fuel Oil Boiler 4-0709	26-0392-A01	5.20E-04	2.85E-03	1.19E-04
Fuel Oil Boiler 5-0710	0339-A01	1.04E-06	1.14E-05	4.76E-07
Fuel Oil Boiler 4-0719	26-0670-A01	5.67E-04	6.24E-03	2.60E-04
Fuel Oil Boiler 4-0720	26-0688-A01	1.25E-04	1.37E-03	5.71E-05
Fuel Oil Boiler 4-0722	26-0449-A01	4.86E-04	5.34E-03	2.22E-04
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	3.03E-02	1.66E-01	6.92E-03
Dual Fuel Boiler 5-0080	26-0345-A02	3.03E-02	1.66E-01	6.92E-03
Dual Fuel Boiler 5-0081	26-0345-A03	3.03E-02	1.66E-01	6.92E-03
Dual Fuel Boiler 5-0085	26-4600-A06	3.33E-05	1.83E-04	7.61E-06
Dual Fuel Boiler 5-0087	26-4600-A08	4.36E-03	2.39E-02	9.96E-04
Dual Fuel Boiler 5-0152	26-3326-A02	1.43E-03	1.57E-02	6.55E-04
Dual Fuel Boiler 5-0167	26-03062-A02	4.69E-06	2.57E-05	1.07E-06
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	1.73E-05	1.90E-04	7.92E-06
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	5.40E-06	5.93E-05	2.47E-06
Dual Fuel Boiler 5-0300	26-HQ Building-A01	3.41E-05	3.74E-04	1.56E-05
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	1.88E-05	2.06E-04	8.59E-06
Dual Fuel Boiler 5-0308	26-04219-A03	1.83E-06	1.00E-05	4.17E-07
Natural Gas Boiler 5-0309	26-5100-A02	6.66E-06	7.31E-05	3.05E-06
Natural Gas Boiler 5-0310	26-5100-A01	6.66E-06	7.31E-05	3.05E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Acrolein **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0315	26-0525-A02	5.22E-06	5.73E-05	2.39E-06
Natural Gas Boiler 5-0322	26-2202-A01	7.56E-06	8.31E-05	3.46E-06
Dual Fuel Boiler 5-0334	26-0525-A03	5.22E-06	5.73E-05	2.39E-06
Dual Fuel Boiler 5-0335	26-0525-A01	5.22E-06	5.73E-05	2.39E-06
Natural Gas Boiler 5-0336	26-04119-A03	3.24E-06	3.56E-05	1.48E-06
Natural Gas Boiler 5-0337	26-0459-A02	1.45E-06	1.59E-05	6.63E-07
Propane Boiler 5-0352	0367-A01	3.18E-04	3.50E-03	1.46E-04
Dual Fuel Boiler 5-0364	26-4312-A01	3.98E-06	2.18E-05	9.08E-07
Dual Fuel Boiler 5-0364	26-4312-A02	3.98E-06	2.18E-05	9.08E-07
Natural Gas Boiler 5-0367	26-2485-A01	1.58E-06	1.74E-05	7.25E-07
Dual Fuel Boiler 5-0370	26-4600-A09	3.33E-05	1.83E-04	7.61E-06
Natural Gas Boiler 5-0371	26-3660-A01	1.48E-06	1.63E-05	6.80E-07
Natural Gas Boiler 5-0376	0383A-A01 & A02	5.64E-06	6.20E-05	2.58E-06
Dual Fuel Boiler 5-0552	26-04219-A02	1.83E-06	1.00E-05	4.17E-07
Natural Gas Boiler 5-0710	0339-A01	1.04E-06	1.14E-05	4.76E-07
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	1.86E-06	3.11E-04	7.61E-05
Emergency Generator 9-0228	03-0394-A02	2.13E-06	3.55E-04	7.61E-05
Emergency Generator 9-0229	03-0328-A01	1.34E-06	2.23E-04	6.08E-05
Emergency Generator 9-0276	03-4600-A04	1.45E-06	2.42E-04	1.06E-04
Emergency Generator 9-0277	03-4600-A05	1.46E-06	2.44E-04	1.06E-04

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Acrolein **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0386	03-0394-A03	1.28E-06	2.13E-04	4.26E-05
Emergency Generator 9-0387	03-0394-A04	9.15E-07	1.52E-04	4.26E-05
Emergency Generator 9-0388	03-0394-A05	4.26E-08	7.09E-06	4.26E-05
Emergency Generator 9-0389	03-0394-A06	1.28E-06	2.13E-04	4.26E-05
Emergency Generator 9-0390	03-0394-A07	1.00E-06	1.67E-04	4.26E-05
Emergency Generator 9-0393	26-GMS-Lab-A04	8.57E-07	1.43E-04	2.14E-04
Emergency Generator 9-0394	26-C2CNTWest-A05	1.25E-07	2.08E-05	1.25E-04
Emergency Generator 9-0395	26-GMS Tower-A04	1.25E-07	2.08E-05	1.25E-04
Emergency Generator 9-0396	26-HQBuilding-A06	3.32E-07	5.53E-05	1.66E-04
Emergency Generator 9-0408	0316-01	9.95E-07	1.66E-04	1.66E-04
Emergency Generator 9-0409	0120-01	1.16E-06	1.93E-04	1.66E-04
Emergency Generator 9-0410	3090-01	2.94E-06	4.91E-04	1.66E-04
Emergency Generator 9-0411	6010-01	1.50E-06	2.50E-04	2.73E-04
Emergency Generator 9-0412	6009-01	4.05E-07	6.75E-05	8.52E-05
Emergency Generator 9-0414	03-0328-A02	2.66E-07	4.44E-05	3.80E-05
Emergency Generator 9-0418	03-0328-A03	2.51E-07	4.18E-05	4.56E-05
Emergency Generator 9-0419	0311-01	2.10E-06	3.50E-04	4.00E-04
Emergency Generator 9-0433	0120-02	1.54E-06	2.57E-04	1.66E-04
Emergency Generator 9-0434	0120-03	1.08E-06	1.80E-04	1.66E-04
Emergency Generator 9-0436	LWE-01	9.40E-05	6.71E-03	1.84E-03
Emergency Generator 9-0437	UTF-01	4.09E-06	5.84E-04	3.33E-04
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	2.89E-07	4.82E-05	4.28E-05
Emergency Generator 9-0500	3660-01	2.79E-07	4.65E-05	3.65E-05

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Acrolein **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0503	Bldg 120 - Gen. #1	1.14E-06	1.89E-04	1.66E-04
Emergency Generator 9-0504	Bldg 120 - Gen. #2	1.09E-06	1.81E-04	1.66E-04
Emergency Generator 9-0510	Bldg 5016 - pending	3.79E-07	6.32E-05	1.33E-04
Emergency Generator 9-0511	Bldg 5046 - pending	1.17E-07	1.95E-05	3.50E-05
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**1.28E-01**	**8.85E-01**	**4.20E-02**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Arsenic **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.17E-04	1.28E-03	5.35E-05
Fuel Oil Boiler 4-0689	26-0642-A01	3.46E-06	3.81E-05	1.59E-06
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	1.96E-06	2.15E-05	8.98E-07
Fuel Oil Boiler 4-0708	26-0394-A01	8.06E-06	8.86E-05	3.69E-06
Fuel Oil Boiler 4-0709	26-0392-A01	2.37E-06	1.30E-05	5.42E-07
Fuel Oil Boiler 5-0710	0339-A01	7.71E-08	8.47E-07	3.53E-08
Fuel Oil Boiler 4-0719	26-0670-A01	2.59E-06	2.85E-05	1.19E-06
Fuel Oil Boiler 4-0720	26-0688-A01	5.69E-07	6.25E-06	2.60E-07
Fuel Oil Boiler 4-0722	26-0449-A01	2.22E-06	2.44E-05	1.02E-06
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	1.40E-04	7.69E-04	3.21E-05
Dual Fuel Boiler 5-0080	26-0345-A02	1.40E-04	7.69E-04	3.21E-05
Dual Fuel Boiler 5-0081	26-0345-A03	1.40E-04	7.69E-04	3.21E-05
Dual Fuel Boiler 5-0085	26-4600-A06	2.47E-06	1.35E-05	5.64E-07
Dual Fuel Boiler 5-0087	26-4600-A08	2.22E-05	1.22E-04	5.08E-06
Dual Fuel Boiler 5-0152	26-3326-A02	1.75E-05	1.92E-04	8.00E-06
Dual Fuel Boiler 5-0167	26-03062-A02	3.48E-07	1.91E-06	7.94E-08
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	1.28E-06	1.41E-05	5.86E-07
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	4.00E-07	4.39E-06	1.83E-07
Dual Fuel Boiler 5-0300	26-HQ Building-A01	1.72E-06	1.89E-05	7.87E-07
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	1.39E-06	1.53E-05	6.36E-07
Dual Fuel Boiler 5-0308	26-04219-A03	1.35E-07	7.41E-07	3.09E-08
Natural Gas Boiler 5-0309	26-5100-A02	4.93E-07	5.42E-06	2.26E-07
Natural Gas Boiler 5-0310	26-5100-A01	4.93E-07	5.42E-06	2.26E-07

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Arsenic **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0315	26-0525-A02	3.87E-07	4.25E-06	1.77E-07
Natural Gas Boiler 5-0322	26-2202-A01	5.60E-07	6.16E-06	2.57E-07
Dual Fuel Boiler 5-0334	26-0525-A03	3.87E-07	4.25E-06	1.77E-07
Dual Fuel Boiler 5-0335	26-0525-A01	3.87E-07	4.25E-06	1.77E-07
Natural Gas Boiler 5-0336	26-04119-A03	2.40E-07	2.64E-06	1.10E-07
Natural Gas Boiler 5-0337	26-0459-A02	1.07E-07	1.18E-06	4.91E-08
Propane Boiler 5-0352	0367-A01	1.45E-06	1.60E-05	6.65E-07
Dual Fuel Boiler 5-0364	26-4312-A01	2.94E-07	1.61E-06	6.72E-08
Dual Fuel Boiler 5-0364	26-4312-A02	2.94E-07	1.61E-06	6.72E-08
Natural Gas Boiler 5-0367	26-2485-A01	1.17E-07	1.29E-06	5.37E-08
Dual Fuel Boiler 5-0370	26-4600-A09	2.47E-06	1.35E-05	5.64E-07
Natural Gas Boiler 5-0371	26-3660-A01	1.10E-07	1.21E-06	5.03E-08
Natural Gas Boiler 5-0376	0383A-A01 & A02	4.18E-07	4.59E-06	1.91E-07
Dual Fuel Boiler 5-0552	26-04219-A02	1.35E-07	7.41E-07	3.09E-08
Natural Gas Boiler 5-0710	0339-A01	7.71E-08	8.47E-07	3.53E-08
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	3.78E-04	6.31E-02	1.54E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Arsenic **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0228	03-0394-A02	4.33E-04	7.21E-02	1.54E-02
Emergency Generator 9-0229	03-0328-A01	2.72E-04	4.53E-02	1.23E-02
Emergency Generator 9-0276	03-4600-A04	2.95E-04	4.92E-02	2.16E-02
Emergency Generator 9-0277	03-4600-A05	2.97E-04	4.96E-02	2.16E-02
Emergency Generator 9-0386	03-0394-A03	2.59E-04	4.32E-02	8.64E-03
Emergency Generator 9-0387	03-0394-A04	1.86E-04	3.10E-02	8.64E-03
Emergency Generator 9-0388	03-0394-A05	8.64E-06	1.44E-03	8.64E-03
Emergency Generator 9-0389	03-0394-A06	2.59E-04	4.32E-02	8.64E-03
Emergency Generator 9-0390	03-0394-A07	2.03E-04	3.38E-02	8.64E-03
Emergency Generator 9-0393	26-GMS-Lab-A04	1.74E-04	2.90E-02	4.35E-02
Emergency Generator 9-0394	26-C2CNTWest-A05	2.53E-05	4.22E-03	2.53E-02
Emergency Generator 9-0395	26-GMS Tower-A04	2.53E-05	4.22E-03	2.53E-02
Emergency Generator 9-0396	26-HQBuilding-A06	6.73E-05	1.12E-02	3.37E-02
Emergency Generator 9-0408	0316-01	2.02E-04	3.37E-02	3.37E-02
Emergency Generator 9-0409	0120-01	2.36E-04	3.93E-02	3.37E-02
Emergency Generator 9-0410	3090-01	5.98E-04	9.96E-02	3.37E-02
Emergency Generator 9-0411	6010-01	3.05E-04	5.08E-02	5.54E-02
Emergency Generator 9-0412	6009-01	8.22E-05	1.37E-02	1.73E-02
Emergency Generator 9-0414	03-0328-A02	5.41E-05	9.01E-03	7.72E-03
Emergency Generator 9-0418	03-0328-A03	5.10E-05	8.50E-03	9.27E-03
Emergency Generator 9-0419	0311-01	3.63E-05	6.05E-03	6.91E-03
Emergency Generator 9-0433	0120-02	3.13E-04	5.22E-02	3.37E-02
Emergency Generator 9-0434	0120-03	2.19E-04	3.65E-02	3.37E-02
Emergency Generator 9-0435	BSS-01	2.48E-03	6.53E-02	6.91E-03
Emergency Generator 9-0436	LWE-01	1.63E-03	1.16E-01	3.19E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Arsenic **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0437	UTF-01	7.08E-05	1.01E-02	5.76E-03
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	5.87E-05	9.78E-03	8.70E-03
Emergency Generator 9-0500	3660-01	5.67E-05	9.44E-03	7.41E-03
Emergency Generator 9-0503	Bldg 120 - Gen. #1	2.31E-04	3.84E-02	3.37E-02
Emergency Generator 9-0504	Bldg 120 - Gen. #2	2.20E-04	3.67E-02	3.37E-02
Emergency Generator 9-0510	Bldg 5016 - pending	7.70E-05	1.28E-02	2.70E-02
Emergency Generator 9-0511	Bldg 5046 - pending	2.38E-05	3.97E-03	7.11E-03
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**1.04E-02**	**1.14E+00**	**6.85E-01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: 1,3-Butadiene **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.08E-03	1.18E-02	4.93E-04
Fuel Oil Boiler 4-0689	26-0642-A01	3.20E-05	3.52E-04	1.47E-05
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	1.81E-05	1.99E-04	8.31E-06
Fuel Oil Boiler 4-0708	26-0394-A01	7.45E-05	8.19E-04	3.41E-05
Fuel Oil Boiler 4-0709	26-0392-A01	2.20E-05	1.20E-04	5.02E-06
Fuel Oil Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0719	26-0670-A01	2.40E-05	2.63E-04	1.10E-05
Fuel Oil Boiler 4-0720	26-0688-A01	5.26E-06	5.78E-05	2.41E-06
Fuel Oil Boiler 4-0722	26-0449-A01	2.05E-05	2.25E-04	9.39E-06
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	1.28E-03	7.01E-03	2.92E-04
Dual Fuel Boiler 5-0080	26-0345-A02	1.28E-03	7.01E-03	2.92E-04
Dual Fuel Boiler 5-0081	26-0345-A03	1.28E-03	7.01E-03	2.92E-04
Dual Fuel Boiler 5-0085	26-4600-A06	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0087	26-4600-A08	1.83E-04	1.00E-03	4.17E-05
Dual Fuel Boiler 5-0152	26-3326-A02	5.38E-05	5.91E-04	2.46E-05
Dual Fuel Boiler 5-0167	26-03062-A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0300	26-HQ Building-A01	4.88E-07	5.37E-06	2.24E-07
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0308	26-04219-A03	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: 1,3-Butadiene **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0310	26-5100-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0315	26-0525-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0322	26-2202-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0334	26-0525-A03	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0335	26-0525-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0336	26-04119-A03	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0337	26-0459-A02	0.00E+00	0.00E+00	0.00E+00
Propane Boiler 5-0352	0367-A01	1.34E-05	1.48E-04	6.15E-06
Dual Fuel Boiler 5-0364	26-4312-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0364	26-4312-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0367	26-2485-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0370	26-4600-A09	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0371	26-3660-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0376	0383A-A01 & A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0552	26-04219-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	5.14E-02	8.57E+00	2.10E+00
Emergency Generator 9-0228	03-0394-A02	5.88E-02	9.80E+00	2.10E+00
Emergency Generator 9-0229	03-0328-A01	3.69E-02	6.15E+00	1.68E+00
Emergency Generator 9-0276	03-4600-A04	4.01E-02	6.68E+00	2.94E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: 1,3-Butadiene **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	4.04E-02	6.73E+00	2.94E+00
Emergency Generator 9-0386	03-0394-A03	3.52E-02	5.87E+00	1.17E+00
Emergency Generator 9-0387	03-0394-A04	2.52E-02	4.21E+00	1.17E+00
Emergency Generator 9-0388	03-0394-A05	1.17E-03	1.96E-01	1.17E+00
Emergency Generator 9-0389	03-0394-A06	3.52E-02	5.87E+00	1.17E+00
Emergency Generator 9-0390	03-0394-A07	2.76E-02	4.60E+00	1.17E+00
Emergency Generator 9-0393	26-GMS-Lab-A04	2.37E-02	3.94E+00	5.91E+00
Emergency Generator 9-0394	26-C2CNTWest-A05	3.44E-03	5.74E-01	3.44E+00
Emergency Generator 9-0395	26-GMS Tower-A04	3.44E-03	5.74E-01	3.44E+00
Emergency Generator 9-0396	26-HQBuilding-A06	9.15E-03	1.52E+00	4.57E+00
Emergency Generator 9-0408	0316-01	2.74E-02	4.57E+00	4.57E+00
Emergency Generator 9-0409	0120-01	3.20E-02	5.34E+00	4.57E+00
Emergency Generator 9-0410	3090-01	8.12E-02	1.35E+01	4.58E+00
Emergency Generator 9-0411	6010-01	4.14E-02	6.90E+00	7.52E+00
Emergency Generator 9-0412	6009-01	1.12E-02	1.86E+00	2.35E+00
Emergency Generator 9-0414	03-0328-A02	7.35E-03	1.22E+00	1.05E+00
Emergency Generator 9-0418	03-0328-A03	6.93E-03	1.15E+00	1.26E+00
Emergency Generator 9-0419	0311-01	8.87E-07	1.48E-04	1.69E-04
Emergency Generator 9-0433	0120-02	4.25E-02	7.09E+00	4.57E+00
Emergency Generator 9-0434	0120-03	2.97E-02	4.95E+00	4.57E+00
Emergency Generator 9-0435	BSS-01	6.07E-05	1.60E-03	1.69E-04
Emergency Generator 9-0436	LWE-01	3.97E-05	2.84E-03	7.79E-04
Emergency Generator 9-0437	UTF-01	1.73E-06	2.47E-04	1.41E-04
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	7.98E-03	1.33E+00	1.18E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: 1,3-Butadiene **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	7.70E-03	1.28E+00	1.01E+00
Emergency Generator 9-0503	Bldg 120 - Gen. #1	3.13E-02	5.22E+00	4.57E+00
Emergency Generator 9-0504	Bldg 120 - Gen. #2	3.00E-02	4.99E+00	4.57E+00
Emergency Generator 9-0510	Bldg 5016 - pending	1.05E-02	1.74E+00	3.67E+00
Emergency Generator 9-0511	Bldg 5046 - pending	3.24E-03	5.39E-01	9.66E-01
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**7.68E-01**	**1.27E+02**	**8.60E+01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration number correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Cadmium **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.11E-04	1.23E-03	5.10E-05
Fuel Oil Boiler 4-0689	26-0642-A01	3.25E-06	3.57E-05	1.49E-06
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	1.84E-06	2.02E-05	8.42E-07
Fuel Oil Boiler 4-0708	26-0394-A01	7.55E-06	8.30E-05	3.46E-06
Fuel Oil Boiler 4-0709	26-0392-A01	2.23E-06	1.22E-05	5.08E-07
Fuel Oil Boiler 5-0710	0339-A01	4.24E-07	4.66E-06	1.94E-07
Fuel Oil Boiler 4-0719	26-0670-A01	2.43E-06	2.67E-05	1.11E-06
Fuel Oil Boiler 4-0720	26-0688-A01	5.33E-07	5.86E-06	2.44E-07
Fuel Oil Boiler 4-0722	26-0449-A01	2.08E-06	2.28E-05	9.52E-07
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	1.41E-04	7.75E-04	3.23E-05
Dual Fuel Boiler 5-0080	26-0345-A02	1.41E-04	7.75E-04	3.23E-05
Dual Fuel Boiler 5-0081	26-0345-A03	1.41E-04	7.75E-04	3.23E-05
Dual Fuel Boiler 5-0085	26-4600-A06	1.36E-05	7.44E-05	3.10E-06
Dual Fuel Boiler 5-0087	26-4600-A08	3.21E-05	1.76E-04	7.33E-06
Dual Fuel Boiler 5-0152	26-3326-A02	6.96E-05	7.64E-04	3.18E-05
Dual Fuel Boiler 5-0167	26-03062-A02	1.91E-06	1.05E-05	4.37E-07
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	7.04E-06	7.74E-05	3.22E-06
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	2.20E-06	2.42E-05	1.01E-06
Dual Fuel Boiler 5-0300	26-HQ Building-A01	9.21E-06	1.01E-04	4.22E-06
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	7.64E-06	8.40E-05	3.50E-06
Dual Fuel Boiler 5-0308	26-04219-A03	7.44E-07	4.08E-06	1.70E-07

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Cadmium **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	2.71E-06	2.98E-05	1.24E-06
Natural Gas Boiler 5-0310	26-5100-A01	2.71E-06	2.98E-05	1.24E-06
Dual Fuel Boiler 5-0315	26-0525-A02	2.13E-06	2.34E-05	9.73E-07
Natural Gas Boiler 5-0322	26-2202-A01	3.08E-06	3.39E-05	1.41E-06
Dual Fuel Boiler 5-0334	26-0525-A03	2.13E-06	2.34E-05	9.73E-07
Dual Fuel Boiler 5-0335	26-0525-A01	2.13E-06	2.34E-05	9.73E-07
Natural Gas Boiler 5-0336	26-04119-A03	1.32E-06	1.45E-05	6.04E-07
Natural Gas Boiler 5-0337	26-0459-A02	5.90E-07	6.49E-06	2.70E-07
Propane Boiler 5-0352	0367-A01	1.36E-06	1.50E-05	6.24E-07
Dual Fuel Boiler 5-0364	26-4312-A01	1.62E-06	8.87E-06	3.70E-07
Dual Fuel Boiler 5-0364	26-4312-A02	1.62E-06	8.87E-06	3.70E-07
Natural Gas Boiler 5-0367	26-2485-A01	6.45E-07	7.09E-06	2.95E-07
Dual Fuel Boiler 5-0370	26-4600-A09	1.36E-05	7.44E-05	3.10E-06
Natural Gas Boiler 5-0371	26-3660-A01	6.05E-07	6.64E-06	2.77E-07
Natural Gas Boiler 5-0376	0383A-A01 & A02	2.30E-06	2.52E-05	1.05E-06
Dual Fuel Boiler 5-0552	26-04219-A02	7.44E-07	4.08E-06	1.70E-07
Natural Gas Boiler 5-0710	0339-A01	4.24E-07	4.66E-06	1.94E-07
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	3.55E-04	5.91E-02	1.45E-02
Emergency Generator 9-0228	03-0394-A02	4.06E-04	6.76E-02	1.45E-02
Emergency Generator 9-0229	03-0328-A01	2.55E-04	4.25E-02	1.16E-02
Emergency Generator 9-0276	03-4600-A04	2.77E-04	4.61E-02	2.03E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Cadmium **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	2.79E-04	4.65E-02	2.03E-02
Emergency Generator 9-0386	03-0394-A03	2.43E-04	4.05E-02	8.10E-03
Emergency Generator 9-0387	03-0394-A04	1.74E-04	2.90E-02	8.10E-03
Emergency Generator 9-0388	03-0394-A05	8.10E-06	1.35E-03	8.10E-03
Emergency Generator 9-0389	03-0394-A06	2.43E-04	4.05E-02	8.10E-03
Emergency Generator 9-0390	03-0394-A07	1.90E-04	3.17E-02	8.10E-03
Emergency Generator 9-0393	26-GMS-Lab-A04	1.63E-04	2.72E-02	4.08E-02
Emergency Generator 9-0394	26-C2CNTWest-A05	2.38E-05	3.96E-03	2.38E-02
Emergency Generator 9-0395	26-GMS Tower-A04	2.38E-05	3.96E-03	2.38E-02
Emergency Generator 9-0396	26-HQBuilding-A06	6.31E-05	1.05E-02	3.16E-02
Emergency Generator 9-0408	0316-01	1.89E-04	3.16E-02	3.16E-02
Emergency Generator 9-0409	0120-01	2.21E-04	3.68E-02	3.16E-02
Emergency Generator 9-0410	3090-01	5.60E-04	9.34E-02	3.16E-02
Emergency Generator 9-0411	6010-01	2.85E-04	4.76E-02	5.19E-02
Emergency Generator 9-0412	6009-01	7.71E-05	1.28E-02	1.62E-02
Emergency Generator 9-0414	03-0328-A02	5.07E-05	8.45E-03	7.24E-03
Emergency Generator 9-0418	03-0328-A03	4.78E-05	7.97E-03	8.69E-03
Emergency Generator 9-0419	0311-01	3.40E-05	5.67E-03	6.48E-03
Emergency Generator 9-0433	0120-02	2.93E-04	4.89E-02	3.16E-02
Emergency Generator 9-0434	0120-03	2.05E-04	3.42E-02	3.16E-02
Emergency Generator 9-0435	BSS-01	2.33E-03	6.13E-02	6.48E-03
Emergency Generator 9-0436	LWE-01	1.52E-03	1.09E-01	2.99E-02
Emergency Generator 9-0437	UTF-01	6.63E-05	9.48E-03	5.40E-03
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	5.50E-05	9.17E-03	8.15E-03

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Cadmium **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	5.31E-05	8.85E-03	6.94E-03
Emergency Generator 9-0503	Bldg 120 - Gen. #1	2.16E-04	3.60E-02	3.16E-02
Emergency Generator 9-0504	Bldg 120 - Gen. #2	2.07E-04	3.45E-02	3.16E-02
Emergency Generator 9-0510	Bldg 5016 - pending	7.22E-05	1.20E-02	2.53E-02
Emergency Generator 9-0511	Bldg 5046 - pending	2.23E-05	3.72E-03	6.66E-03
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**9.95E-03**	**1.07E+00**	**6.42E-01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration number correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Cobalt **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.72E-07	1.89E-06	7.87E-08
Fuel Oil Boiler 4-0689	26-0642-A01	0.00E+00	0.00E+00	0.00E+00
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0708	26-0394-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0709	26-0392-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 5-0710	0339-A01	3.24E-08	3.56E-07	1.48E-08
Fuel Oil Boiler 4-0719	26-0670-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0720	26-0688-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0722	26-0449-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	8.98E-07	4.92E-06	2.05E-07
Dual Fuel Boiler 5-0080	26-0345-A02	8.98E-07	4.92E-06	2.05E-07
Dual Fuel Boiler 5-0081	26-0345-A03	8.98E-07	4.92E-06	2.05E-07
Dual Fuel Boiler 5-0085	26-4600-A06	1.04E-06	5.69E-06	2.37E-07
Dual Fuel Boiler 5-0087	26-4600-A08	1.04E-06	5.69E-06	2.37E-07
Dual Fuel Boiler 5-0152	26-3326-A02	4.90E-06	5.38E-05	2.24E-06
Dual Fuel Boiler 5-0167	26-03062-A02	1.46E-07	8.00E-07	3.33E-08
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	5.38E-07	5.91E-06	2.46E-07
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	1.68E-07	1.84E-06	7.69E-08
Dual Fuel Boiler 5-0300	26-HQ Building-A01	7.00E-07	7.69E-06	3.20E-07
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	5.83E-07	6.41E-06	2.67E-07
Dual Fuel Boiler 5-0308	26-04219-A03	5.68E-08	3.11E-07	1.30E-08

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Cobalt **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	2.07E-07	2.28E-06	9.48E-08
Natural Gas Boiler 5-0310	26-5100-A01	2.07E-07	2.28E-06	9.48E-08
Dual Fuel Boiler 5-0315	26-0525-A02	1.62E-07	1.78E-06	7.43E-08
Natural Gas Boiler 5-0322	26-2202-A01	2.35E-07	2.59E-06	1.08E-07
Dual Fuel Boiler 5-0334	26-0525-A03	1.62E-07	1.78E-06	7.43E-08
Dual Fuel Boiler 5-0335	26-0525-A01	1.62E-07	1.78E-06	7.43E-08
Natural Gas Boiler 5-0336	26-04119-A03	1.01E-07	1.11E-06	4.61E-08
Natural Gas Boiler 5-0337	26-0459-A02	4.51E-08	4.95E-07	2.06E-08
Propane Boiler 5-0352	0367-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0364	26-4312-A01	1.24E-07	6.78E-07	2.82E-08
Dual Fuel Boiler 5-0364	26-4312-A02	1.24E-07	6.78E-07	2.82E-08
Natural Gas Boiler 5-0367	26-2485-A01	4.92E-08	5.41E-07	2.25E-08
Dual Fuel Boiler 5-0370	26-4600-A09	1.04E-06	5.69E-06	2.37E-07
Natural Gas Boiler 5-0371	26-3660-A01	4.62E-08	5.07E-07	2.11E-08
Natural Gas Boiler 5-0376	0383A-A01 & A02	1.75E-07	1.93E-06	8.03E-08
Dual Fuel Boiler 5-0552	26-04219-A02	5.68E-08	3.11E-07	1.30E-08
Natural Gas Boiler 5-0710	0339-A01	3.24E-08	3.56E-07	1.48E-08
Paint Spray Booth 6-0159	07-00525-A06	3.64E-04	7.38E-02	6.99E-02
Paint Spray Booth 6-0162	07-00525-A04	1.12E-03	7.80E-02	6.93E-02
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0228	03-0394-A02	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0229	03-0328-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0276	03-4600-A04	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Cobalt **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0386	03-0394-A03	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0387	03-0394-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0388	03-0394-A05	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0389	03-0394-A06	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0390	03-0394-A07	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0393	26-GMS-Lab-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0394	26-C2CNTWest-A05	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0395	26-GMS Tower-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0396	26-HQBuilding-A06	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0408	0316-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0409	0120-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0410	3090-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0411	6010-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0412	6009-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0414	03-0328-A02	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0418	03-0328-A03	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0419	0311-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0433	0120-02	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0434	0120-03	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0435	BSS-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0436	LWE-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0437	UTF-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Cobalt **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0503	Bldg 120 - Gen. #1	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0504	Bldg 120 - Gen. #2	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0510	Bldg 5016 - pending	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0511	Bldg 5046 - pending	0.00E+00	0.00E+00	0.00E+00
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**1.49E-03**	**1.52E-01**	**1.39E-01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration number correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Copper **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	2.99E-04	3.28E-03	1.37E-04
Fuel Oil Boiler 4-0689	26-0642-A01	8.88E-06	9.75E-05	4.06E-06
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	5.02E-06	5.52E-05	2.30E-06
Fuel Oil Boiler 4-0708	26-0394-A01	2.06E-05	2.27E-04	9.45E-06
Fuel Oil Boiler 4-0709	26-0392-A01	6.09E-06	3.33E-05	1.39E-06
Fuel Oil Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0719	26-0670-A01	6.64E-06	7.29E-05	3.04E-06
Fuel Oil Boiler 4-0720	26-0688-A01	1.46E-06	1.60E-05	6.67E-07
Fuel Oil Boiler 4-0722	26-0449-A01	5.68E-06	6.24E-05	2.60E-06
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	3.54E-04	1.94E-03	8.09E-05
Dual Fuel Boiler 5-0080	26-0345-A02	3.54E-04	1.94E-03	8.09E-05
Dual Fuel Boiler 5-0081	26-0345-A03	3.54E-04	1.94E-03	8.09E-05
Dual Fuel Boiler 5-0085	26-4600-A06	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0087	26-4600-A08	5.06E-05	2.77E-04	1.16E-05
Dual Fuel Boiler 5-0152	26-3326-A02	1.49E-05	1.64E-04	6.82E-06
Dual Fuel Boiler 5-0167	26-03062-A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0300	26-HQ Building-A01	1.35E-07	1.49E-06	6.20E-08
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0308	26-04219-A03	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0309	26-5100-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0310	26-5100-A01	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Copper **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0315	26-0525-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0322	26-2202-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0334	26-0525-A03	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0335	26-0525-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0336	26-04119-A03	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0337	26-0459-A02	0.00E+00	0.00E+00	0.00E+00
Propane Boiler 5-0352	0367-A01	3.72E-06	4.09E-05	1.70E-06
Dual Fuel Boiler 5-0364	26-4312-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0364	26-4312-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0367	26-2485-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0370	26-4600-A09	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0371	26-3660-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0376	0383A-A01 & A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0552	26-04219-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	9.70E-04	1.62E-01	3.96E-02
Emergency Generator 9-0228	03-0394-A02	1.11E-03	1.85E-01	3.96E-02
Emergency Generator 9-0229	03-0328-A01	6.96E-04	1.16E-01	3.16E-02
Emergency Generator 9-0276	03-4600-A04	7.56E-04	1.26E-01	5.54E-02
Emergency Generator 9-0277	03-4600-A05	7.62E-04	1.27E-01	5.54E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Copper **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0386	03-0394-A03	6.64E-04	1.11E-01	2.21E-02
Emergency Generator 9-0387	03-0394-A04	4.76E-04	7.93E-02	2.21E-02
Emergency Generator 9-0388	03-0394-A05	2.21E-05	3.69E-03	2.21E-02
Emergency Generator 9-0389	03-0394-A06	6.64E-04	1.11E-01	2.21E-02
Emergency Generator 9-0390	03-0394-A07	5.20E-04	8.67E-02	2.21E-02
Emergency Generator 9-0393	26-GMS-Lab-A04	4.46E-04	7.44E-02	1.12E-01
Emergency Generator 9-0394	26-C2CNTWest-A05	6.49E-05	1.08E-02	6.49E-02
Emergency Generator 9-0395	26-GMS Tower-A04	6.49E-05	1.08E-02	6.49E-02
Emergency Generator 9-0396	26-HQBuilding-A06	1.73E-04	2.88E-02	8.63E-02
Emergency Generator 9-0408	0316-01	5.18E-04	8.63E-02	8.63E-02
Emergency Generator 9-0409	0120-01	6.04E-04	1.01E-01	8.63E-02
Emergency Generator 9-0410	3090-01	1.53E-03	2.55E-01	8.63E-02
Emergency Generator 9-0411	6010-01	7.80E-04	1.30E-01	1.42E-01
Emergency Generator 9-0412	6009-01	2.11E-04	3.51E-02	4.43E-02
Emergency Generator 9-0414	03-0328-A02	1.39E-04	2.31E-02	1.98E-02
Emergency Generator 9-0418	03-0328-A03	1.31E-04	2.18E-02	2.38E-02
Emergency Generator 9-0419	0311-01	9.30E-05	1.55E-02	1.77E-02
Emergency Generator 9-0433	0120-02	8.02E-04	1.34E-01	8.63E-02
Emergency Generator 9-0434	0120-03	5.61E-04	9.34E-02	8.63E-02
Emergency Generator 9-0435	BSS-01	6.36E-03	1.67E-01	1.77E-02
Emergency Generator 9-0436	LWE-01	4.16E-03	2.97E-01	8.17E-02
Emergency Generator 9-0437	UTF-01	1.81E-04	2.59E-02	1.48E-02
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Copper **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0499	2202-01	1.50E-04	2.51E-02	2.23E-02
Emergency Generator 9-0500	3660-01	1.45E-04	2.42E-02	1.90E-02
Emergency Generator 9-0503	Bldg 120 - Gen. #1	5.91E-04	9.85E-02	8.63E-02
Emergency Generator 9-0504	Bldg 120 - Gen. #2	5.65E-04	9.42E-02	8.63E-02
Emergency Generator 9-0510	Bldg 5016 - pending	1.97E-04	3.29E-02	6.93E-02
Emergency Generator 9-0511	Bldg 5046 - pending	6.10E-05	1.02E-02	1.82E-02
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**2.67E-02**	**2.91E+00**	**1.75E+00**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Formaldehyde **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	2.56E-03	2.81E-02	1.17E-03
Fuel Oil Boiler 4-0689	26-0642-A01	7.14E-05	7.85E-04	3.27E-05
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	4.04E-05	4.44E-04	1.85E-05
Fuel Oil Boiler 4-0708	26-0394-A01	1.66E-04	1.83E-03	7.61E-05
Fuel Oil Boiler 4-0709	26-0392-A01	4.90E-05	2.68E-04	1.12E-05
Fuel Oil Boiler 5-0710	0339-A01	2.89E-05	3.18E-04	1.32E-05
Fuel Oil Boiler 4-0719	26-0670-A01	5.34E-05	5.87E-04	2.45E-05
Fuel Oil Boiler 4-0720	26-0688-A01	1.17E-05	1.29E-04	5.37E-06
Fuel Oil Boiler 4-0722	26-0449-A01	4.57E-05	5.03E-04	2.09E-05
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	3.65E-03	2.00E-02	8.34E-04
Dual Fuel Boiler 5-0080	26-0345-A02	3.65E-03	2.00E-02	8.34E-04
Dual Fuel Boiler 5-0081	26-0345-A03	3.65E-03	2.00E-02	8.34E-04
Dual Fuel Boiler 5-0085	26-4600-A06	9.26E-04	5.08E-03	2.12E-04
Dual Fuel Boiler 5-0087	26-4600-A08	1.33E-03	7.31E-03	3.05E-04
Dual Fuel Boiler 5-0152	26-3326-A02	4.49E-03	4.93E-02	2.06E-03
Dual Fuel Boiler 5-0167	26-03062-A02	1.30E-04	7.14E-04	2.98E-05
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	4.80E-04	5.28E-03	2.20E-04
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	1.50E-04	1.65E-03	6.86E-05
Dual Fuel Boiler 5-0300	26-HQ Building-A01	6.26E-04	6.88E-03	2.87E-04
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	5.21E-04	5.73E-03	2.39E-04
Dual Fuel Boiler 5-0308	26-04219-A03	5.07E-05	2.78E-04	1.16E-05
Natural Gas Boiler 5-0309	26-5100-A02	1.85E-04	2.03E-03	8.47E-05
Natural Gas Boiler 5-0310	26-5100-A01	1.85E-04	2.03E-03	8.47E-05

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Formaldehyde **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0315	26-0525-A02	1.45E-04	1.59E-03	6.64E-05
Natural Gas Boiler 5-0322	26-2202-A01	2.10E-04	2.31E-03	9.62E-05
Dual Fuel Boiler 5-0334	26-0525-A03	1.45E-04	1.59E-03	6.64E-05
Dual Fuel Boiler 5-0335	26-0525-A01	1.45E-04	1.59E-03	6.64E-05
Natural Gas Boiler 5-0336	26-04119-A03	8.99E-05	9.88E-04	4.12E-05
Natural Gas Boiler 5-0337	26-0459-A02	4.02E-05	4.42E-04	1.84E-05
Propane Boiler 5-0352	0367-A01	3.00E-05	3.29E-04	1.37E-05
Dual Fuel Boiler 5-0364	26-4312-A01	1.10E-04	6.05E-04	2.52E-05
Dual Fuel Boiler 5-0364	26-4312-A02	1.10E-04	6.05E-04	2.52E-05
Natural Gas Boiler 5-0367	26-2485-A01	4.40E-05	4.83E-04	2.01E-05
Dual Fuel Boiler 5-0370	26-4600-A09	9.26E-04	5.08E-03	2.12E-04
Natural Gas Boiler 5-0371	26-3660-A01	4.12E-05	4.53E-04	1.89E-05
Natural Gas Boiler 5-0376	0383A-A01 & A02	1.57E-04	1.72E-03	7.17E-05
Dual Fuel Boiler 5-0552	26-04219-A02	5.07E-05	2.78E-04	1.16E-05
Natural Gas Boiler 5-0710	0339-A01	2.89E-05	3.18E-04	1.32E-05
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	1.87E-05	3.11E-03	7.62E-04
Emergency Generator 9-0228	03-0394-A02	2.13E-05	3.56E-03	7.62E-04
Emergency Generator 9-0229	03-0328-A01	1.34E-05	2.23E-03	6.09E-04

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Formaldehyde **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0276	03-4600-A04	1.46E-05	2.43E-03	1.07E-03
Emergency Generator 9-0277	03-4600-A05	1.47E-05	2.44E-03	1.07E-03
Emergency Generator 9-0386	03-0394-A03	1.28E-05	2.13E-03	4.26E-04
Emergency Generator 9-0387	03-0394-A04	9.16E-06	1.53E-03	4.26E-04
Emergency Generator 9-0388	03-0394-A05	4.26E-07	7.10E-05	4.26E-04
Emergency Generator 9-0389	03-0394-A06	1.28E-05	2.13E-03	4.26E-04
Emergency Generator 9-0390	03-0394-A07	1.00E-05	1.67E-03	4.26E-04
Emergency Generator 9-0393	26-GMS-Lab-A04	8.58E-06	1.43E-03	2.15E-03
Emergency Generator 9-0394	26-C2CNTWest-A05	1.25E-06	2.08E-04	1.25E-03
Emergency Generator 9-0395	26-GMS Tower-A04	1.25E-06	2.08E-04	1.25E-03
Emergency Generator 9-0396	26-HQBuilding-A06	3.32E-06	5.53E-04	1.66E-03
Emergency Generator 9-0408	0316-01	9.96E-06	1.66E-03	1.66E-03
Emergency Generator 9-0409	0120-01	1.16E-05	1.94E-03	1.66E-03
Emergency Generator 9-0410	3090-01	2.95E-05	4.91E-03	1.66E-03
Emergency Generator 9-0411	6010-01	1.50E-05	2.50E-03	2.73E-03
Emergency Generator 9-0412	6009-01	4.05E-06	6.75E-04	8.53E-04
Emergency Generator 9-0414	03-0328-A02	2.67E-06	4.44E-04	3.81E-04
Emergency Generator 9-0418	03-0328-A03	2.51E-06	4.19E-04	4.57E-04
Emergency Generator 9-0419	0311-01	2.68E-05	4.46E-03	5.10E-03
Emergency Generator 9-0433	0120-02	1.54E-05	2.57E-03	1.66E-03
Emergency Generator 9-0434	0120-03	1.08E-05	1.80E-03	1.66E-03
Emergency Generator 9-0435	BSS-01	1.83E-03	4.82E-02	5.10E-03
Emergency Generator 9-0436	LWE-01	1.20E-03	8.56E-02	2.35E-02
Emergency Generator 9-0437	UTF-01	5.22E-05	7.46E-03	4.25E-03
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Formaldehyde **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0499	2202-01	2.90E-06	4.83E-04	4.29E-04
Emergency Generator 9-0500	3660-01	2.79E-06	4.66E-04	3.65E-04
Emergency Generator 9-0503	Bldg 120 - Gen. #1	1.14E-05	1.90E-03	1.66E-03
Emergency Generator 9-0504	Bldg 120 - Gen. #2	1.09E-05	1.81E-03	1.66E-03
Emergency Generator 9-0510	Bldg 5016 - pending	3.80E-06	6.33E-04	1.33E-03
Emergency Generator 9-0511	Bldg 5046 - pending	1.17E-06	1.96E-04	3.51E-04
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**2.87E-02**	**3.90E-01**	**7.74E-02**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Hexamethylene diisocyanate **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0689	26-0642-A01	0.00E+00	0.00E+00	0.00E+00
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0708	26-0394-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0709	26-0392-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0719	26-0670-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0720	26-0688-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0722	26-0449-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0080	26-0345-A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0081	26-0345-A03	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0085	26-4600-A06	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0087	26-4600-A08	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0152	26-3326-A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0167	26-03062-A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0300	26-HQ Building-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0308	26-04219-A03	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0309	26-5100-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0310	26-5100-A01	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Hexamethylene diisocyanate **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0315	26-0525-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0322	26-2202-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0334	26-0525-A03	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0335	26-0525-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0336	26-04119-A03	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0337	26-0459-A02	0.00E+00	0.00E+00	0.00E+00
Propane Boiler 5-0352	0367-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0364	26-4312-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0364	26-4312-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0367	26-2485-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0370	26-4600-A09	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0371	26-3660-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0376	0383A-A01 & A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0552	26-04219-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0159	07-00525-A06	2.18E-02	7.06E+00	6.68E+00
Paint Spray Booth 6-0162	07-00525-A04	8.83E-02	7.20E+00	6.40E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0228	03-0394-A02	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0229	03-0328-A01	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Hexamethylene diisocyanate **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0276	03-4600-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0277	03-4600-A05	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0386	03-0394-A03	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0387	03-0394-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0388	03-0394-A05	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0389	03-0394-A06	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0390	03-0394-A07	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0393	26-GMS-Lab-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0394	26-C2CNTWest-A05	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0395	26-GMS Tower-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0396	26-HQBuilding-A06	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0408	0316-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0409	0120-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0410	3090-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0411	6010-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0412	6009-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0414	03-0328-A02	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0418	03-0328-A03	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0419	0311-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0433	0120-02	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0434	0120-03	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0435	BSS-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0436	LWE-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0437	UTF-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Hexamethylene diisocyanate **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0499	2202-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0500	3660-01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0503	Bldg 120 - Gen. #1	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0504	Bldg 120 - Gen. #2	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0510	Bldg 5016 - pending	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0511	Bldg 5046 - pending	0.00E+00	0.00E+00	0.00E+00
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**1.10E-01**	**1.43E+01**	**1.31E+01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Hydrochloric acid **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.60E-07	1.75E-06	7.30E-08
Fuel Oil Boiler 4-0689	26-0642-A01	4.03E-04	4.43E-03	1.85E-04
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	2.28E-04	2.51E-03	1.05E-04
Fuel Oil Boiler 4-0708	26-0394-A01	9.38E-04	1.03E-02	4.30E-04
Fuel Oil Boiler 4-0709	26-0392-A01	2.77E-04	1.52E-03	6.31E-05
Fuel Oil Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0719	26-0670-A01	3.02E-04	3.31E-03	1.38E-04
Fuel Oil Boiler 4-0720	26-0688-A01	6.62E-05	7.28E-04	3.03E-05
Fuel Oil Boiler 4-0722	26-0449-A01	2.58E-04	2.84E-03	1.18E-04
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	1.61E-02	8.82E-02	3.68E-03
Dual Fuel Boiler 5-0080	26-0345-A02	1.61E-02	8.82E-02	3.68E-03
Dual Fuel Boiler 5-0081	26-0345-A03	1.61E-02	8.82E-02	3.68E-03
Dual Fuel Boiler 5-0085	26-4600-A06	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0087	26-4600-A08	2.30E-03	1.26E-02	5.25E-04
Dual Fuel Boiler 5-0152	26-3326-A02	1.13E-07	1.24E-06	5.16E-08
Dual Fuel Boiler 5-0167	26-03062-A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	1.15E-08	1.27E-07	5.28E-09
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	3.60E-09	3.95E-08	1.65E-09
Dual Fuel Boiler 5-0300	26-HQ Building-A01	1.51E-08	1.66E-07	6.90E-09
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	1.25E-08	1.37E-07	5.73E-09
Dual Fuel Boiler 5-0308	26-04219-A03	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Hydrochloric acid **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0310	26-5100-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0315	26-0525-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0322	26-2202-A01	5.04E-09	5.54E-08	2.31E-09
Dual Fuel Boiler 5-0334	26-0525-A03	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0335	26-0525-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0336	26-04119-A03	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0337	26-0459-A02	0.00E+00	0.00E+00	0.00E+00
Propane Boiler 5-0352	0367-A01	1.69E-04	1.86E-03	7.75E-05
Dual Fuel Boiler 5-0364	26-4312-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0364	26-4312-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0367	26-2485-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0370	26-4600-A09	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0371	26-3660-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0376	0383A-A01 & A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0552	26-04219-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	4.41E-02	7.34E+00	1.80E+00
Emergency Generator 9-0228	03-0394-A02	5.04E-02	8.39E+00	1.80E+00
Emergency Generator 9-0229	03-0328-A01	3.16E-02	5.27E+00	1.44E+00
Emergency Generator 9-0276	03-4600-A04	3.44E-02	5.73E+00	2.52E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Hydrochloric acid **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	3.46E-02	5.77E+00	2.52E+00
Emergency Generator 9-0386	03-0394-A03	3.02E-02	5.03E+00	1.01E+00
Emergency Generator 9-0387	03-0394-A04	2.16E-02	3.60E+00	1.01E+00
Emergency Generator 9-0388	03-0394-A05	1.01E-03	1.68E-01	1.01E+00
Emergency Generator 9-0389	03-0394-A06	3.02E-02	5.03E+00	1.01E+00
Emergency Generator 9-0390	03-0394-A07	2.36E-02	3.94E+00	1.01E+00
Emergency Generator 9-0393	26-GMS-Lab-A04	2.03E-02	3.38E+00	5.07E+00
Emergency Generator 9-0394	26-C2CNTWest-A05	2.95E-03	4.92E-01	2.95E+00
Emergency Generator 9-0395	26-GMS Tower-A04	2.95E-03	4.92E-01	2.95E+00
Emergency Generator 9-0396	26-HQBuilding-A06	7.84E-03	1.31E+00	3.92E+00
Emergency Generator 9-0408	0316-01	2.35E-02	3.92E+00	3.92E+00
Emergency Generator 9-0409	0120-01	2.74E-02	4.57E+00	3.92E+00
Emergency Generator 9-0410	3090-01	6.96E-02	1.16E+01	3.92E+00
Emergency Generator 9-0411	6010-01	7.88E-08	1.31E-05	1.43E-05
Emergency Generator 9-0412	6009-01	9.57E-03	1.59E+00	2.01E+00
Emergency Generator 9-0414	03-0328-A02	6.30E-03	1.05E+00	8.99E-01
Emergency Generator 9-0418	03-0328-A03	5.94E-03	9.89E-01	1.08E+00
Emergency Generator 9-0419	0311-01	4.23E-03	7.04E-01	8.05E-01
Emergency Generator 9-0433	0120-02	3.65E-02	6.08E+00	3.92E+00
Emergency Generator 9-0434	0120-03	2.55E-02	4.25E+00	3.92E+00
Emergency Generator 9-0435	BSS-01	2.89E-01	7.61E+00	8.05E-01
Emergency Generator 9-0436	LWE-01	3.81E-07	2.72E-05	7.47E-06
Emergency Generator 9-0437	UTF-01	8.24E-03	1.18E+00	6.71E-01
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	6.84E-03	1.14E+00	1.01E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Hydrochloric acid **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	6.60E-03	1.10E+00	8.62E-01
Emergency Generator 9-0503	Bldg 120 - Gen. #1	2.68E-02	4.47E+00	3.92E+00
Emergency Generator 9-0504	Bldg 120 - Gen. #2	2.57E-02	4.28E+00	3.92E+00
Emergency Generator 9-0510	Bldg 5016 - pending	8.97E-03	1.49E+00	3.15E+00
Emergency Generator 9-0511	Bldg 5046 - pending	2.77E-03	4.62E-01	8.28E-01
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**9.73E-01**	**1.13E+02**	**6.96E+01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Lead **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	6.05E-04	6.65E-03	2.77E-04
Fuel Oil Boiler 4-0689	26-0642-A01	1.80E-05	1.97E-04	8.23E-06
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	1.02E-05	1.12E-04	4.66E-06
Fuel Oil Boiler 4-0708	26-0394-A01	4.18E-05	4.59E-04	1.91E-05
Fuel Oil Boiler 4-0709	26-0392-A01	1.23E-05	6.75E-05	2.81E-06
Fuel Oil Boiler 5-0710	0339-A01	1.93E-07	2.12E-06	8.82E-08
Fuel Oil Boiler 4-0719	26-0670-A01	1.34E-05	1.48E-04	6.15E-06
Fuel Oil Boiler 4-0720	26-0688-A01	2.95E-06	3.24E-05	1.35E-06
Fuel Oil Boiler 4-0722	26-0449-A01	1.15E-05	1.26E-04	5.27E-06
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	7.23E-04	3.96E-03	1.65E-04
Dual Fuel Boiler 5-0080	26-0345-A02	7.23E-04	3.96E-03	1.65E-04
Dual Fuel Boiler 5-0081	26-0345-A03	7.23E-04	3.96E-03	1.65E-04
Dual Fuel Boiler 5-0085	26-4600-A06	6.18E-06	3.38E-05	1.41E-06
Dual Fuel Boiler 5-0087	26-4600-A08	1.09E-04	5.96E-04	2.48E-05
Dual Fuel Boiler 5-0152	26-3326-A02	5.93E-05	6.51E-04	2.71E-05
Dual Fuel Boiler 5-0167	26-03062-A02	8.69E-07	4.76E-06	1.98E-07
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	3.20E-06	3.52E-05	1.47E-06
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	9.99E-07	1.10E-05	4.58E-07
Dual Fuel Boiler 5-0300	26-HQ Building-A01	4.44E-06	4.88E-05	2.03E-06
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	3.47E-06	3.82E-05	1.59E-06
Dual Fuel Boiler 5-0308	26-04219-A03	3.38E-07	1.85E-06	7.72E-08

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Lead **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	1.23E-06	1.35E-05	5.64E-07
Natural Gas Boiler 5-0310	26-5100-A01	1.23E-06	1.35E-05	5.64E-07
Dual Fuel Boiler 5-0315	26-0525-A02	9.66E-07	1.06E-05	4.42E-07
Natural Gas Boiler 5-0322	26-2202-A01	1.40E-06	1.54E-05	6.41E-07
Dual Fuel Boiler 5-0334	26-0525-A03	9.66E-07	1.06E-05	4.42E-07
Dual Fuel Boiler 5-0335	26-0525-A01	9.66E-07	1.06E-05	4.42E-07
Natural Gas Boiler 5-0336	26-04119-A03	6.00E-07	6.59E-06	2.75E-07
Natural Gas Boiler 5-0337	26-0459-A02	2.68E-07	2.95E-06	1.23E-07
Propane Boiler 5-0352	0367-A01	7.54E-06	8.28E-05	3.45E-06
Dual Fuel Boiler 5-0364	26-4312-A01	7.36E-07	4.03E-06	1.68E-07
Dual Fuel Boiler 5-0364	26-4312-A02	7.36E-07	4.03E-06	1.68E-07
Natural Gas Boiler 5-0367	26-2485-A01	2.93E-07	3.22E-06	1.34E-07
Dual Fuel Boiler 5-0370	26-4600-A09	6.18E-06	3.38E-05	1.41E-06
Natural Gas Boiler 5-0371	26-3660-A01	2.75E-07	3.02E-06	1.26E-07
Natural Gas Boiler 5-0376	0383A-A01 & A02	1.04E-06	1.15E-05	4.78E-07
Dual Fuel Boiler 5-0552	26-04219-A02	3.38E-07	1.85E-06	7.72E-08
Natural Gas Boiler 5-0710	0339-A01	1.93E-07	2.12E-06	8.82E-08
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	1.96E-03	3.27E-01	8.01E-02
Emergency Generator 9-0228	03-0394-A02	2.24E-03	3.74E-01	8.01E-02
Emergency Generator 9-0229	03-0328-A01	1.41E-03	2.35E-01	6.41E-02
Emergency Generator 9-0276	03-4600-A04	1.53E-03	2.55E-01	1.12E-01

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Lead **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	1.54E-03	2.57E-01	1.12E-01
Emergency Generator 9-0386	03-0394-A03	1.34E-03	2.24E-01	4.48E-02
Emergency Generator 9-0387	03-0394-A04	9.64E-04	1.61E-01	4.48E-02
Emergency Generator 9-0388	03-0394-A05	4.48E-05	7.47E-03	4.48E-02
Emergency Generator 9-0389	03-0394-A06	1.34E-03	2.24E-01	4.48E-02
Emergency Generator 9-0390	03-0394-A07	1.05E-03	1.76E-01	4.48E-02
Emergency Generator 9-0393	26-GMS-Lab-A04	9.03E-04	1.51E-01	2.26E-01
Emergency Generator 9-0394	26-C2CNTWest-A05	1.31E-04	2.19E-02	1.31E-01
Emergency Generator 9-0395	26-GMS Tower-A04	1.31E-04	2.19E-02	1.31E-01
Emergency Generator 9-0396	26-HQBuilding-A06	3.49E-04	5.82E-02	1.75E-01
Emergency Generator 9-0408	0316-01	1.05E-03	1.75E-01	1.75E-01
Emergency Generator 9-0409	0120-01	1.22E-03	2.04E-01	1.75E-01
Emergency Generator 9-0410	3090-01	3.10E-03	5.17E-01	1.75E-01
Emergency Generator 9-0411	6010-01	1.58E-03	2.63E-01	2.87E-01
Emergency Generator 9-0412	6009-01	4.26E-04	7.11E-02	8.98E-02
Emergency Generator 9-0414	03-0328-A02	2.80E-04	4.67E-02	4.01E-02
Emergency Generator 9-0418	03-0328-A03	2.64E-04	4.41E-02	4.81E-02
Emergency Generator 9-0419	0311-01	1.88E-04	3.14E-02	3.59E-02
Emergency Generator 9-0433	0120-02	1.62E-03	2.71E-01	1.75E-01
Emergency Generator 9-0434	0120-03	1.14E-03	1.89E-01	1.75E-01
Emergency Generator 9-0435	BSS-01	1.29E-02	3.39E-01	3.59E-02
Emergency Generator 9-0436	LWE-01	8.43E-03	6.02E-01	1.65E-01
Emergency Generator 9-0437	UTF-01	3.67E-04	5.24E-02	2.99E-02
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	3.05E-04	5.08E-02	4.51E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Lead **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	2.94E-04	4.90E-02	3.84E-02
Emergency Generator 9-0503	Bldg 120 - Gen. #1	1.20E-03	1.99E-01	1.75E-01
Emergency Generator 9-0504	Bldg 120 - Gen. #2	1.14E-03	1.91E-01	1.75E-01
Emergency Generator 9-0510	Bldg 5016 - pending	4.00E-04	6.66E-02	1.40E-01
Emergency Generator 9-0511	Bldg 5046 - pending	1.24E-04	2.06E-02	3.69E-02
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**5.41E-02**	**5.90E+00**	**3.55E+00**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Manganese **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	2.27E-04	2.49E-03	1.04E-04
Fuel Oil Boiler 4-0689	26-0642-A01	6.71E-06	7.38E-05	3.07E-06
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	3.80E-06	4.18E-05	1.74E-06
Fuel Oil Boiler 4-0708	26-0394-A01	1.56E-05	1.72E-04	7.15E-06
Fuel Oil Boiler 4-0709	26-0392-A01	4.60E-06	2.52E-05	1.05E-06
Fuel Oil Boiler 5-0710	0339-A01	1.46E-07	1.61E-06	6.70E-08
Fuel Oil Boiler 4-0719	26-0670-A01	5.02E-06	5.51E-05	2.30E-06
Fuel Oil Boiler 4-0720	26-0688-A01	1.10E-06	1.21E-05	5.05E-07
Fuel Oil Boiler 4-0722	26-0449-A01	4.30E-06	4.72E-05	1.97E-06
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	2.72E-04	1.49E-03	6.21E-05
Dual Fuel Boiler 5-0080	26-0345-A02	2.72E-04	1.49E-03	6.21E-05
Dual Fuel Boiler 5-0081	26-0345-A03	2.72E-04	1.49E-03	6.21E-05
Dual Fuel Boiler 5-0085	26-4600-A06	4.69E-06	2.57E-05	1.07E-06
Dual Fuel Boiler 5-0087	26-4600-A08	4.30E-05	2.36E-04	9.81E-06
Dual Fuel Boiler 5-0152	26-3326-A02	3.34E-05	3.67E-04	1.53E-05
Dual Fuel Boiler 5-0167	26-03062-A02	6.61E-07	3.62E-06	1.51E-07
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	2.43E-06	2.67E-05	1.11E-06
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	7.59E-07	8.35E-06	3.48E-07
Dual Fuel Boiler 5-0300	26-HQ Building-A01	3.27E-06	3.59E-05	1.50E-06
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	2.64E-06	2.90E-05	1.21E-06
Dual Fuel Boiler 5-0308	26-04219-A03	2.57E-07	1.41E-06	5.87E-08

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Manganese **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	9.37E-07	1.03E-05	4.29E-07
Natural Gas Boiler 5-0310	26-5100-A01	9.37E-07	1.03E-05	4.29E-07
Dual Fuel Boiler 5-0315	26-0525-A02	7.34E-07	8.07E-06	3.36E-07
Natural Gas Boiler 5-0322	26-2202-A01	1.06E-06	1.17E-05	4.87E-07
Dual Fuel Boiler 5-0334	26-0525-A03	7.34E-07	8.07E-06	3.36E-07
Dual Fuel Boiler 5-0335	26-0525-A01	7.34E-07	8.07E-06	3.36E-07
Natural Gas Boiler 5-0336	26-04119-A03	4.56E-07	5.01E-06	2.09E-07
Natural Gas Boiler 5-0337	26-0459-A02	2.04E-07	2.24E-06	9.34E-08
Propane Boiler 5-0352	0367-A01	2.81E-06	3.09E-05	1.29E-06
Dual Fuel Boiler 5-0364	26-4312-A01	5.60E-07	3.07E-06	1.28E-07
Dual Fuel Boiler 5-0364	26-4312-A02	5.60E-07	3.07E-06	1.28E-07
Natural Gas Boiler 5-0367	26-2485-A01	2.23E-07	2.45E-06	1.02E-07
Dual Fuel Boiler 5-0370	26-4600-A09	4.69E-06	2.57E-05	1.07E-06
Natural Gas Boiler 5-0371	26-3660-A01	2.09E-07	2.30E-06	9.56E-08
Natural Gas Boiler 5-0376	0383A-A01 & A02	7.94E-07	8.72E-06	3.63E-07
Dual Fuel Boiler 5-0552	26-04219-A02	2.57E-07	1.41E-06	5.87E-08
Natural Gas Boiler 5-0710	0339-A01	1.46E-07	1.61E-06	6.70E-08
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	7.33E-04	1.22E-01	2.99E-02
Emergency Generator 9-0228	03-0394-A02	8.38E-04	1.40E-01	2.99E-02
Emergency Generator 9-0229	03-0328-A01	5.26E-04	8.77E-02	2.39E-02
Emergency Generator 9-0276	03-4600-A04	5.72E-04	9.53E-02	4.19E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Manganese **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	5.76E-04	9.60E-02	4.19E-02
Emergency Generator 9-0386	03-0394-A03	5.02E-04	8.37E-02	1.67E-02
Emergency Generator 9-0387	03-0394-A04	3.60E-04	6.00E-02	1.67E-02
Emergency Generator 9-0388	03-0394-A05	1.67E-05	2.79E-03	1.67E-02
Emergency Generator 9-0389	03-0394-A06	5.02E-04	8.37E-02	1.67E-02
Emergency Generator 9-0390	03-0394-A07	3.93E-04	6.56E-02	1.67E-02
Emergency Generator 9-0393	26-GMS-Lab-A04	3.37E-04	5.62E-02	8.43E-02
Emergency Generator 9-0394	26-C2CNTWest-A05	4.91E-05	8.18E-03	4.91E-02
Emergency Generator 9-0395	26-GMS Tower-A04	4.91E-05	8.18E-03	4.91E-02
Emergency Generator 9-0396	26-HQBuilding-A06	1.30E-04	2.17E-02	6.52E-02
Emergency Generator 9-0408	0316-01	3.91E-04	6.52E-02	6.52E-02
Emergency Generator 9-0409	0120-01	4.57E-04	7.61E-02	6.52E-02
Emergency Generator 9-0410	3090-01	1.16E-03	1.93E-01	6.52E-02
Emergency Generator 9-0411	6010-01	5.90E-04	9.83E-02	1.07E-01
Emergency Generator 9-0412	6009-01	1.59E-04	2.65E-02	3.35E-02
Emergency Generator 9-0414	03-0328-A02	1.05E-04	1.75E-02	1.50E-02
Emergency Generator 9-0418	03-0328-A03	9.88E-05	1.65E-02	1.80E-02
Emergency Generator 9-0419	0311-01	7.03E-05	1.17E-02	1.34E-02
Emergency Generator 9-0433	0120-02	6.07E-04	1.01E-01	6.52E-02
Emergency Generator 9-0434	0120-03	4.24E-04	7.07E-02	6.52E-02
Emergency Generator 9-0435	BSS-01	4.81E-03	1.27E-01	1.34E-02
Emergency Generator 9-0436	LWE-01	3.15E-03	2.25E-01	6.17E-02
Emergency Generator 9-0437	UTF-01	1.37E-04	1.96E-02	1.12E-02
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	1.14E-04	1.90E-02	1.69E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Manganese **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	1.10E-04	1.83E-02	1.44E-02
Emergency Generator 9-0503	Bldg 120 - Gen. #1	4.47E-04	7.45E-02	6.52E-02
Emergency Generator 9-0504	Bldg 120 - Gen. #2	4.27E-04	7.12E-02	6.52E-02
Emergency Generator 9-0510	Bldg 5016 - pending	1.49E-04	2.49E-02	5.24E-02
Emergency Generator 9-0511	Bldg 5046 - pending	4.61E-05	7.69E-03	1.38E-02
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**2.02E-02**	**2.20E+00**	**1.33E+00**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbe correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Mercury **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.46E-04	1.61E-03	6.69E-05
Fuel Oil Boiler 4-0689	26-0642-A01	4.33E-06	4.76E-05	1.98E-06
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	2.45E-06	2.69E-05	1.12E-06
Fuel Oil Boiler 4-0708	26-0394-A01	1.01E-05	1.11E-04	4.61E-06
Fuel Oil Boiler 4-0709	26-0392-A01	2.97E-06	1.63E-05	6.78E-07
Fuel Oil Boiler 5-0710	0339-A01	1.00E-07	1.10E-06	4.59E-08
Fuel Oil Boiler 4-0719	26-0670-A01	3.24E-06	3.56E-05	1.48E-06
Fuel Oil Boiler 4-0720	26-0688-A01	7.11E-07	7.81E-06	3.26E-07
Fuel Oil Boiler 4-0722	26-0449-A01	2.77E-06	3.05E-05	1.27E-06
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	1.76E-04	9.62E-04	4.01E-05
Dual Fuel Boiler 5-0080	26-0345-A02	1.76E-04	9.62E-04	4.01E-05
Dual Fuel Boiler 5-0081	26-0345-A03	1.76E-04	9.62E-04	4.01E-05
Dual Fuel Boiler 5-0085	26-4600-A06	3.21E-06	1.76E-05	7.33E-07
Dual Fuel Boiler 5-0087	26-4600-A08	2.79E-05	1.53E-04	6.37E-06
Dual Fuel Boiler 5-0152	26-3326-A02	2.24E-05	2.46E-04	1.03E-05
Dual Fuel Boiler 5-0167	26-03062-A02	4.52E-07	2.48E-06	1.03E-07
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	1.66E-06	1.83E-05	7.62E-07
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	5.20E-07	5.71E-06	2.38E-07
Dual Fuel Boiler 5-0300	26-HQ Building-A01	2.23E-06	2.45E-05	1.02E-06
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	1.81E-06	1.98E-05	8.27E-07
Dual Fuel Boiler 5-0308	26-04219-A03	1.76E-07	9.64E-07	4.02E-08

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Mercury **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	6.41E-07	7.04E-06	2.93E-07
Natural Gas Boiler 5-0310	26-5100-A01	6.41E-07	7.04E-06	2.93E-07
Dual Fuel Boiler 5-0315	26-0525-A02	5.02E-07	5.52E-06	2.30E-07
Natural Gas Boiler 5-0322	26-2202-A01	7.28E-07	8.00E-06	3.33E-07
Dual Fuel Boiler 5-0334	26-0525-A03	5.02E-07	5.52E-06	2.30E-07
Dual Fuel Boiler 5-0335	26-0525-A01	5.02E-07	5.52E-06	2.30E-07
Natural Gas Boiler 5-0336	26-04119-A03	3.12E-07	3.43E-06	1.43E-07
Natural Gas Boiler 5-0337	26-0459-A02	1.40E-07	1.53E-06	6.39E-08
Propane Boiler 5-0352	0367-A01	1.82E-06	2.00E-05	8.32E-07
Dual Fuel Boiler 5-0364	26-4312-A01	3.83E-07	2.10E-06	8.74E-08
Dual Fuel Boiler 5-0364	26-4312-A02	3.83E-07	2.10E-06	8.74E-08
Natural Gas Boiler 5-0367	26-2485-A01	1.52E-07	1.67E-06	6.98E-08
Dual Fuel Boiler 5-0370	26-4600-A09	3.21E-06	1.76E-05	7.33E-07
Natural Gas Boiler 5-0371	26-3660-A01	1.43E-07	1.57E-06	6.54E-08
Natural Gas Boiler 5-0376	0383A-A01 & A02	5.43E-07	5.97E-06	2.49E-07
Dual Fuel Boiler 5-0552	26-04219-A02	1.76E-07	9.64E-07	4.02E-08
Natural Gas Boiler 5-0710	0339-A01	1.00E-07	1.10E-06	4.59E-08
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	4.73E-04	7.89E-02	1.93E-02
Emergency Generator 9-0228	03-0394-A02	5.41E-04	9.01E-02	1.93E-02
Emergency Generator 9-0229	03-0328-A01	3.40E-04	5.66E-02	1.54E-02
Emergency Generator 9-0276	03-4600-A04	3.69E-04	6.15E-02	2.70E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Mercury **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	3.72E-04	6.19E-02	2.70E-02
Emergency Generator 9-0386	03-0394-A03	3.24E-04	5.40E-02	1.08E-02
Emergency Generator 9-0387	03-0394-A04	2.32E-04	3.87E-02	1.08E-02
Emergency Generator 9-0388	03-0394-A05	1.08E-05	1.80E-03	1.08E-02
Emergency Generator 9-0389	03-0394-A06	3.24E-04	5.40E-02	1.08E-02
Emergency Generator 9-0390	03-0394-A07	2.54E-04	4.23E-02	1.08E-02
Emergency Generator 9-0393	26-GMS-Lab-A04	2.18E-04	3.63E-02	5.44E-02
Emergency Generator 9-0394	26-C2CNTWest-A05	3.17E-05	5.28E-03	3.17E-02
Emergency Generator 9-0395	26-GMS Tower-A04	3.17E-05	5.28E-03	3.17E-02
Emergency Generator 9-0396	26-HQBuilding-A06	8.42E-05	1.40E-02	4.21E-02
Emergency Generator 9-0408	0316-01	2.52E-04	4.21E-02	4.21E-02
Emergency Generator 9-0409	0120-01	2.95E-04	4.91E-02	4.21E-02
Emergency Generator 9-0410	3090-01	7.47E-04	1.25E-01	4.21E-02
Emergency Generator 9-0411	6010-01	3.81E-04	6.34E-02	6.92E-02
Emergency Generator 9-0412	6009-01	1.03E-04	1.71E-02	2.16E-02
Emergency Generator 9-0414	03-0328-A02	6.76E-05	1.13E-02	9.66E-03
Emergency Generator 9-0418	03-0328-A03	6.37E-05	1.06E-02	1.16E-02
Emergency Generator 9-0419	0311-01	4.54E-05	7.56E-03	8.64E-03
Emergency Generator 9-0433	0120-02	3.91E-04	6.52E-02	4.21E-02
Emergency Generator 9-0434	0120-03	2.73E-04	4.56E-02	4.21E-02
Emergency Generator 9-0435	BSS-01	3.10E-03	8.17E-02	8.64E-03
Emergency Generator 9-0436	LWE-01	2.03E-03	1.45E-01	3.98E-02
Emergency Generator 9-0437	UTF-01	8.85E-05	1.26E-02	7.20E-03
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	7.34E-05	1.22E-02	1.09E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Mercury **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	7.08E-05	1.18E-02	9.26E-03
Emergency Generator 9-0503	Bldg 120 - Gen. #1	2.88E-04	4.80E-02	4.21E-02
Emergency Generator 9-0504	Bldg 120 - Gen. #2	2.76E-04	4.59E-02	4.21E-02
Emergency Generator 9-0510	Bldg 5016 - pending	9.63E-05	1.60E-02	3.38E-02
Emergency Generator 9-0511	Bldg 5046 - pending	2.98E-05	4.96E-03	8.88E-03
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**1.31E-02**	**1.42E+00**	**8.56E-01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Nickel **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	2.88E-04	3.17E-03	1.32E-04
Fuel Oil Boiler 4-0689	26-0642-A01	8.44E-06	9.28E-05	3.87E-06
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	4.78E-06	5.25E-05	2.19E-06
Fuel Oil Boiler 4-0708	26-0394-A01	1.96E-05	2.16E-04	8.99E-06
Fuel Oil Boiler 4-0709	26-0392-A01	5.79E-06	3.17E-05	1.32E-06
Fuel Oil Boiler 5-0710	0339-A01	8.09E-07	8.89E-06	3.71E-07
Fuel Oil Boiler 4-0719	26-0670-A01	6.31E-06	6.94E-05	2.89E-06
Fuel Oil Boiler 4-0720	26-0688-A01	1.39E-06	1.52E-05	6.35E-07
Fuel Oil Boiler 4-0722	26-0449-A01	5.41E-06	5.94E-05	2.48E-06
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	3.59E-04	1.97E-03	8.21E-05
Dual Fuel Boiler 5-0080	26-0345-A02	3.59E-04	1.97E-03	8.21E-05
Dual Fuel Boiler 5-0081	26-0345-A03	3.59E-04	1.97E-03	8.21E-05
Dual Fuel Boiler 5-0085	26-4600-A06	2.59E-05	1.42E-04	5.92E-06
Dual Fuel Boiler 5-0087	26-4600-A08	7.41E-05	4.06E-04	1.69E-05
Dual Fuel Boiler 5-0152	26-3326-A02	1.37E-04	1.50E-03	6.25E-05
Dual Fuel Boiler 5-0167	26-03062-A02	3.65E-06	2.00E-05	8.34E-07
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	1.34E-05	1.48E-04	6.16E-06
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	4.20E-06	4.61E-05	1.92E-06
Dual Fuel Boiler 5-0300	26-HQ Building-A01	1.76E-05	1.94E-04	8.07E-06
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	1.46E-05	1.60E-04	6.68E-06
Dual Fuel Boiler 5-0308	26-04219-A03	1.42E-06	7.78E-06	3.24E-07

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Nickel **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	5.18E-06	5.69E-05	2.37E-06
Natural Gas Boiler 5-0310	26-5100-A01	5.18E-06	5.69E-05	2.37E-06
Dual Fuel Boiler 5-0315	26-0525-A02	4.06E-06	4.46E-05	1.86E-06
Natural Gas Boiler 5-0322	26-2202-A01	5.88E-06	6.46E-05	2.69E-06
Dual Fuel Boiler 5-0334	26-0525-A03	4.06E-06	4.46E-05	1.86E-06
Dual Fuel Boiler 5-0335	26-0525-A01	4.06E-06	4.46E-05	1.86E-06
Natural Gas Boiler 5-0336	26-04119-A03	2.52E-06	2.77E-05	1.15E-06
Natural Gas Boiler 5-0337	26-0459-A02	1.13E-06	1.24E-05	5.16E-07
Propane Boiler 5-0352	0367-A01	3.54E-06	3.89E-05	1.62E-06
Dual Fuel Boiler 5-0364	26-4312-A01	3.09E-06	1.69E-05	7.06E-07
Dual Fuel Boiler 5-0364	26-4312-A02	3.09E-06	1.69E-05	7.06E-07
Natural Gas Boiler 5-0367	26-2485-A01	1.23E-06	1.35E-05	5.64E-07
Dual Fuel Boiler 5-0370	26-4600-A09	2.59E-05	1.42E-04	5.92E-06
Natural Gas Boiler 5-0371	26-3660-A01	1.15E-06	1.27E-05	5.29E-07
Natural Gas Boiler 5-0376	0383A-A01 & A02	4.39E-06	4.82E-05	2.01E-06
Dual Fuel Boiler 5-0552	26-04219-A02	1.42E-06	7.78E-06	3.24E-07
Natural Gas Boiler 5-0710	0339-A01	8.09E-07	8.89E-06	3.71E-07
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	9.23E-04	1.54E-01	3.77E-02
Emergency Generator 9-0228	03-0394-A02	1.05E-03	1.76E-01	3.77E-02
Emergency Generator 9-0229	03-0328-A01	6.62E-04	1.10E-01	3.01E-02
Emergency Generator 9-0276	03-4600-A04	7.19E-04	1.20E-01	5.27E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Nickel **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	7.25E-04	1.21E-01	5.27E-02
Emergency Generator 9-0386	03-0394-A03	6.32E-04	1.05E-01	2.11E-02
Emergency Generator 9-0387	03-0394-A04	4.53E-04	7.55E-02	2.11E-02
Emergency Generator 9-0388	03-0394-A05	2.11E-05	3.51E-03	2.11E-02
Emergency Generator 9-0389	03-0394-A06	6.32E-04	1.05E-01	2.11E-02
Emergency Generator 9-0390	03-0394-A07	4.95E-04	8.25E-02	2.11E-02
Emergency Generator 9-0393	26-GMS-Lab-A04	4.24E-04	7.07E-02	1.06E-01
Emergency Generator 9-0394	26-C2CNTWest-A05	6.18E-05	1.03E-02	6.18E-02
Emergency Generator 9-0395	26-GMS Tower-A04	6.18E-05	1.03E-02	6.18E-02
Emergency Generator 9-0396	26-HQBuilding-A06	1.64E-04	2.73E-02	8.20E-02
Emergency Generator 9-0408	0316-01	4.92E-04	8.20E-02	8.20E-02
Emergency Generator 9-0409	0120-01	5.74E-04	9.57E-02	8.20E-02
Emergency Generator 9-0410	3090-01	1.46E-03	2.43E-01	8.21E-02
Emergency Generator 9-0411	6010-01	7.42E-04	1.24E-01	1.35E-01
Emergency Generator 9-0412	6009-01	2.00E-04	3.34E-02	4.22E-02
Emergency Generator 9-0414	03-0328-A02	1.32E-04	2.20E-02	1.88E-02
Emergency Generator 9-0418	03-0328-A03	1.24E-04	2.07E-02	2.26E-02
Emergency Generator 9-0419	0311-01	8.85E-05	1.47E-02	1.68E-02
Emergency Generator 9-0433	0120-02	7.63E-04	1.27E-01	8.20E-02
Emergency Generator 9-0434	0120-03	5.33E-04	8.89E-02	8.20E-02
Emergency Generator 9-0435	BSS-01	6.05E-03	1.59E-01	1.68E-02
Emergency Generator 9-0436	LWE-01	3.96E-03	2.83E-01	7.77E-02
Emergency Generator 9-0437	UTF-01	1.72E-04	2.46E-02	1.40E-02
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	1.43E-04	2.39E-02	2.12E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Nickel **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	1.38E-04	2.30E-02	1.81E-02
Emergency Generator 9-0503	Bldg 120 - Gen. #1	5.62E-04	9.37E-02	8.20E-02
Emergency Generator 9-0504	Bldg 120 - Gen. #2	5.37E-04	8.96E-02	8.20E-02
Emergency Generator 9-0510	Bldg 5016 - pending	1.88E-04	3.13E-02	6.59E-02
Emergency Generator 9-0511	Bldg 5046 - pending	5.80E-05	9.67E-03	1.73E-02
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**2.57E-02**	**2.77E+00**	**1.67E+00**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Selenium **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.60E-04	1.76E-03	7.34E-05
Fuel Oil Boiler 4-0689	26-0642-A01	4.76E-06	5.23E-05	2.18E-06
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	2.70E-06	2.96E-05	1.23E-06
Fuel Oil Boiler 4-0708	26-0394-A01	1.11E-05	1.22E-04	5.07E-06
Fuel Oil Boiler 4-0709	26-0392-A01	3.27E-06	1.79E-05	7.46E-07
Fuel Oil Boiler 5-0710	0339-A01	9.25E-09	1.02E-07	4.23E-09
Fuel Oil Boiler 4-0719	26-0670-A01	3.56E-06	3.91E-05	1.63E-06
Fuel Oil Boiler 4-0720	26-0688-A01	7.82E-07	8.59E-06	3.58E-07
Fuel Oil Boiler 4-0722	26-0449-A01	3.05E-06	3.35E-05	1.40E-06
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	1.90E-04	1.04E-03	4.35E-05
Dual Fuel Boiler 5-0080	26-0345-A02	1.90E-04	1.04E-03	4.35E-05
Dual Fuel Boiler 5-0081	26-0345-A03	1.90E-04	1.04E-03	4.35E-05
Dual Fuel Boiler 5-0085	26-4600-A06	2.96E-07	1.62E-06	6.77E-08
Dual Fuel Boiler 5-0087	26-4600-A08	2.75E-05	1.51E-04	6.27E-06
Dual Fuel Boiler 5-0152	26-3326-A02	9.39E-06	1.03E-04	4.30E-06
Dual Fuel Boiler 5-0167	26-03062-A02	4.17E-08	2.29E-07	9.53E-09
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	1.54E-07	1.69E-06	7.04E-08
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	4.80E-08	5.27E-07	2.20E-08
Dual Fuel Boiler 5-0300	26-HQ Building-A01	2.73E-07	3.00E-06	1.25E-07
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	1.67E-07	1.83E-06	7.63E-08
Dual Fuel Boiler 5-0308	26-04219-A03	1.62E-08	8.90E-08	3.71E-09
Natural Gas Boiler 5-0309	26-5100-A02	5.92E-08	6.50E-07	2.71E-08

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Selenium **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0310	26-5100-A01	5.92E-08	6.50E-07	2.71E-08
Dual Fuel Boiler 5-0315	26-0525-A02	4.64E-08	5.10E-07	2.12E-08
Natural Gas Boiler 5-0322	26-2202-A01	6.72E-08	7.39E-07	3.08E-08
Dual Fuel Boiler 5-0334	26-0525-A03	4.64E-08	5.10E-07	2.12E-08
Dual Fuel Boiler 5-0335	26-0525-A01	4.64E-08	5.10E-07	2.12E-08
Natural Gas Boiler 5-0336	26-04119-A03	2.88E-08	3.16E-07	1.32E-08
Natural Gas Boiler 5-0337	26-0459-A02	1.29E-08	1.42E-07	5.90E-09
Propane Boiler 5-0352	0367-A01	2.00E-06	2.20E-05	9.15E-07
Dual Fuel Boiler 5-0364	26-4312-A01	3.53E-08	1.94E-07	8.07E-09
Dual Fuel Boiler 5-0364	26-4312-A02	3.53E-08	1.94E-07	8.07E-09
Natural Gas Boiler 5-0367	26-2485-A01	1.41E-08	1.55E-07	6.44E-09
Dual Fuel Boiler 5-0370	26-4600-A09	2.96E-07	1.62E-06	6.77E-08
Natural Gas Boiler 5-0371	26-3660-A01	1.32E-08	1.45E-07	6.04E-09
Natural Gas Boiler 5-0376	0383A-A01 & A02	5.01E-08	5.51E-07	2.30E-08
Dual Fuel Boiler 5-0552	26-04219-A02	1.62E-08	8.90E-08	3.71E-09
Natural Gas Boiler 5-0710	0339-A01	9.25E-09	1.02E-07	4.23E-09
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	5.20E-04	8.67E-02	2.12E-02
Emergency Generator 9-0228	03-0394-A02	5.95E-04	9.91E-02	2.12E-02
Emergency Generator 9-0229	03-0328-A01	3.74E-04	6.23E-02	1.70E-02
Emergency Generator 9-0276	03-4600-A04	4.06E-04	6.76E-02	2.97E-02
Emergency Generator 9-0277	03-4600-A05	4.09E-04	6.81E-02	2.97E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Selenium **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0386	03-0394-A03	3.56E-04	5.94E-02	1.19E-02
Emergency Generator 9-0387	03-0394-A04	2.55E-04	4.26E-02	1.19E-02
Emergency Generator 9-0388	03-0394-A05	1.19E-05	1.98E-03	1.19E-02
Emergency Generator 9-0389	03-0394-A06	3.56E-04	5.94E-02	1.19E-02
Emergency Generator 9-0390	03-0394-A07	2.79E-04	4.65E-02	1.19E-02
Emergency Generator 9-0393	26-GMS-Lab-A04	2.39E-04	3.99E-02	5.98E-02
Emergency Generator 9-0394	26-C2CNTWest-A05	3.48E-05	5.81E-03	3.48E-02
Emergency Generator 9-0395	26-GMS Tower-A04	3.48E-05	5.81E-03	3.48E-02
Emergency Generator 9-0396	26-HQBuilding-A06	9.26E-05	1.54E-02	4.63E-02
Emergency Generator 9-0408	0316-01	2.78E-04	4.63E-02	4.63E-02
Emergency Generator 9-0409	0120-01	3.24E-04	5.40E-02	4.63E-02
Emergency Generator 9-0410	3090-01	8.22E-04	1.37E-01	4.63E-02
Emergency Generator 9-0411	6010-01	4.19E-04	6.98E-02	7.61E-02
Emergency Generator 9-0412	6009-01	1.13E-04	1.88E-02	2.38E-02
Emergency Generator 9-0414	03-0328-A02	7.43E-05	1.24E-02	1.06E-02
Emergency Generator 9-0418	03-0328-A03	7.01E-05	1.17E-02	1.27E-02
Emergency Generator 9-0419	0311-01	4.99E-05	8.32E-03	9.50E-03
Emergency Generator 9-0433	0120-02	4.30E-04	7.17E-02	4.63E-02
Emergency Generator 9-0434	0120-03	3.01E-04	5.01E-02	4.63E-02
Emergency Generator 9-0435	BSS-01	3.41E-03	8.99E-02	9.50E-03
Emergency Generator 9-0436	LWE-01	2.23E-03	1.60E-01	4.38E-02
Emergency Generator 9-0437	UTF-01	9.73E-05	1.39E-02	7.92E-03
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	8.07E-05	1.35E-02	1.20E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Selenium **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0500	3660-01	7.79E-05	1.30E-02	1.02E-02
Emergency Generator 9-0503	Bldg 120 - Gen. #1	3.17E-04	5.28E-02	4.63E-02
Emergency Generator 9-0504	Bldg 120 - Gen. #2	3.03E-04	5.05E-02	4.63E-02
Emergency Generator 9-0510	Bldg 5016 - pending	1.06E-04	1.77E-02	3.72E-02
Emergency Generator 9-0511	Bldg 5046 - pending	0.00E+00	0.00E+00	0.00E+00
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**1.43E-02**	**1.56E+00**	**9.32E-01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Zinc **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.63E-03	1.79E-02	7.47E-04
Fuel Oil Boiler 4-0689	26-0642-A01	4.85E-05	5.33E-04	2.22E-05
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	2.75E-05	3.02E-04	1.26E-05
Fuel Oil Boiler 4-0708	26-0394-A01	1.13E-04	1.24E-03	5.17E-05
Fuel Oil Boiler 4-0709	26-0392-A01	3.32E-05	1.82E-04	7.59E-06
Fuel Oil Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0719	26-0670-A01	3.63E-05	3.98E-04	1.66E-05
Fuel Oil Boiler 4-0720	26-0688-A01	7.96E-06	8.75E-05	3.65E-06
Fuel Oil Boiler 4-0722	26-0449-A01	3.10E-05	3.41E-04	1.42E-05
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	1.94E-03	1.06E-02	4.42E-04
Dual Fuel Boiler 5-0080	26-0345-A02	1.94E-03	1.06E-02	4.42E-04
Dual Fuel Boiler 5-0081	26-0345-A03	1.94E-03	1.06E-02	4.42E-04
Dual Fuel Boiler 5-0085	26-4600-A06	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0087	26-4600-A08	2.77E-04	1.52E-03	6.32E-05
Dual Fuel Boiler 5-0152	26-3326-A02	8.14E-05	8.94E-04	3.73E-05
Dual Fuel Boiler 5-0167	26-03062-A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0300	26-HQ Building-A01	7.39E-07	8.12E-06	3.38E-07
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0308	26-04219-A03	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0309	26-5100-A02	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Zinc **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0310	26-5100-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0315	26-0525-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0322	26-2202-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0334	26-0525-A03	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0335	26-0525-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0336	26-04119-A03	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0337	26-0459-A02	0.00E+00	0.00E+00	0.00E+00
Propane Boiler 5-0352	0367-A01	2.03E-05	2.24E-04	9.31E-06
Dual Fuel Boiler 5-0364	26-4312-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0364	26-4312-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0367	26-2485-A01	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0370	26-4600-A09	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0371	26-3660-A01	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0376	0383A-A01 & A02	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0552	26-04219-A02	0.00E+00	0.00E+00	0.00E+00
Natural Gas Boiler 5-0710	0339-A01	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0159	07-00525-A06	8.11E-06	6.67E-03	6.32E-03
Paint Spray Booth 6-0162	07-00525-A04	2.36E-05	8.11E-03	7.21E-03
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A04	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	5.30E-03	8.83E-01	2.16E-01
Emergency Generator 9-0228	03-0394-A02	6.06E-03	1.01E+00	2.16E-01
Emergency Generator 9-0229	03-0328-A01	3.80E-03	6.34E-01	1.73E-01
Emergency Generator 9-0276	03-4600-A04	4.13E-03	6.89E-01	3.03E-01

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Zinc **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0277	03-4600-A05	4.16E-03	6.94E-01	3.03E-01
Emergency Generator 9-0386	03-0394-A03	3.63E-03	6.05E-01	1.21E-01
Emergency Generator 9-0387	03-0394-A04	2.60E-03	4.33E-01	1.21E-01
Emergency Generator 9-0388	03-0394-A05	1.21E-04	2.02E-02	1.21E-01
Emergency Generator 9-0389	03-0394-A06	3.63E-03	6.05E-01	1.21E-01
Emergency Generator 9-0390	03-0394-A07	2.84E-03	4.74E-01	1.21E-01
Emergency Generator 9-0393	26-GMS-Lab-A04	2.44E-03	4.06E-01	6.09E-01
Emergency Generator 9-0394	26-C2CNTWest-A05	3.55E-04	5.91E-02	3.55E-01
Emergency Generator 9-0395	26-GMS Tower-A04	3.55E-04	5.91E-02	3.55E-01
Emergency Generator 9-0396	26-HQBuilding-A06	9.43E-04	1.57E-01	4.71E-01
Emergency Generator 9-0408	0316-01	2.83E-03	4.71E-01	4.71E-01
Emergency Generator 9-0409	0120-01	3.30E-03	5.50E-01	4.71E-01
Emergency Generator 9-0410	3090-01	8.37E-03	1.39E+00	4.71E-01
Emergency Generator 9-0411	6010-01	4.26E-03	7.11E-01	7.75E-01
Emergency Generator 9-0412	6009-01	1.15E-03	1.92E-01	2.42E-01
Emergency Generator 9-0414	03-0328-A02	7.57E-04	1.26E-01	1.08E-01
Emergency Generator 9-0418	03-0328-A03	7.14E-04	1.19E-01	1.30E-01
Emergency Generator 9-0419	0311-01	5.08E-04	8.47E-02	9.68E-02
Emergency Generator 9-0433	0120-02	4.38E-03	7.30E-01	4.71E-01
Emergency Generator 9-0434	0120-03	3.06E-03	5.11E-01	4.71E-01
Emergency Generator 9-0435	BSS-01	3.48E-02	9.15E-01	9.68E-02
Emergency Generator 9-0436	LWE-01	2.28E-02	1.63E+00	4.46E-01
Emergency Generator 9-0437	UTF-01	9.91E-04	1.42E-01	8.06E-02
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081

Pollutant: Zinc **Calendar Year: 2023**

Equipment Description/ Registration No.	Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0499	2202-01	8.22E-04	1.37E-01	1.22E-01
Emergency Generator 9-0500	3660-01	7.93E-04	1.32E-01	1.04E-01
Emergency Generator 9-0503	Bldg 120 - Gen. #1	3.23E-03	5.38E-01	4.71E-01
Emergency Generator 9-0504	Bldg 120 - Gen. #2	3.09E-03	5.14E-01	4.71E-01
Emergency Generator 9-0510	Bldg 5016 - pending	1.08E-03	1.80E-01	3.78E-01
Emergency Generator 9-0511	Bldg 5046 - pending	3.33E-04	5.56E-02	9.95E-02
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**1.46E-01**	**1.59E+01**	**9.60E+00**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit, even though only one emission unit number is listed.

FORM 5

BILLABLE TOXIC AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 Calendar Year: 2023

Chemical Name	CAS Number		Actual Emissions Tons/yr	Actual Emissions lbs/dy	Actual Emissions lbs/dy		Estimation Method
Carbon Disulfide	75-15-0	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Carbonyl Sulfide	463-58-1	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Chlorine	7782-50-5	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Cyanide Compounds	57-12-5	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Hydrochloric Acid	7647-01-0	s	9.73E-01	1.13E+02	6.96E+01		C3
		f					
Hydrogen Fluoride	7664-39-3	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Methyl Chloroform	71-55-6	s	2.11E-05	2.26E-04	9.42E-06		C3
		f					
Methylene Chloride	74-87-3	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Perchloroethylene	127-18-4	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Phosphine	7803-51-2	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Titanium Tetrachloride	7550-45-0	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Totals			9.73E-01	1.13E+02	6.96E+01		

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source

PLEASE NOTE: Be sure to attach all data and calculations necessary to support the emissions figures shown above

Emission Estimation Method

A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
A9 - Other, Specify

C1 - User calculated based on source test or other measurement.
C2 - User calculated based on material balance using engineering knowledge of the process.
C3 - User calculated based on AP-42.
C4 - User calculated by best guess / engineering judgement.
C5 - User calculated based on a State or local agency factor.
C6 - New Construction, not operational.
C7 - Source closed, operation ceased.
C8 - Computer calculated based on standard.

This form to include only the eleven chemicals identified

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** CO_2

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	1.90E+03	2.09E+04	8.70E+02
Fuel Oil Boiler 4-0689	26-0642-A01	4.83E+01	5.31E+02	2.21E+01
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	2.73E+01	3.00E+02	1.25E+01
Fuel Oil Boiler 4-0708	26-0394-A01	1.12E+02	1.23E+03	5.14E+01
Fuel Oil Boiler 4-0709	26-0392-A01	3.31E+01	1.81E+02	7.56E+00
Fuel Oil Boiler 5-0710	0339-A01	4.72E+01	5.18E+02	2.16E+01
Fuel Oil Boiler 4-0719	26-0670-A01	3.61E+01	3.97E+02	1.65E+01
Fuel Oil Boiler 4-0720	26-0688-A01	7.93E+00	8.71E+01	3.63E+00
Fuel Oil Boiler 4-0722	26-0449-A01	3.09E+01	3.40E+02	1.42E+01
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	3.24E+03	1.77E+04	7.39E+02
Dual Fuel Boiler 5-0080	26-0345-A02	3.24E+03	1.77E+04	7.39E+02
Dual Fuel Boiler 5-0081	26-0345-A03	3.24E+03	1.77E+04	7.39E+02
Dual Fuel Boiler 5-0085	26-4600-A06	1.51E+03	8.28E+03	3.45E+02
Dual Fuel Boiler 5-0087	26-4600-A08	1.51E+03	8.28E+03	3.45E+02
Dual Fuel Boiler 5-0152	26-3326-A02	7.21E+03	7.93E+04	3.30E+03
Dual Fuel Boiler 5-0167	26-03062-A02	2.13E+02	1.17E+03	4.86E+01
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	7.84E+02	8.61E+03	3.59E+02
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	2.45E+02	2.69E+03	1.12E+02
Dual Fuel Boiler 5-0300	26-HQ Building-A01	1.02E+03	1.12E+04	4.67E+02
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	8.50E+02	9.34E+03	3.89E+02
Dual Fuel Boiler 5-0308	26-04219-A03	8.28E+01	4.54E+02	1.89E+01
Natural Gas Boiler 5-0309	26-5100-A02	3.02E+02	3.32E+03	1.38E+02

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** CO_2

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0310	26-5100-A01	3.02E+02	3.32E+03	1.38E+02
Dual Fuel Boiler 5-0315	26-0525-A02	2.37E+02	2.60E+03	1.08E+02
Natural Gas Boiler 5-0322	26-2202-A01	3.43E+02	3.77E+03	1.57E+02
Dual Fuel Boiler 5-0334	26-0525-A03	2.37E+02	2.60E+03	1.08E+02
Dual Fuel Boiler 5-0335	26-0525-A01	2.37E+02	2.60E+03	1.08E+02
Natural Gas Boiler 5-0336	26-04119-A03	1.47E+02	1.61E+03	6.72E+01
Natural Gas Boiler 5-0337	26-0459-A02	6.57E+01	7.22E+02	3.01E+01
Propane Boiler 5-0352	0367-A01	1.14E+01	1.25E+02	5.20E+00
Dual Fuel Boiler 5-0364	26-4312-A01	1.80E+02	9.88E+02	4.11E+01
Dual Fuel Boiler 5-0364	26-4312-A02	1.80E+02	9.88E+02	4.11E+01
Natural Gas Boiler 5-0367	26-2485-A01	7.17E+01	7.88E+02	3.28E+01
Dual Fuel Boiler 5-0370	26-4600-A09	1.51E+03	8.28E+03	3.45E+02
Natural Gas Boiler 5-0371	26-3660-A01	6.73E+01	7.39E+02	3.08E+01
Natural Gas Boiler 5-0376	0383A-A01 & A02	2.56E+02	2.81E+03	1.17E+02
Dual Fuel Boiler 5-0552	26-04219-A02	8.28E+01	4.54E+02	1.89E+01
Natural Gas Boiler 5-0710	0339-A01	4.72E+01	5.18E+02	2.16E+01
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	3.86E+01	6.43E+03	1.57E+03
Emergency Generator 9-0228	03-0394-A02	4.41E+01	7.35E+03	1.57E+03
Emergency Generator 9-0229	03-0328-A01	2.77E+01	4.61E+03	1.26E+03

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** CO_2

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0276	03-4600-A04	3.01E+01	5.01E+03	2.20E+03
Emergency Generator 9-0277	03-4600-A05	3.03E+01	5.05E+03	2.20E+03
Emergency Generator 9-0386	03-0394-A03	2.64E+01	4.40E+03	8.80E+02
Emergency Generator 9-0387	03-0394-A04	1.89E+01	3.16E+03	8.80E+02
Emergency Generator 9-0388	03-0394-A05	8.80E-01	1.47E+02	8.80E+02
Emergency Generator 9-0389	03-0394-A06	2.64E+01	4.40E+03	8.80E+02
Emergency Generator 9-0390	03-0394-A07	2.07E+01	3.45E+03	8.80E+02
Emergency Generator 9-0393	26-GMS-Lab-A04	1.77E+01	2.96E+03	4.44E+03
Emergency Generator 9-0394	26-C2CNTWest-A05	2.58E+00	4.30E+02	2.58E+03
Emergency Generator 9-0395	26-GMS Tower-A04	2.58E+00	4.30E+02	2.58E+03
Emergency Generator 9-0396	26-HQBuilding-A06	6.86E+00	1.14E+03	3.43E+03
Emergency Generator 9-0408	0316-01	2.06E+01	3.43E+03	3.43E+03
Emergency Generator 9-0409	0120-01	2.40E+01	4.00E+03	3.43E+03
Emergency Generator 9-0410	3090-01	6.09E+01	1.02E+04	3.43E+03
Emergency Generator 9-0411	6010-01	3.10E+01	5.17E+03	5.64E+03
Emergency Generator 9-0412	6009-01	8.38E+00	1.40E+03	1.76E+03
Emergency Generator 9-0414	03-0328-A02	5.51E+00	9.18E+02	7.87E+02
Emergency Generator 9-0418	03-0328-A03	5.20E+00	8.66E+02	9.45E+02
Emergency Generator 9-0419	0311-01	3.70E+00	6.16E+02	7.04E+02
Emergency Generator 9-0433	0120-02	3.19E+01	5.32E+03	3.43E+03
Emergency Generator 9-0434	0120-03	2.23E+01	3.72E+03	3.43E+03
Emergency Generator 9-0435	BSS-01	2.53E+02	6.66E+03	7.04E+02
Emergency Generator 9-0436	LWE-01	1.66E+02	1.18E+04	3.25E+03
Emergency Generator 9-0437	UTF-01	7.21E+00	1.03E+03	5.87E+02

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** CO_2

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	5.98E+00	9.97E+02	8.86E+02
Emergency Generator 9-0500	3660-01	5.77E+00	9.62E+02	7.55E+02
Emergency Generator 9-0503	Bldg 120 - Gen. #1	2.35E+01	3.92E+03	3.43E+03
Emergency Generator 9-0504	Bldg 120 - Gen. #2	2.25E+01	3.74E+03	3.43E+03
Emergency Generator 9-0510	Bldg 5016 - pending	7.85E+00	1.31E+03	2.75E+03
Emergency Generator 9-0511	Bldg 5046 - pending	2.43E+00	4.04E+02	7.24E+02
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**3.07E+04**	**3.59E+05**	**7.99E+04**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond more than one emission unit, even though only one emission unit number is listed.

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** CH_4

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	2.08E-02	2.28E-01	9.52E-03
Fuel Oil Boiler 4-0689	26-0642-A01	4.68E-04	5.14E-03	2.14E-04
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	2.65E-04	2.91E-03	1.21E-04
Fuel Oil Boiler 4-0708	26-0394-A01	1.09E-03	1.20E-02	4.98E-04
Fuel Oil Boiler 4-0709	26-0392-A01	3.21E-04	1.76E-03	7.32E-05
Fuel Oil Boiler 5-0710	0339-A01	9.04E-04	9.93E-03	4.14E-04
Fuel Oil Boiler 4-0719	26-0670-A01	3.50E-04	3.84E-03	1.60E-04
Fuel Oil Boiler 4-0720	26-0688-A01	7.68E-05	8.44E-04	3.52E-05
Fuel Oil Boiler 4-0722	26-0449-A01	2.99E-04	3.29E-03	1.37E-04
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	4.37E-02	2.40E-01	9.99E-03
Dual Fuel Boiler 5-0080	26-0345-A02	4.37E-02	2.40E-01	9.99E-03
Dual Fuel Boiler 5-0081	26-0345-A03	4.37E-02	2.40E-01	9.99E-03
Dual Fuel Boiler 5-0085	26-4600-A06	2.90E-02	1.59E-01	6.62E-03
Dual Fuel Boiler 5-0087	26-4600-A08	2.90E-02	1.59E-01	6.62E-03
Dual Fuel Boiler 5-0152	26-3326-A02	1.38E-01	1.51E+00	6.30E-02
Dual Fuel Boiler 5-0167	26-03062-A02	4.08E-03	2.23E-02	9.31E-04
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	1.50E-02	1.65E-01	6.88E-03
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	4.69E-03	5.15E-02	2.15E-03
Dual Fuel Boiler 5-0300	26-HQ Building-A01	1.96E-02	2.15E-01	8.95E-03
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	1.63E-02	1.79E-01	7.46E-03
Dual Fuel Boiler 5-0308	26-04219-A03	1.59E-03	8.70E-03	3.62E-04

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** CH_4

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0309	26-5100-A02	5.78E-03	6.36E-02	2.65E-03
Natural Gas Boiler 5-0310	26-5100-A01	5.78E-03	6.36E-02	2.65E-03
Dual Fuel Boiler 5-0315	26-0525-A02	4.53E-03	4.98E-02	2.08E-03
Natural Gas Boiler 5-0322	26-2202-A01	6.57E-03	7.22E-02	3.01E-03
Dual Fuel Boiler 5-0334	26-0525-A03	4.53E-03	4.98E-02	2.08E-03
Dual Fuel Boiler 5-0335	26-0525-A01	4.53E-03	4.98E-02	2.08E-03
Natural Gas Boiler 5-0336	26-04119-A03	2.81E-03	3.09E-02	1.29E-03
Natural Gas Boiler 5-0337	26-0459-A02	1.26E-03	1.38E-02	5.76E-04
Propane Boiler 5-0352	0367-A01	1.82E-04	2.00E-03	8.32E-05
Dual Fuel Boiler 5-0364	26-4312-A01	3.45E-03	1.89E-02	7.89E-04
Dual Fuel Boiler 5-0364	26-4312-A02	3.45E-03	1.89E-02	7.89E-04
Natural Gas Boiler 5-0367	26-2485-A01	1.38E-03	1.51E-02	6.30E-04
Dual Fuel Boiler 5-0370	26-4600-A09	2.90E-02	1.59E-01	6.62E-03
Natural Gas Boiler 5-0371	26-3660-A01	1.29E-03	1.42E-02	5.90E-04
Natural Gas Boiler 5-0376	0383A-A01 & A02	4.90E-03	5.38E-02	2.24E-03
Dual Fuel Boiler 5-0552	26-04219-A02	1.59E-03	8.70E-03	3.62E-04
Natural Gas Boiler 5-0710	0339-A01	9.04E-04	9.93E-03	4.14E-04
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	1.56E-03	2.61E-01	6.39E-02
Emergency Generator 9-0228	03-0394-A02	1.79E-03	2.98E-01	6.39E-02
Emergency Generator 9-0229	03-0328-A01	1.12E-03	1.87E-01	5.10E-02

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** CH_4

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0276	03-4600-A04	1.22E-03	2.03E-01	8.94E-02
Emergency Generator 9-0277	03-4600-A05	1.23E-03	2.05E-01	8.94E-02
Emergency Generator 9-0386	03-0394-A03	1.07E-03	1.79E-01	3.57E-02
Emergency Generator 9-0387	03-0394-A04	7.68E-04	1.28E-01	3.57E-02
Emergency Generator 9-0388	03-0394-A05	3.57E-05	5.95E-03	3.57E-02
Emergency Generator 9-0389	03-0394-A06	1.07E-03	1.79E-01	3.57E-02
Emergency Generator 9-0390	03-0394-A07	8.39E-04	1.40E-01	3.57E-02
Emergency Generator 9-0393	26-GMS-Lab-A04	7.20E-04	1.20E-01	1.80E-01
Emergency Generator 9-0394	26-C2CNTWest-A05	1.05E-04	1.75E-02	1.05E-01
Emergency Generator 9-0395	26-GMS Tower-A04	1.05E-04	1.75E-02	1.05E-01
Emergency Generator 9-0396	26-HQBuilding-A06	2.78E-04	4.64E-02	1.39E-01
Emergency Generator 9-0408	0316-01	8.35E-04	1.39E-01	1.39E-01
Emergency Generator 9-0409	0120-01	9.74E-04	1.62E-01	1.39E-01
Emergency Generator 9-0410	3090-01	2.47E-03	4.12E-01	1.39E-01
Emergency Generator 9-0411	6010-01	1.26E-03	2.10E-01	2.29E-01
Emergency Generator 9-0412	6009-01	3.40E-04	5.66E-02	7.15E-02
Emergency Generator 9-0414	03-0328-A02	2.24E-04	3.73E-02	3.19E-02
Emergency Generator 9-0418	03-0328-A03	2.11E-04	3.51E-02	3.83E-02
Emergency Generator 9-0419	0311-01	1.50E-04	2.50E-02	2.86E-02
Emergency Generator 9-0433	0120-02	1.29E-03	2.16E-01	1.39E-01
Emergency Generator 9-0434	0120-03	9.04E-04	1.51E-01	1.39E-01
Emergency Generator 9-0435	BSS-01	1.03E-02	2.70E-01	2.86E-02
Emergency Generator 9-0436	LWE-01	6.72E-03	4.80E-01	1.32E-01
Emergency Generator 9-0437	UTF-01	2.93E-04	4.18E-02	2.38E-02
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** CH_4

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0499	2202-01	2.43E-04	4.04E-02	3.60E-02
Emergency Generator 9-0500	3660-01	2.34E-04	3.90E-02	3.06E-02
Emergency Generator 9-0503	Bldg 120 - Gen. #1	9.53E-04	1.59E-01	1.39E-01
Emergency Generator 9-0504	Bldg 120 - Gen. #2	9.11E-04	1.52E-01	1.39E-01
Emergency Generator 9-0510	Bldg 5016 - pending	3.18E-04	5.31E-02	1.12E-01
Emergency Generator 9-0511	Bldg 5046 - pending	9.84E-05	1.64E-02	2.94E-02
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**5.11E-01**	**8.57E+00**	**2.99E+00**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond t
more than one emission unit, even though only one emission unit number is listed.

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** N_2O

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0619	26-0030-A01	2.38E-02	2.62E-01	1.09E-02
Fuel Oil Boiler 4-0689	26-0642-A01	5.63E-04	6.19E-03	2.58E-04
Atmospheric Burner 4-0692	Atmospheric Burner #1	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0707	26-0445-A01	3.19E-04	3.50E-03	1.46E-04
Fuel Oil Boiler 4-0708	26-0394-A01	1.31E-03	1.44E-02	6.00E-04
Fuel Oil Boiler 4-0709	26-0392-A01	3.86E-04	2.11E-03	8.81E-05
Fuel Oil Boiler 5-0710	0339-A01	8.65E-04	9.50E-03	3.96E-04
Fuel Oil Boiler 4-0719	26-0670-A01	4.21E-04	4.62E-03	1.93E-04
Fuel Oil Boiler 4-0720	26-0688-A01	9.24E-05	1.02E-03	4.23E-05
Fuel Oil Boiler 4-0722	26-0449-A01	3.60E-04	3.96E-03	1.65E-04
Fuel Oil Boiler 4-0724	Bldg 906C - pending	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0079	26-0345-A01	4.65E-02	2.55E-01	1.06E-02
Dual Fuel Boiler 5-0080	26-0345-A02	4.65E-02	2.55E-01	1.06E-02
Dual Fuel Boiler 5-0081	26-0345-A03	4.65E-02	2.55E-01	1.06E-02
Dual Fuel Boiler 5-0085	26-4600-A06	2.77E-02	1.52E-01	6.33E-03
Dual Fuel Boiler 5-0087	26-4600-A08	2.77E-02	1.52E-01	6.33E-03
Dual Fuel Boiler 5-0152	26-3326-A02	1.32E-01	1.45E+00	6.03E-02
Dual Fuel Boiler 5-0167	26-03062-A02	3.90E-03	2.14E-02	8.91E-04
Dual Fuel Boiler 5-0298	26-C2CNT West-A01	1.44E-02	1.58E-01	6.58E-03
Dual Fuel Boiler 5-0299	26-GMS Tower-A01	4.48E-03	4.93E-02	2.05E-03
Dual Fuel Boiler 5-0300	26-HQ Building-A01	1.87E-02	2.06E-01	8.57E-03
Dual Fuel Boiler 5-0301	26-GMS Lab-A01	1.56E-02	1.71E-01	7.14E-03
Dual Fuel Boiler 5-0308	26-04219-A03	1.52E-03	8.32E-03	3.47E-04
Natural Gas Boiler 5-0309	26-5100-A02	5.53E-03	6.08E-02	2.53E-03

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** N_2O

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Natural Gas Boiler 5-0310	26-5100-A01	5.53E-03	6.08E-02	2.53E-03
Dual Fuel Boiler 5-0315	26-0525-A02	4.34E-03	4.77E-02	1.99E-03
Natural Gas Boiler 5-0322	26-2202-A01	6.29E-03	6.91E-02	2.88E-03
Dual Fuel Boiler 5-0334	26-0525-A03	4.34E-03	4.77E-02	1.99E-03
Dual Fuel Boiler 5-0335	26-0525-A01	4.34E-03	4.77E-02	1.99E-03
Natural Gas Boiler 5-0336	26-04119-A03	2.69E-03	2.96E-02	1.23E-03
Natural Gas Boiler 5-0337	26-0459-A02	1.20E-03	1.32E-02	5.51E-04
Propane Boiler 5-0352	0367-A01	8.17E-04	8.98E-03	3.74E-04
Dual Fuel Boiler 5-0364	26-4312-A01	3.30E-03	1.81E-02	7.54E-04
Dual Fuel Boiler 5-0364	26-4312-A02	3.30E-03	1.81E-02	7.54E-04
Natural Gas Boiler 5-0367	26-2485-A01	1.32E-03	1.45E-02	6.02E-04
Dual Fuel Boiler 5-0370	26-4600-A09	2.77E-02	1.52E-01	6.33E-03
Natural Gas Boiler 5-0371	26-3660-A01	1.23E-03	1.36E-02	5.65E-04
Natural Gas Boiler 5-0376	0383A-A01 & A02	4.69E-03	5.15E-02	2.15E-03
Dual Fuel Boiler 5-0552	26-04219-A02	1.52E-03	8.32E-03	3.47E-04
Natural Gas Boiler 5-0710	0339-A01	8.65E-04	9.50E-03	3.96E-04
Paint Spray Booth 6-0159	07-00525-A06	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0162	07-00525-A04	0.00E+00	0.00E+00	0.00E+00
Gasoline Storage Tanks 9-0152	26-4029-A03 & -A05	0.00E+00	0.00E+00	0.00E+00
Fire Test Lab (IFEL) 9-0216	07-0525-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0227	03-0394-A01	3.13E-04	5.22E-02	1.28E-02
Emergency Generator 9-0228	03-0394-A02	3.58E-04	5.96E-02	1.28E-02
Emergency Generator 9-0229	03-0328-A01	2.25E-04	3.74E-02	1.02E-02

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** N_2O

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0276	03-4600-A04	2.44E-04	4.07E-02	1.79E-02
Emergency Generator 9-0277	03-4600-A05	2.46E-04	4.10E-02	1.79E-02
Emergency Generator 9-0386	03-0394-A03	2.14E-04	3.57E-02	7.14E-03
Emergency Generator 9-0387	03-0394-A04	1.54E-04	2.56E-02	7.14E-03
Emergency Generator 9-0388	03-0394-A05	7.14E-06	1.19E-03	7.14E-03
Emergency Generator 9-0389	03-0394-A06	2.14E-04	3.57E-02	7.14E-03
Emergency Generator 9-0390	03-0394-A07	1.68E-04	2.80E-02	7.14E-03
Emergency Generator 9-0393	26-GMS-Lab-A04	1.44E-04	2.40E-02	3.60E-02
Emergency Generator 9-0394	26-C2CNTWest-A05	2.10E-05	3.49E-03	2.10E-02
Emergency Generator 9-0395	26-GMS Tower-A04	2.10E-05	3.49E-03	2.10E-02
Emergency Generator 9-0396	26-HQBuilding-A06	5.57E-05	9.28E-03	2.78E-02
Emergency Generator 9-0408	0316-01	1.67E-04	2.78E-02	2.78E-02
Emergency Generator 9-0409	0120-01	1.95E-04	3.25E-02	2.78E-02
Emergency Generator 9-0410	3090-01	4.94E-04	8.24E-02	2.78E-02
Emergency Generator 9-0411	6010-01	2.52E-04	4.20E-02	4.58E-02
Emergency Generator 9-0412	6009-01	6.79E-05	1.13E-02	1.43E-02
Emergency Generator 9-0414	03-0328-A02	4.47E-05	7.45E-03	6.39E-03
Emergency Generator 9-0418	03-0328-A03	4.21E-05	7.02E-03	7.66E-03
Emergency Generator 9-0419	0311-01	3.00E-05	5.00E-03	5.71E-03
Emergency Generator 9-0433	0120-02	2.59E-04	4.31E-02	2.78E-02
Emergency Generator 9-0434	0120-03	1.81E-04	3.01E-02	2.78E-02
Emergency Generator 9-0435	BSS-01	2.05E-03	5.40E-02	5.71E-03
Emergency Generator 9-0436	LWE-01	1.34E-03	9.60E-02	2.63E-02
Emergency Generator 9-0437	UTF-01	5.85E-05	8.36E-03	4.76E-03

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Aberdeen Area **Facility ID #:** 24-25-00081 **Pollutant:** N_2O

Equipment Description/ Registration No.	Boilers Emission Unit No.	Actual Emissions		
		Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0491	3147-A01	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0499	2202-01	4.85E-05	8.09E-03	7.19E-03
Emergency Generator 9-0500	3660-01	4.68E-05	7.81E-03	6.12E-03
Emergency Generator 9-0503	Bldg 120 - Gen. #1	1.91E-04	3.18E-02	2.78E-02
Emergency Generator 9-0504	Bldg 120 - Gen. #2	1.82E-04	3.04E-02	2.78E-02
Emergency Generator 9-0510	Bldg 5016 - pending	6.37E-05	1.06E-02	2.23E-02
Emergency Generator 9-0511	Bldg 5046 - pending	1.97E-05	3.28E-03	5.88E-03
ECO Mobile Incinerator N/A	N/A	0.00E+00	0.00E+00	0.00E+00
Total		**5.00E-01**	**5.04E+00**	**7.37E-01**

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond more than one emission unit, even though only one emission unit number is listed.

SUPPORTING CALCULATIONS

Annual Usage
Data Input CY
2023

Report Year	2023	
Report type	Annual	
Total Natural Gas	3,652,757	therms
Total Fuel Oil	694,918	gals

Boilers

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
5-0152 Exempt	26-3326-A02	Natural Gas	17,791	therms
		Hours of Operation (NG)		hrs
5-0376	0383A-A01 & A02	Natural Gas	42,606	therms
		Hours of Operation (NG)		hrs
5-0337	26-0459-A02	Natural Gas	10,948	therms
		Hours of Operation (NG)		hrs
5-0322	26-2202-A01	Natural Gas	28,572	therms
		Hours of Operation (NG)		hrs
5-0322	26-2202-A02	Natural Gas	28,572	therms
		Hours of Operation (NG)		hrs
5-0152 Exempt	26-3300-A02	Natural Gas	6,748	therms
		Hours of Operation (NG)		hrs
5-0152 Exempt	26-3300-A01	Natural Gas	6,748	therms
		Hours of Operation (NG)		hrs
5-0152	26-3144-A01	Natural Gas	62,366	therms
		Hours of Operation (NG)		hrs
5-0371	26-3660-A01	Natural Gas	11,214	therms
		Hours of Operation (NG)		hrs
5-0336	26-04119-A03	Natural Gas	24,464	therms
		Hours of Operation (NG)		hrs
5-0310	26-5100-A01	Natural Gas	50,294	therms
		Hours of Operation (NG)		hrs
5-0309	26-5100-A02	Natural Gas	50,294	therms
		Hours of Operation (NG)		hrs
5-0710	0339-A01	Natural Gas	7,861	therms
		Hours of Operation (NG)		hrs
5-0367	26-2485-A01	Natural Gas	11,957	therms
		Hours of Operation (NG)		hrs
5-0152	26-4304-A02	Natural Gas	8,806	therms
		Hours of Operation (NG)		hrs
4-0619	5046-A01	Natural Gas	5,427	therms
		Hours of Operation (NG)		hrs
4-0619	5046-A02	Natural Gas	5,427	therms
		Hours of Operation (NG)		hrs
4-0619	5046-A03	Natural Gas	5,427	therms
		Hours of Operation (NG)		hrs
5-0152	26-0436-A01	Natural Gas	32,663	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs

Annual Usage
Data Input CY
2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
5-0152	26-0436-A02	Natural Gas	32,663	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-0120-A01	Natural Gas	11,933	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-0120-A02	Natural Gas	11,933	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0384	26-0400-A02	Natural Gas	10,343	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0384	26-0400-A03	Natural Gas	10,343	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-0402-A01	Natural Gas	4,354	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-0402-A02	Natural Gas	4,354	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-0455-A01	Natural Gas	2,741	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	2,171	gals
		Hours of Operation (Oil)		hrs
5-0152	26-0455-A02	Natural Gas	2,741	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	2,171	gals
		Hours of Operation (Oil)		hrs
5-0335	26-0525-A01	Natural Gas	39,425	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0315	26-0525-A02	Natural Gas	39,425	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0334	26-0525-A03	Natural Gas	39,425	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs

Annual Usage
Data Input CY
2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
5-0152	26-2352-A01	Natural Gas	73,036	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	1,504	gals
		Hours of Operation (Oil)		hrs
5-0152 Exempt	26-3245-A01	Natural Gas	14,780	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-04119-A02	Natural Gas	24,464	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	1,419	gals
		Hours of Operation (Oil)		hrs
5-0152 Exempt	26-2401-A01	Natural Gas	14,058	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0552	26-04219-A02	Natural Gas	13,800	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0308	26-04219-A03	Natural Gas	13,800	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0364	26-4312-A01	Natural Gas	30,038	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0364	26-4312-A02	Natural Gas	30,038	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-4404-A04	Natural Gas	386,876	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-4404-A06	Natural Gas	386,876	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-4727-A01	Natural Gas	25,213	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0152	26-5014-A03	Natural Gas	12,742	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs

Annual Usage
Data Input CY
2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
5-0152	26-5016-A01	Natural Gas	9,499	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0300	26-HQ Building-A01	Natural Gas	33,996	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	13	gals
		Hours of Operation (Oil)		hrs
5-0300	26-HQ Building-A02	Natural Gas	33,996	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	13	gals
		Hours of Operation (Oil)		hrs
5-0300	26-HQ Building-A03	Natural Gas	33,996	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	13	gals
		Hours of Operation (Oil)		hrs
5-0300	26-HQ Building-A04	Natural Gas	33,996	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	13	gals
		Hours of Operation (Oil)		hrs
5-0300	26-HQ Building-A05	Natural Gas	33,996	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	13	gals
		Hours of Operation (Oil)		hrs
5-0301	26-GMS Lab-A01	Natural Gas	47,236	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0301	26-GMS Lab-A02	Natural Gas	47,236	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0301	26-GMS Lab-A03	Natural Gas	47,236	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0299	26-GMS Tower-A01	Natural Gas	13,591	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0299	26-GMS Tower-A02	Natural Gas	13,591	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0299	26-GMS Tower-A03	Natural Gas	13,591	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs

Annual Usage
Data Input CY
2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
5-0298	26-C2CNT West-A01	Natural Gas	32,655	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0298	26-C2CNT West-A02	Natural Gas	32,655	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0298	26-C2CNT West-A03	Natural Gas	32,655	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0298	26-C2CNT West-A04	Natural Gas	32,655	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0079	26-0345-A01	Natural Gas	218,087	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	172,814	gals
		Hours of Operation (Oil)		hrs
5-0080	26-0345-A02	Natural Gas	218,087	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	172,814	gals
		Hours of Operation (Oil)		hrs
5-0081	26-0345-A03	Natural Gas	218,087	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	172,814	gals
		Hours of Operation (Oil)		hrs
5-0152	26-3062-A01	Natural Gas	35,465	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0167	26-03062-A02	Natural Gas	35,465	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0085	26-4600-A06	Natural Gas	251,975	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0370	26-4600-A09	Natural Gas	251,975	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0087	26-4600-A08	Natural Gas	251,975	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs

Annual Usage
Data Input CY
2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
5-0164 reported under 4-0619	26-5014-A01	Natural Gas	12,742	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0165 reported under 4-0619	26-5014-A02	Natural Gas	12,742	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
4-0619	26-0030-A01	No. 2 Oil	2,401	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0030-A02	No. 2 Oil	2,401	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0045-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0322-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0384-A01	No. 2 Oil	2,333	gal
		Hours of Operation (Oil)		hrs
4-0619	0402-A03	No. 2 Oil	1,539	gal
		Hours of Operation (Oil)		hrs
4-0709	26-0392-A01	No. 2 Oil	2,969	gal
		Hours of Operation (Oil)		hrs
4-0708	26-0394-A01	No. 2 Oil	10,073	gal
		Hours of Operation (Oil)		hrs
4-0546	0400-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0439-A01	No. 2 Oil	2,018	gal
		Hours of Operation (Oil)		hrs
4-0707	26-0445-A01	No. 2 Oil	2,451	gal
		Hours of Operation (Oil)		hrs
4-0722	26-0449-A01	No. 2 Oil	2,772	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0456-A01	No. 2 Oil	545	gal
		Hours of Operation (Oil)		hrs
4-0717 reported under 4-0619	0507-A05	No. 2 Oil	19,796	gal
		Hours of Operation (Oil)		hrs
5-0104 reported under 4-0619	0507-A04	No. 2 Oil	19,796	gal
		Hours of Operation (Oil)		hrs
4-0689	26-0642-A01	No. 2 Oil	4,330	gal
		Hours of Operation (Oil)		hrs
4-0721 reported under 4-0619	26-0643-A01	No. 2 Oil	2,933	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0644-A01	No. 2 Oil	2,439	gal
		Hours of Operation (Oil)		hrs
4-0719	26-0670-A01	No. 2 Oil	3,237	gal
		Hours of Operation (Oil)		hrs

Annual Usage
Data Input CY
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MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
4-0720	26-0688-A01	No. 2 Oil	711	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0699A-A01	No. 2 Oil	9,867	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0700-A01	No. 2 Oil	1,613	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0702-A01	No. 2 Oil	898	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0745A-A01	No. 2 Oil	128	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0860-A01	No. 2 Oil	1,286	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0896-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-1064-A01	No. 2 Oil	5,977	gal
		Hours of Operation (Oil)		hrs
4-0619	26-1064-A02	No. 2 Oil	5,977	gal
		Hours of Operation (Oil)		hrs
4-0619	26-1134-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-2184-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-2207-A03	No. 2 Oil	8,163	gal
		Hours of Operation (Oil)		hrs
4-0619 Removed from Title V 4/2020	26-2377-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-2377-A02	No. 2 Oil	8,699	gal
		Hours of Operation (Oil)		hrs
4-0619 Exempt	26-2379-A01	No. 2 Oil	5,310	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0269B-A01	No. 2 Oil	3,598	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0280B-A01	No. 2 Oil	1,420	gal
		Hours of Operation (Oil)		hrs
4-0619	26-3011-A01	No. 2 Oil	1,642	gal
		Hours of Operation (Oil)		hrs
4-0619	3070-A01	No. 2 Oil	17,242	gal
		Hours of Operation (Oil)		hrs
4-0619	26-4725-A01	No. 2 Oil	3,251	gal
		Hours of Operation (Oil)		hrs
4-0619	26-4728-A02	No. 2 Oil	5,192	gal
		Hours of Operation (Oil)		hrs
4-0724	Bldg 906C - pending	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-5109-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs

Annual Usage
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MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
4-0619	26-5116-A01	No. 2 Oil	1,027	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0733A-A01	No. 2 Oil	1,142	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0740B-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-0740C-A01	No. 2 Oil	3,972	gal
		Hours of Operation (Oil)		hrs
4-0619	26-1100F-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-745A-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0619	26-2312-A02	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0692	Atmospheric Burner #1	F-24	0	gal
		Hours of Operation		hrs
5-0352	0367-A01	Propane	1,816	gal
		Hours of Operation (Oil)		hrs

* - For the annual report, the hours of operation are based on fuel usage and boiler ratings.

Operation Days: All NSPS boilers are assumed to be 365 days.
All space heating boilers are assumed to be 182 days.

	Standby Generators			
		Diesel		MMBtu
9-0409	0120-01	Hours of Operation	14.00	hrs
		Diesel		MMBtu
9-0433	0120-02	Hours of Operation	18.60	hrs
		Diesel		MMBtu
9-0434	0120-03	Hours of Operation	13.00	hrs
		Diesel		MMBtu
9-0503	Bldg 120 - Gen. #1	Hours of Operation	13.70	hrs
		Diesel		MMBtu
9-0504	Bldg 120 - Gen. #2	Hours of Operation	13.10	hrs
		Diesel		MMBtu
9-0410	3090-01	Hours of Operation	35.50	hrs
		Diesel		MMBtu
9-0408	0316-01	Hours of Operation	12.00	hrs
		Diesel		MMBtu
9-0418	03-0328-A03	Hours of Operation	11.00	hrs
		Diesel		MMBtu
9-0414	03-0328-A02	Hours of Operation	14.00	hrs
		Diesel		MMBtu
9-0229	03-0328-A01	Hours of Operation	44.00	hrs
		Diesel		MMBtu
9-0227	03-0394-A01	Hours of Operation	49.00	hrs

Annual Usage
Data Input CY
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MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
		Diesel		MMBtu
9-0228	03-0394-A02	Hours of Operation	56.00	hrs
		Diesel		MMBtu
9-0386	03-0394-A03	Hours of Operation	60.00	hrs
		Diesel		MMBtu
9-0387	03-0394-A04	Hours of Operation	43.00	hrs
		Diesel		MMBtu
9-0388	03-0394-A05	Hours of Operation	2.00	hrs
		Diesel		MMBtu
9-0389	03-0394-A06	Hours of Operation	60.00	hrs
		Diesel		MMBtu
9-0390	03-0394-A07	Hours of Operation	47.00	hrs
		Diesel		MMBtu
9-0276	03-4600-A04	Hours of Operation	27.30	hrs
		Diesel		MMBtu
9-0277	03-4600-A05	Hours of Operation	27.50	hrs
		Diesel		MMBtu
9-0412	6009-01	Hours of Operation	9.50	hrs
		Diesel		MMBtu
9-0411	6010-01	Hours of Operation	11.00	hrs
		Diesel		MMBtu
9-0411	6010-02	Hours of Operation	7.00	hrs
		Diesel		MMBtu
9-0436	LWE-01	Hours of Operation	102.00	hrs
		Diesel		MMBtu
9-0436	LWE-02	Hours of Operation	103.00	hrs
		Diesel		MMBtu
9-0436	LWE-03	Hours of Operation	104.00	hrs
		Diesel		MMBtu
9-0436	LWE-04	Hours of Operation	102.00	hrs
		Diesel		MMBtu
9-0436	LWE-05	Hours of Operation	102.00	hrs
		Diesel		MMBtu
9-0393	26-GMS-Lab-A04	Hours of Operation	8.00	hrs
		Diesel		MMBtu
9-0394	26-C2CNTWest-A05	Hours of Operation	2.00	hrs
		Diesel		MMBtu
9-0395	26-GMS Tower-A04	Hours of Operation	2.00	hrs
		Diesel		MMBtu
9-0396	26-HQBuilding-A06	Hours of Operation	4.00	hrs
		Diesel		MMBtu
9-0510	Bldg 5016 - pending	Hours of Operation	5.70	hrs
		Diesel		MMBtu
9-0511	Bldg 5046 - pending	Hours of Operation	6.70	hrs
		Diesel		MMBtu
9-0435	BSS-01	Hours of Operation	718.50	hrs

Annual Usage
Data Input CY
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MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
9-0437	UTF-01	Diesel		MMBtu
		Hours of Operation	24.57	hrs
9-0419	0311-01	Diesel		MMBtu
		Hours of Operation	10.50	hrs
9-0491	3147-A01	Diesel		MMBtu
		Hours of Operation	0.00	hrs
9-0499	2202-01	Diesel		MMBtu
		Hours of Operation	13.50	hrs
9-0500	3660-01	Diesel		MMBtu
		Hours of Operation	15.30	hrs

Operation Days:

All emergency generators are assumed to be 12 days

Pollutant	Fuel oil lb/10^3 gal
PM Filterable	2
PM-10 Filterable	1.08
PM-2.5 Filterable	0.83
PM Condensable	1.3

Pollutant	Fuel oil lb/10^3 gal
CO2	22,300
CH4	0.216
N2O	0.26

utant Emission Factors from Table 1.4-1 and 1.4-2 of AP-42.
tion factors, Table 1.4-2.

C4ISR (See C4ISR EF" Tab n spreadsheet)	Pollutant	Natural Gas lb/10^6 cft
36	PM Filterable	1.9
0.6	PM-10 Filterable*	1.9
84	PM-2.5 Filterable*	1.9
5.5	PM Condensable*	5.7

Pollutant	Natural Gas lb/10^6 cft
CO2	120000
CH4	2.3
N2O	2.2

Pollutant	Natural Gas (low NOx burner) lb/10^6 cft	Natural Gas (fuel gas recirculation) lb/10^6 cft
NOx	50	32

e) is assumed to be less than 1.0 micrometer in diameter.
ented here may be used to estimate PM10, PM2.5 or PM1 emissions.

utant and GHG Emission Factors from Table 1.5-1 of AP-42.

Pollutant	Propane lb/10^3 gal
PM Filterable	0.2
PM-10 Filterable**	0.2
PM-2.5 Filterable**	0.2
PM Condensable**	0.5

Pollutant	Propane lb/10^3 gal
CO2	12500
CH4	0.2
N2O	0.9

sulfur fuel content for LPG

le) is assumed to be less than 1.0 micrometer in diameter.
ented here may be used to estimate PM10, PM2.5 or PM1 emissions.

on Factor) X (Fuel Used) / 2000
rate (tons/yr) X 2000 / Days per year

Type of Boiler	Oil/Propane Used (gal)	Gas Used (Therm)	NOx (tpy)	SOx (tpy)	CO (tpy)	VOC (tpy)	CO2 (tpy)	CH4 (tpy)	N2O (tpy)	PM Filterable	PM-10 Filterable
atural Gas	0	17791	8.90E-02	5.34E-04	7.47E-02	4.89E-03	1.07E+02	2.05E-03	1.96E-03	1.69E-03	1.69E-03
atural Gas	0	42606	2.13E-01	1.28E-03	1.79E-01	1.17E-02	2.56E+02	4.90E-03	4.69E-03	4.05E-03	4.05E-03
atural Gas	0	10948	5.47E-02	3.28E-04	4.60E-02	3.01E-03	6.57E+01	1.26E-03	1.20E-03	1.04E-03	1.04E-03
atural Gas	0	28571.5	1.43E-01	8.57E-04	1.20E-01	7.86E-03	1.71E+02	3.29E-03	3.14E-03	2.71E-03	2.71E-03
atural Gas	0	28571.5	1.43E-01	8.57E-04	1.20E-01	7.86E-03	1.71E+02	3.29E-03	3.14E-03	2.71E-03	2.71E-03
atural Gas	0	6748	3.37E-02	2.02E-04	2.83E-02	1.86E-03	4.05E+01	7.76E-04	7.42E-04	6.41E-04	6.41E-04
atural Gas	0	6748	3.37E-02	2.02E-04	2.83E-02	1.86E-03	4.05E+01	7.76E-04	7.42E-04	6.41E-04	6.41E-04
atural Gas	0	62366	3.12E-01	1.87E-03	2.62E-01	1.72E-02	3.74E+02	7.17E-03	6.86E-03	5.92E-03	5.92E-03
atural Gas	0	11214	5.61E-02	3.36E-04	4.71E-02	3.08E-03	6.73E+01	1.29E-03	1.23E-03	1.07E-03	1.07E-03
atural Gas	0	24463.5	1.22E-01	7.34E-04	1.03E-01	6.73E-03	1.47E+02	2.81E-03	2.69E-03	2.32E-03	2.32E-03
atural Gas	0	50293.5	2.51E-01	1.51E-03	2.11E-01	1.38E-02	3.02E+02	5.78E-03	5.53E-03	4.78E-03	4.78E-03
atural Gas	0	50293.5	2.51E-01	1.51E-03	2.11E-01	1.38E-02	3.02E+02	5.78E-03	5.53E-03	4.78E-03	4.78E-03
atural Gas	0	7861	3.93E-02	2.36E-04	3.30E-02	2.16E-03	4.72E+01	9.04E-04	8.65E-04	7.47E-04	7.47E-04

atural Gas	0	5427	2.71E-02	1.63E-04	2.28E-02	1.49E-03	3.26E+01	6.24E-04	5.97E-04	5.16E-04	5.16E-04
atural Gas	0	10342.5	5.17E-02	3.10E-04	4.34E-02	2.84E-03	6.21E+01	1.19E-03	1.14E-03	9.83E-04	9.83E-04
atural Gas	0	10342.5	5.17E-02	3.10E-04	4.34E-02	2.84E-03	6.21E+01	1.19E-03	1.14E-03	9.83E-04	9.83E-04
ual Fuel	0.00	32662.5	1.63E-01	9.80E-04	1.37E-01	8.98E-03	1.96E+02	3.76E-03	3.59E-03	3.10E-03	3.10E-03
ual Fuel	0.00	32662.5	1.63E-01	9.80E-04	1.37E-01	8.98E-03	1.96E+02	3.76E-03	3.59E-03	3.10E-03	3.10E-03
ual Fuel	0.00	11933	5.97E-02	3.58E-04	5.01E-02	3.28E-03	7.16E+01	1.37E-03	1.31E-03	1.13E-03	1.13E-03
ual Fuel	0.00	11933	5.97E-02	3.58E-04	5.01E-02	3.28E-03	7.16E+01	1.37E-03	1.31E-03	1.13E-03	1.13E-03
ual Fuel	0.00	4353.5	2.18E-02	1.31E-04	1.83E-02	1.20E-03	2.61E+01	5.01E-04	4.79E-04	4.14E-04	4.14E-04
ual Fuel	0.00	4353.5	2.18E-02	1.31E-04	1.83E-02	1.20E-03	2.61E+01	5.01E-04	4.79E-04	4.14E-04	4.14E-04
ual Fuel	2170.80	2741	3.54E-02	7.90E-03	1.69E-02	1.12E-03	4.07E+01	5.50E-04	5.84E-04	2.43E-03	1.43E-03
ual Fuel	2170.80	2741	3.54E-02	7.90E-03	1.69E-02	1.12E-03	4.07E+01	5.50E-04	5.84E-04	2.43E-03	1.43E-03
ual Fuel	0.00	39425.33333	1.97E-01	1.18E-03	1.66E-01	1.08E-02	2.37E+02	4.53E-03	4.34E-03	3.75E-03	3.75E-03
ual Fuel	0.00	39425.33333	1.97E-01	1.18E-03	1.66E-01	1.08E-02	2.37E+02	4.53E-03	4.34E-03	3.75E-03	3.75E-03
ual Fuel	0.00	39425.33333	1.97E-01	1.18E-03	1.66E-01	1.08E-02	2.37E+02	4.53E-03	4.34E-03	3.75E-03	3.75E-03
ual Fuel	1503.50	73036	3.80E-01	7.60E-03	3.11E-01	2.03E-02	4.55E+02	8.56E-03	8.23E-03	8.44E-03	7.75E-03
ual Fuel	0.00	14780	7.39E-02	4.43E-04	6.21E-02	4.06E-03	8.87E+01	1.70E-03	1.63E-03	1.40E-03	1.40E-03
ual Fuel	1419.10	24463.5	1.37E-01	5.84E-03	1.06E-01	6.97E-03	1.63E+02	2.97E-03	2.88E-03	3.74E-03	3.09E-03
ual Fuel	0.00	14058	7.03E-02	4.22E-04	5.90E-02	3.87E-03	8.43E+01	1.62E-03	1.55E-03	1.34E-03	1.34E-03
ual Fuel	0.00	13800	6.90E-02	4.14E-04	5.80E-02	3.80E-03	8.28E+01	1.59E-03	1.52E-03	1.31E-03	1.31E-03
ual Fuel	0.00	13800	6.90E-02	4.14E-04	5.80E-02	3.80E-03	8.28E+01	1.59E-03	1.52E-03	1.31E-03	1.31E-03
ual Fuel	0.00	30037.5	1.50E-01	9.01E-04	1.26E-01	8.26E-03	1.80E+02	3.45E-03	3.30E-03	2.85E-03	2.85E-03
ual Fuel	0	30037.5	1.50E-01	9.01E-04	1.26E-01	8.26E-03	1.80E+02	3.45E-03	3.30E-03	2.85E-03	2.85E-03
ual Fuel	0	386875.5	1.93E+00	1.16E-02	1.62E+00	1.06E-01	2.32E+03	4.45E-02	4.26E-02	3.68E-02	3.68E-02
ual Fuel	0	386875.5	1.93E+00	1.16E-02	1.62E+00	1.06E-01	2.32E+03	4.45E-02	4.26E-02	3.68E-02	3.68E-02
ual Fuel	0	25213	1.26E-01	7.56E-04	1.06E-01	6.93E-03	1.51E+02	2.90E-03	2.77E-03	2.40E-03	2.40E-03
ual Fuel	0	12742	6.37E-02	3.82E-04	5.35E-02	3.50E-03	7.65E+01	1.47E-03	1.40E-03	1.21E-03	1.21E-03
ual Fuel	0	9499	4.75E-02	2.85E-04	3.99E-02	2.61E-03	5.70E+01	1.09E-03	1.04E-03	9.02E-04	9.02E-04
ual Fuel	13	33995.6	6.13E-02	1.07E-03	1.43E-01	9.35E-03	2.04E+02	3.91E-03	3.74E-03	3.24E-03	3.24E-03
ual Fuel	13	33995.6	6.13E-02	1.07E-03	1.43E-01	9.35E-03	2.04E+02	3.91E-03	3.74E-03	3.24E-03	3.24E-03
ual Fuel	13	33995.6	6.13E-02	1.07E-03	1.43E-01	9.35E-03	2.04E+02	3.91E-03	3.74E-03	3.24E-03	3.24E-03
ual Fuel	13	33995.6	6.13E-02	1.07E-03	1.43E-01	9.35E-03	2.04E+02	3.91E-03	3.74E-03	3.24E-03	3.24E-03
ual Fuel	13	33995.6	6.13E-02	1.07E-03	1.43E-01	9.35E-03	2.04E+02	3.91E-03	3.74E-03	3.24E-03	3.24E-03
ual Fuel	0	47235.66667	8.50E-02	1.42E-03	1.98E-01	1.30E-02	2.83E+02	5.43E-03	5.20E-03	4.49E-03	4.49E-03
ual Fuel	0	47235.66667	8.50E-02	1.42E-03	1.98E-01	1.30E-02	2.83E+02	5.43E-03	5.20E-03	4.49E-03	4.49E-03
ual Fuel	0	47235.66667	8.50E-02	1.42E-03	1.98E-01	1.30E-02	2.83E+02	5.43E-03	5.20E-03	4.49E-03	4.49E-03
ual Fuel	0	13590.66667	2.45E-02	4.08E-04	5.71E-02	3.74E-03	8.15E+01	1.56E-03	1.49E-03	1.29E-03	1.29E-03
ual Fuel	0	13590.66667	2.45E-02	4.08E-04	5.71E-02	3.74E-03	8.15E+01	1.56E-03	1.49E-03	1.29E-03	1.29E-03
ual Fuel	0	13590.66667	2.45E-02	4.08E-04	5.71E-02	3.74E-03	8.15E+01	1.56E-03	1.49E-03	1.29E-03	1.29E-03
ual Fuel	0	32655.25	5.88E-02	9.80E-04	1.37E-01	8.98E-03	1.96E+02	3.76E-03	3.59E-03	3.10E-03	3.10E-03
ual Fuel	0	32655.25	5.88E-02	9.80E-04	1.37E-01	8.98E-03	1.96E+02	3.76E-03	3.59E-03	3.10E-03	3.10E-03
ual Fuel	0	32655.25	5.88E-02	9.80E-04	1.37E-01	8.98E-03	1.96E+02	3.76E-03	3.59E-03	3.10E-03	3.10E-03
ual Fuel	0	32655.25	5.88E-02	9.80E-04	1.37E-01	8.98E-03	1.96E+02	3.76E-03	3.59E-03	3.10E-03	3.10E-03
ual Fuel	172814	218087.3333	2.82E+00	6.29E-01	1.35E+00	8.94E-02	3.24E+03	4.37E-02	4.65E-02	1.94E-01	1.14E-01
ual Fuel	172814	218087.3333	2.82E+00	6.29E-01	1.35E+00	8.94E-02	3.24E+03	4.37E-02	4.65E-02	1.94E-01	1.14E-01
ual Fuel	172814	218087.3333	2.82E+00	6.29E-01	1.35E+00	8.94E-02	3.24E+03	4.37E-02	4.65E-02	1.94E-01	1.14E-01
ual Fuel	0	35464.5	1.77E-01	1.06E-03	1.49E-01	9.75E-03	2.13E+02	4.08E-03	3.90E-03	3.37E-03	3.37E-03
ual Fuel	0	35464.5	1.77E-01	1.06E-03	1.49E-01	9.75E-03	2.13E+02	4.08E-03	3.90E-03	3.37E-03	3.37E-03
ual Fuel	0	251975.3333	1.26E+00	7.56E-03	1.06E+00	6.93E-02	1.51E+03	2.90E-02	2.77E-02	2.39E-02	2.39E-02
ual Fuel	0	251975.3333	1.26E+00	7.56E-03	1.06E+00	6.93E-02	1.51E+03	2.90E-02	2.77E-02	2.39E-02	2.39E-02
ual Fuel	0	251975.3333	1.26E+00	7.56E-03	1.06E+00	6.93E-02	1.51E+03	2.90E-02	2.77E-02	2.39E-02	2.39E-02
ual Fuel	0	12742	6.37E-02	3.82E-04	5.35E-02	3.50E-03	7.65E+01	1.47E-03	1.40E-03	1.21E-03	1.21E-03
ual Fuel	0	12742	6.37E-02	3.82E-04	5.35E-02	3.50E-03	7.65E+01	1.47E-03	1.40E-03	1.21E-03	1.21E-03
uel Oil	2400.5	0	2.40E-02	8.64E-03	6.00E-03	4.08E-04	2.68E+01	2.59E-04	3.12E-04	2.40E-04	1.30E-04
uel Oil	2400.5	0	2.40E-02	8.64E-03	6.00E-03	4.08E-04	2.68E+01	2.59E-04	3.12E-04	2.40E-04	1.30E-04

uel Oil	1539.3	0	1.54E-02	5.54E-03	3.85E-03	2.62E-04	1.72E+01	1.66E-04	2.00E-04	1.54E-04	8.31E-05
uel Oil	2968.5	0	2.97E-02	1.07E-02	7.42E-03	5.05E-04	3.31E+01	3.21E-04	3.86E-04	2.97E-04	1.60E-04
uel Oil	10072.8	0	1.01E-01	3.63E-02	2.52E-02	1.71E-03	1.12E+02	1.09E-03	1.31E-03	1.01E-03	5.44E-04
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	2018	0	2.02E-02	7.26E-03	5.05E-03	3.43E-04	2.25E+01	2.18E-04	2.62E-04	2.02E-04	1.09E-04
uel Oil	2451.2	0	2.45E-02	8.82E-03	6.13E-03	4.17E-04	2.73E+01	2.65E-04	3.19E-04	2.45E-04	1.32E-04
uel Oil	2772	0	2.77E-02	9.98E-03	6.93E-03	4.71E-04	3.09E+01	2.99E-04	3.60E-04	2.77E-04	1.50E-04
uel Oil	545	0	5.45E-03	1.96E-03	1.36E-03	9.27E-05	6.08E+00	5.89E-05	7.09E-05	5.45E-05	2.94E-05
uel Oil	19795.75	0	1.98E-01	7.13E-02	4.95E-02	3.37E-03	2.21E+02	2.14E-03	2.57E-03	1.98E-03	1.07E-03
uel Oil	19795.75	0	1.98E-01	7.13E-02	4.95E-02	3.37E-03	2.21E+02	2.14E-03	2.57E-03	1.98E-03	1.07E-03
uel Oil	4330	0	4.33E-02	1.56E-02	1.08E-02	7.36E-04	4.83E+01	4.68E-04	5.63E-04	4.33E-04	2.34E-04
uel Oil	2933.3	0	2.93E-02	1.06E-02	7.33E-03	4.99E-04	3.27E+01	3.17E-04	3.81E-04	2.93E-04	1.58E-04
uel Oil	2439	0	2.44E-02	8.78E-03	6.10E-03	4.15E-04	2.72E+01	2.63E-04	3.17E-04	2.44E-04	1.32E-04
uel Oil	3237	0	3.24E-02	1.17E-02	8.09E-03	5.50E-04	3.61E+01	3.50E-04	4.21E-04	3.24E-04	1.75E-04
uel Oil	711	0	7.11E-03	2.56E-03	1.78E-03	1.21E-04	7.93E+00	7.68E-05	9.24E-05	7.11E-05	3.84E-05
uel Oil	9866.6	0	9.87E-02	3.55E-02	2.47E-02	1.68E-03	1.10E+02	1.07E-03	1.28E-03	9.87E-04	5.33E-04
uel Oil	1613	0	1.61E-02	5.81E-03	4.03E-03	2.74E-04	1.80E+01	1.74E-04	2.10E-04	1.61E-04	8.71E-05
uel Oil	898	0	8.98E-03	3.23E-03	2.25E-03	1.53E-04	1.00E+01	9.70E-05	1.17E-04	8.98E-05	4.85E-05
uel Oil	128	0	1.28E-03	4.61E-04	3.20E-04	2.18E-05	1.43E+00	1.38E-05	1.66E-05	1.28E-05	6.91E-06
uel Oil	1286	0	1.29E-02	4.63E-03	3.22E-03	2.19E-04	1.43E+01	1.39E-04	1.67E-04	1.29E-04	6.94E-05
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	5977.3	0	5.98E-02	2.15E-02	1.49E-02	1.02E-03	6.66E+01	6.46E-04	7.77E-04	5.98E-04	3.23E-04
uel Oil	5977.3	0	5.98E-02	2.15E-02	1.49E-02	1.02E-03	6.66E+01	6.46E-04	7.77E-04	5.98E-04	3.23E-04
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	8163.1	0	8.16E-02	2.94E-02	2.04E-02	1.39E-03	9.10E+01	8.82E-04	1.06E-03	8.16E-04	4.41E-04
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	8698.8	0	8.70E-02	3.13E-02	2.17E-02	1.48E-03	9.70E+01	9.39E-04	1.13E-03	8.70E-04	4.70E-04
uel Oil	5310.3	0	5.31E-02	1.91E-02	1.33E-02	9.03E-04	5.92E+01	5.74E-04	6.90E-04	5.31E-04	2.87E-04
uel Oil	3597.9	0	3.60E-02	1.30E-02	8.99E-03	6.12E-04	4.01E+01	3.89E-04	4.68E-04	3.60E-04	1.94E-04
uel Oil	1419.8	0	1.42E-02	5.11E-03	3.55E-03	2.41E-04	1.58E+01	1.53E-04	1.85E-04	1.42E-04	7.67E-05
uel Oil	1642	0	1.64E-02	5.91E-03	4.11E-03	2.79E-04	1.83E+01	1.77E-04	2.13E-04	1.64E-04	8.87E-05
uel Oil	17242.4	0	1.72E-01	6.21E-02	4.31E-02	2.93E-03	1.92E+02	1.86E-03	2.24E-03	1.72E-03	9.31E-04
uel Oil	3250.6	0	3.25E-02	1.17E-02	8.13E-03	5.53E-04	3.62E+01	3.51E-04	4.23E-04	3.25E-04	1.76E-04
uel Oil	5192.2	0	5.19E-02	1.87E-02	1.30E-02	8.83E-04	5.79E+01	5.61E-04	6.75E-04	5.19E-04	2.80E-04
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	5427	0	5.43E-02	1.95E-02	1.36E-02	9.23E-04	6.05E+01	5.86E-04	7.06E-04	5.43E-04	2.93E-04
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	1027.4	0	1.03E-02	3.70E-03	2.57E-03	1.75E-04	1.15E+01	1.11E-04	1.34E-04	1.03E-04	5.55E-05
uel Oil	1142	0	1.14E-02	4.11E-03	2.86E-03	1.94E-04	1.27E+01	1.23E-04	1.48E-04	1.14E-04	6.17E-05
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	3972	0	3.97E-02	1.43E-02	9.93E-03	6.75E-04	4.43E+01	4.29E-04	5.16E-04	3.97E-04	2.14E-04
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
uel Oil	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
-24	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ropane	1816	0	1.18E-02	4.90E-05	6.81E-03	7.26E-04	1.14E+01	1.82E-04	8.17E-04	1.82E-04	9.81E-05
		Totals	2.37E+01	2.63E+00	1.71E+01	1.12E+00	2.97E+04	4.96E-01	4.94E-01	8.90E-01	6.40E-01

ACTUAL EMISSION
CALCULATIONS CY 2023
EMERGENCY GENERATORS

Emission Factor Source: Criteria Pollutant Emission Factors from Table 3.4-1 and 3.4-2 of AP-42.
GHG factors derived from oil combustion factors, 40 CFR 98, Subpart C, Tables C-1 and C-2

Pollutant	Fuel Oil lb/MMBtu (2-02-004-01)
NOx	3.2
SOx	0.001515
CO	0.85
PM	0.1
VOC	0.0819

Pollutant	Fuel Oil lb/MMBtu (2-02-004-01)
PM (Filterable)	0.062
PM-10 (Filterable)	0.0496
PM-2.5 (Filterable)	0.0479
PM Condensable	0.0077

Pollutant	Fuel Oil lb/MMBtu (2-02-004-01)
CO2	163.05
CH4	0.00661386
N2O	0.001322772

Note: All generators at APG are fueled by ultra-low sulfur diesel.

Calculation Method
Annual Emission Rate = (Emission Factor) X (Horsepower of generator) X (7.2E-03 MMBtu/hr/hp) X (hours operated/yr) / 2000
Daily Emission Rate = Annual emission rate X 2000 / Days per year
Capacity Factor = Hours Operated/8760 X 100

	EF lb/hp-hr From Permit Application					Ratio Permit Application to AP-42				Permit Application EF converted to lb/MMBtu			
	C2CNT and GMS	HQ1 and 2	GMS Lab	MTF and FIFF	AP-42	C2CNT and GMS	HQ1 and 2	GMS Lab	MTF and FIFF	GMS Lab	C2CNT and GMS Tower	HQ1 and 2 Building	MTF and FIFF
Pollutant	**lb/hp-hr**	**lb/hp-hr**	**lb/hp-hr**	**lb/hp-hr**	**lb/hp-hr**	**Ratio**	**Ratio**	**Ratio**	**Ratio**	**lb/MMBtu**	**lb/MMBtu**	**lb/MMBtu**	**lb/MMBtu**
NOx	0.015	0.014	0.020	0.010	0.024	0.63	0.58	0.83	0.42	2.67	2.00	1.87	1.33
SOx													
CO	5.29E-04	7.94E-04	1.79E-03	8.82E-04	5.50E-03	0.10	0.14	0.33	0.16	0.28	0.08	0.12	0.14
PM	2.20E-04	2.65E-04	2.20E-04	2.20E-04	7.00E-04	0.31	0.38	0.31	0.31	0.03	0.03	0.04	0.03
VOC	3.09E-04	4.19E-04	4.19E-04	1.98E-04	7.05E-04	0.44	0.59	0.59	0.28	0.05	0.04	0.05	0.02

Used ratio of EF from permit application to AP-42 in lb/hp-hr to convert lb/MMBtu in spreadsheet to Permit Application values

ACTUAL EMISSION
CALCULATIONS CY 2023
EMERGENCY GENERATORS

Emission Unit Number	MDE Reg. Number	HP	Capacity Factor	Hours/Yr	Emission Rates							
					NOx		SOx		CO		VOC	
					tpy	lb/day	tpy	lb/day	tpy	lb/day	tpy	lb/day
0120-01	9-0409	2922	0.16%	14.0	4.71E-01	7.85E+01	2.23E-04	3.72E-02	1.25E-01	2.09E+01	1.21E-02	2.01E+00
0120-02	9-0433	2922	0.21%	18.6	6.26E-01	1.04E+02	2.96E-04	4.94E-02	1.66E-01	2.77E+01	1.60E-02	2.67E+00
0120-03	9-0434	2922	0.15%	13.0	4.38E-01	7.29E+01	2.07E-04	3.45E-02	1.16E-01	1.94E+01	1.12E-02	1.87E+00
Bldg 120 - Gen. #1	9-0503	2922	0.16%	13.7	4.61E-01	7.69E+01	2.18E-04	3.64E-02	1.22E-01	2.04E+01	1.18E-02	1.97E+00
Bldg 120 - Gen. #2	9-0504	2922	0.15%	13.1	4.41E-01	7.35E+01	2.09E-04	3.48E-02	1.17E-01	1.95E+01	1.13E-02	1.88E+00
3090-01	9-0410	2923	0.41%	35.5	1.20E+00	1.99E+02	5.66E-04	9.43E-02	3.18E-01	5.29E+01	3.06E-02	5.10E+00
0316-01	9-0408	2922	0.14%	12.0	4.04E-01	6.73E+01	1.91E-04	3.19E-02	1.07E-01	1.79E+01	1.03E-02	1.72E+00
03-0328-A03	9-0418	804.6	0.13%	11.0	1.02E-01	1.70E+01	4.83E-05	8.05E-03	2.71E-02	4.51E+00	2.61E-03	4.35E-01
03-0328-A02	9-0414	670.5	0.16%	14.0	1.08E-01	1.80E+01	5.12E-05	8.53E-03	2.87E-02	4.79E+00	2.77E-03	4.61E-01
03-0328-A01	9-0229	1072	0.50%	44.0	5.43E-01	9.06E+01	2.57E-04	4.29E-02	1.44E-01	2.41E+01	1.39E-02	2.32E+00
03-0394-A01	9-0227	1341	0.56%	49.0	7.57E-01	1.26E+02	3.58E-04	5.97E-02	2.01E-01	3.35E+01	1.94E-02	3.23E+00
03-0394-A02	9-0228	1341	0.64%	56.0	8.65E-01	1.44E+02	4.10E-04	6.83E-02	2.30E-01	3.83E+01	2.21E-02	3.69E+00
03-0394-A03	9-0386	750	0.68%	60.0	5.18E-01	8.64E+01	2.45E-04	4.09E-02	1.38E-01	2.30E+01	1.33E-02	2.21E+00
03-0394-A04	9-0387	750	0.49%	43.0	3.72E-01	6.19E+01	1.76E-04	2.93E-02	9.87E-02	1.64E+01	9.51E-03	1.58E+00
03-0394-A05	9-0388	750	0.02%	2.0	1.73E-02	2.88E+00	8.18E-06	1.36E-03	4.59E-03	7.65E-01	4.42E-04	7.37E-02
03-0394-A06	9-0389	750	0.68%	60.0	5.18E-01	8.64E+01	2.45E-04	4.09E-02	1.38E-01	2.30E+01	1.33E-02	2.21E+00
03-0394-A07	9-0390	750	0.54%	47.0	4.06E-01	6.77E+01	1.92E-04	3.20E-02	1.08E-01	1.80E+01	1.04E-02	1.73E+00
03-4600-A04	9-0276	1877	0.31%	27.3	5.90E-01	9.84E+01	2.79E-04	4.66E-02	1.57E-01	2.61E+01	1.51E-02	2.52E+00
03-4600-A05	9-0277	1877	0.31%	27.5	5.95E-01	9.91E+01	2.82E-04	4.69E-02	1.58E-01	2.63E+01	1.52E-02	2.54E+00
6009-01	9-0412	1502	0.11%	9.5	1.64E-01	2.74E+01	7.78E-05	1.30E-02	4.37E-02	7.28E+00	4.21E-03	7.01E-01
6010-01	9-0411	2937	0.13%	11.0	3.72E-01	6.20E+01	1.76E-04	2.94E-02	9.89E-02	1.65E+01	9.53E-03	1.59E+00
6010-02	9-0411	2937	0.08%	7.0	2.37E-01	3.95E+01	1.12E-04	1.87E-02	6.29E-02	1.05E+01	6.06E-03	1.01E+00
LWE-01	9-0436	550	1.16%	102.0	6.46E-01	4.62E+01	3.06E-04	2.19E-02	1.72E-01	1.23E+01	1.65E-02	1.18E+00
LWE-02	9-0436	550	1.18%	103.0	6.53E-01	4.66E+01	3.09E-04	2.21E-02	1.73E-01	1.24E+01	1.67E-02	1.19E+00
LWE-03	9-0436	550	1.19%	104.0	6.59E-01	4.71E+01	3.12E-04	2.23E-02	1.75E-01	1.25E+01	1.69E-02	1.20E+00
LWE-04	9-0436	550	1.16%	102.0	6.46E-01	4.62E+01	3.06E-04	2.19E-02	1.72E-01	1.23E+01	1.65E-02	1.18E+00
LWE-05	9-0436	550	1.16%	102.0	6.46E-01	4.62E+01	3.06E-04	2.19E-02	1.72E-01	1.23E+01	1.65E-02	1.18E+00
26-GMS-Lab-A04	9-0393	3778	0.09%	8.0	2.90E-01	4.84E+01	1.65E-04	2.75E-02	3.01E-02	5.02E+00	5.30E-03	8.83E-01
26-C2CNTWest-A05	9-0394	2200	0.02%	2.0	3.17E-02	5.28E+00	2.40E-05	4.00E-03	1.29E-03	2.16E-01	5.69E-04	9.48E-02
26-GMS Tower-A04	9-0395	2200	0.02%	2.0	3.17E-02	5.28E+00	2.40E-05	4.00E-03	1.29E-03	2.16E-01	5.69E-04	9.48E-02
26-HQBuilding-A06	9-0396	2922	0.05%	4.0	7.85E-02	1.31E+01	6.37E-05	1.06E-02	5.16E-03	8.61E-01	2.05E-03	3.41E-01
Bldg 5016 - pending	9-0510	2346	0.07%	5.7	1.54E-01	2.57E+01	7.29E-05	1.22E-02	4.09E-02	6.82E+00	3.94E-03	6.57E-01
Bldg 5046 - pending	9-0511	617	0.08%	6.7	4.76E-02	7.94E+00	2.25E-05	3.76E-03	1.26E-02	2.11E+00	1.22E-03	2.03E-01
BSS-01	9-0435	600	8.20%	718.5	4.97E+00	1.31E+02	2.35E-03	6.19E-02	1.32E+00	3.47E+01	1.27E-01	3.34E+00
UTF-01	9-0437	500	0.28%	24.6	1.42E-01	2.02E+01	6.70E-05	9.57E-03	3.76E-02	5.37E+00	3.62E-03	5.17E-01
0311-01	9-0419	600	0.12%	10.5	7.26E-02	1.21E+01	3.44E-05	5.73E-03	1.93E-02	3.21E+00	1.86E-03	3.10E-01
3147-A01	9-0491	670	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2202-01	9-0499	755	0.15%	13.5	1.17E-01	1.96E+01	5.56E-05	9.26E-03	3.12E-02	5.20E+00	3.01E-03	5.01E-01
3660-01	9-0500	643	0.17%	15.3	1.13E-01	1.89E+01	5.37E-05	8.94E-03	3.01E-02	5.02E+00	2.90E-03	4.83E-01
				Total	**1.95E+01**	**2.24E+03**	**9.30E-03**	**1.07E+00**	**5.10E+00**	**5.82E+02**	**4.96E-01**	**5.69E+01**

ACTUAL EMISSION
CALCULATIONS CY 2023
EMERGENCY GENERATORS

Emission Unit Number	MDE Reg. Number	HP	Capacity Factor	Hours/Yr	Emission Rates							
					PM (filterable)		PM-10 (filterable)		PM-2.5 (filterable)		PM Condensable	
					tpy	lb/day	tpy	lb/day	tpy	lb/day	tpy	lb/day
0120-01	9-0409	2922	0.16%	14.0	9.13E-03	1.52E+00	7.30E-03	1.22E+00	7.05E-03	1.18E+00	1.13E-03	1.89E-01
0120-02	9-0433	2922	0.21%	18.6	1.21E-02	2.02E+00	9.70E-03	1.62E+00	9.37E-03	1.56E+00	1.51E-03	2.51E-01
0120-03	9-0434	2922	0.15%	13.0	8.48E-03	1.41E+00	6.78E-03	1.13E+00	6.55E-03	1.09E+00	1.05E-03	1.75E-01
Bldg 120 - Gen. #1	9-0503	2922	0.16%	13.7	8.94E-03	1.49E+00	7.15E-03	1.19E+00	6.90E-03	1.15E+00	1.11E-03	1.85E-01
Bldg 120 - Gen. #2	9-0504	2922	0.15%	13.1	8.54E-03	1.42E+00	6.83E-03	1.14E+00	6.60E-03	1.10E+00	1.06E-03	1.77E-01
3090-01	9-0410	2923	0.41%	35.5	2.32E-02	3.86E+00	1.85E-02	3.09E+00	1.79E-02	2.98E+00	2.88E-03	4.79E-01
0316-01	9-0408	2922	0.14%	12.0	7.83E-03	1.30E+00	6.26E-03	1.04E+00	6.05E-03	1.01E+00	9.72E-04	1.62E-01
03-0328-A03	9-0418	804.6	0.13%	11.0	1.98E-03	3.29E-01	1.58E-03	2.63E-01	1.53E-03	2.54E-01	2.45E-04	4.09E-02
03-0328-A02	9-0414	670.5	0.16%	14.0	2.10E-03	3.49E-01	1.68E-03	2.79E-01	1.62E-03	2.70E-01	2.60E-04	4.34E-02
03-0328-A01	9-0229	1072	0.50%	44.0	1.05E-02	1.75E+00	8.42E-03	1.40E+00	8.13E-03	1.36E+00	1.31E-03	2.18E-01
03-0394-A01	9-0227	1341	0.56%	49.0	1.47E-02	2.44E+00	1.17E-02	1.96E+00	1.13E-02	1.89E+00	1.82E-03	3.04E-01
03-0394-A02	9-0228	1341	0.64%	56.0	1.68E-02	2.79E+00	1.34E-02	2.23E+00	1.29E-02	2.16E+00	2.08E-03	3.47E-01
03-0394-A03	9-0386	750	0.68%	60.0	1.00E-02	1.67E+00	8.04E-03	1.34E+00	7.76E-03	1.29E+00	1.25E-03	2.08E-01
03-0394-A04	9-0387	750	0.49%	43.0	7.20E-03	1.20E+00	5.76E-03	9.60E-01	5.56E-03	9.27E-01	8.94E-04	1.49E-01
03-0394-A05	9-0388	750	0.02%	2.0	3.35E-04	5.58E-02	2.68E-04	4.46E-02	2.59E-04	4.31E-02	4.16E-05	6.93E-03
03-0394-A06	9-0389	750	0.68%	60.0	1.00E-02	1.67E+00	8.04E-03	1.34E+00	7.76E-03	1.29E+00	1.25E-03	2.08E-01
03-0394-A07	9-0390	750	0.54%	47.0	7.87E-03	1.31E+00	6.29E-03	1.05E+00	6.08E-03	1.01E+00	9.77E-04	1.63E-01
03-4600-A04	9-0276	1877	0.31%	27.3	1.14E-02	1.91E+00	9.15E-03	1.52E+00	8.84E-03	1.47E+00	1.42E-03	2.37E-01
03-4600-A05	9-0277	1877	0.31%	27.5	1.15E-02	1.92E+00	9.22E-03	1.54E+00	8.90E-03	1.48E+00	1.43E-03	2.38E-01
6009-01	9-0412	1502	0.11%	9.5	3.18E-03	5.31E-01	2.55E-03	4.25E-01	2.46E-03	4.10E-01	3.96E-04	6.59E-02
6010-01	9-0411	2937	0.13%	11.0	7.21E-03	1.20E+00	5.77E-03	9.61E-01	5.57E-03	9.29E-01	8.96E-04	1.49E-01
6010-02	9-0411	2937	0.08%	7.0	4.59E-03	7.65E-01	3.67E-03	6.12E-01	3.55E-03	5.91E-01	5.70E-04	9.50E-02
LWE-01	9-0436	550	1.16%	102.0	1.25E-02	8.94E-01	1.00E-02	7.16E-01	9.67E-03	6.91E-01	1.56E-03	1.11E-01
LWE-02	9-0436	550	1.18%	103.0	1.26E-02	9.03E-01	1.01E-02	7.23E-01	9.77E-03	6.98E-01	1.57E-03	1.12E-01
LWE-03	9-0436	550	1.19%	104.0	1.28E-02	9.12E-01	1.02E-02	7.30E-01	9.86E-03	7.05E-01	1.59E-03	1.13E-01
LWE-04	9-0436	550	1.16%	102.0	1.25E-02	8.94E-01	1.00E-02	7.16E-01	9.67E-03	6.91E-01	1.56E-03	1.11E-01
LWE-05	9-0436	550	1.16%	102.0	1.25E-02	8.94E-01	1.00E-02	7.16E-01	9.67E-03	6.91E-01	1.56E-03	1.11E-01
26-GMS-Lab-A04	9-0393	3778	0.09%	8.0	6.75E-03	1.12E+00	5.40E-03	8.99E-01	5.21E-03	8.69E-01	8.38E-04	1.40E-01
26-C2CNTWest-A05	9-0394	2200	0.02%	2.0	9.82E-04	1.64E-01	7.86E-04	1.31E-01	7.59E-04	1.26E-01	1.22E-04	2.03E-02
26-GMS Tower-A04	9-0395	2200	0.02%	2.0	9.82E-04	1.64E-01	7.86E-04	1.31E-01	7.59E-04	1.26E-01	1.22E-04	2.03E-02
26-HQBuilding-A06	9-0396	2922	0.05%	4.0	2.61E-03	4.35E-01	2.09E-03	3.48E-01	2.02E-03	3.36E-01	3.24E-04	5.40E-02
Bldg 5016 - pending	9-0510	2346	0.07%	5.7	2.98E-03	4.97E-01	2.39E-03	3.98E-01	2.31E-03	3.84E-01	3.71E-04	6.18E-02
Bldg 5046 - pending	9-0511	617	0.08%	6.7	9.23E-04	1.54E-01	7.38E-04	1.23E-01	7.13E-04	1.19E-01	1.15E-04	1.91E-02
BSS-01	9-0435	600	8.20%	718.5	9.62E-02	2.53E+00	7.70E-02	2.03E+00	7.43E-02	1.96E+00	1.20E-02	3.14E-01
UTF-01	9-0437	500	0.28%	24.6	2.74E-03	3.92E-01	2.19E-03	3.13E-01	2.12E-03	3.03E-01	3.41E-04	4.86E-02
0311-01	9-0419	600	0.12%	10.5	1.41E-03	2.34E-01	1.12E-03	1.87E-01	1.09E-03	1.81E-01	1.75E-04	2.91E-02
3147-A01	9-0491	670	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2202-01	9-0499	755	0.15%	13.5	2.27E-03	3.79E-01	1.82E-03	3.03E-01	1.76E-03	2.93E-01	2.83E-04	4.71E-02
3660-01	9-0500	643	0.17%	15.3	2.20E-03	3.66E-01	1.76E-03	2.93E-01	1.70E-03	2.83E-01	2.73E-04	4.55E-02
				Total	**3.81E-01**	**4.39E+01**	**3.05E-01**	**3.51E+01**	**2.94E-01**	**3.39E+01**	**4.73E-02**	**5.45E+00**

ACTUAL EMISSION
CALCULATIONS CY 2023
EMERGENCY GENERATORS

Emission Unit Number	MDE Reg. Number	HP	Capacity Factor	Hours/Yr	Emission Rates					
					CO2		CH4		N2O	
					tpy	lb/day	tpy	lb/day	tpy	lb/day
0120-01	9-0409	2922	0.16%	14.0	2.40E+01	4.00E+03	9.74E-04	1.62E-01	1.95E-04	3.25E-02
0120-02	9-0433	2922	0.21%	18.6	3.19E+01	5.32E+03	1.29E-03	2.16E-01	2.59E-04	4.31E-02
0120-03	9-0434	2922	0.15%	13.0	2.23E+01	3.72E+03	9.04E-04	1.51E-01	1.81E-04	3.01E-02
Bldg 120 - Gen. #1	9-0503	2922	0.16%	13.7	2.35E+01	3.92E+03	9.53E-04	1.59E-01	1.91E-04	3.18E-02
Bldg 120 - Gen. #2	9-0504	2922	0.15%	13.1	2.25E+01	3.74E+03	9.11E-04	1.52E-01	1.82E-04	3.04E-02
3090-01	9-0410	2923	0.41%	35.5	6.09E+01	1.02E+04	2.47E-03	4.12E-01	4.94E-04	8.24E-02
0316-01	9-0408	2922	0.14%	12.0	2.06E+01	3.43E+03	8.35E-04	1.39E-01	1.67E-04	2.78E-02
03-0328-A03	9-0418	804.6	0.13%	11.0	5.20E+00	8.66E+02	2.11E-04	3.51E-02	4.21E-05	7.02E-03
03-0328-A02	9-0414	670.5	0.16%	14.0	5.51E+00	9.18E+02	2.24E-04	3.73E-02	4.47E-05	7.45E-03
03-0328-A01	9-0229	1072	0.50%	44.0	2.77E+01	4.61E+03	1.12E-03	1.87E-01	2.25E-04	3.74E-02
03-0394-A01	9-0227	1341	0.56%	49.0	3.86E+01	6.43E+03	1.56E-03	2.61E-01	3.13E-04	5.22E-02
03-0394-A02	9-0228	1341	0.64%	56.0	4.41E+01	7.35E+03	1.79E-03	2.98E-01	3.58E-04	5.96E-02
03-0394-A03	9-0386	750	0.68%	60.0	2.64E+01	4.40E+03	1.07E-03	1.79E-01	2.14E-04	3.57E-02
03-0394-A04	9-0387	750	0.49%	43.0	1.89E+01	3.16E+03	7.68E-04	1.28E-01	1.54E-04	2.56E-02
03-0394-A05	9-0388	750	0.02%	2.0	8.80E-01	1.47E+02	3.57E-05	5.95E-03	7.14E-06	1.19E-03
03-0394-A06	9-0389	750	0.68%	60.0	2.64E+01	4.40E+03	1.07E-03	1.79E-01	2.14E-04	3.57E-02
03-0394-A07	9-0390	750	0.54%	47.0	2.07E+01	3.45E+03	8.39E-04	1.40E-01	1.68E-04	2.80E-02
03-4600-A04	9-0276	1877	0.31%	27.3	3.01E+01	5.01E+03	1.22E-03	2.03E-01	2.44E-04	4.07E-02
03-4600-A05	9-0277	1877	0.31%	27.5	3.03E+01	5.05E+03	1.23E-03	2.05E-01	2.46E-04	4.10E-02
6009-01	9-0412	1502	0.11%	9.5	8.38E+00	1.40E+03	3.40E-04	5.66E-02	6.79E-05	1.13E-02
6010-01	9-0411	2937	0.13%	11.0	1.90E+01	3.16E+03	7.69E-04	1.28E-01	1.54E-04	2.56E-02
6010-02	9-0411	2937	0.08%	7.0	1.21E+01	2.01E+03	4.90E-04	8.16E-02	9.79E-05	1.63E-02
LWE-01	9-0436	550	1.16%	102.0	3.29E+01	2.35E+03	1.34E-03	9.54E-02	2.67E-04	1.91E-02
LWE-02	9-0436	550	1.18%	103.0	3.33E+01	2.38E+03	1.35E-03	9.63E-02	2.70E-04	1.93E-02
LWE-03	9-0436	550	1.19%	104.0	3.36E+01	2.40E+03	1.36E-03	9.73E-02	2.72E-04	1.95E-02
LWE-04	9-0436	550	1.16%	102.0	3.29E+01	2.35E+03	1.34E-03	9.54E-02	2.67E-04	1.91E-02
LWE-05	9-0436	550	1.16%	102.0	3.29E+01	2.35E+03	1.34E-03	9.54E-02	2.67E-04	1.91E-02
26-GMS-Lab-A04	9-0393	3778	0.09%	8.0	1.77E+01	2.96E+03	7.20E-04	1.20E-01	1.44E-04	2.40E-02
26-C2CNTWest-A05	9-0394	2200	0.02%	2.0	2.58E+00	4.30E+02	1.05E-04	1.75E-02	2.10E-05	3.49E-03
26-GMS Tower-A04	9-0395	2200	0.02%	2.0	2.58E+00	4.30E+02	1.05E-04	1.75E-02	2.10E-05	3.49E-03
26-HQBuilding-A06	9-0396	2922	0.05%	4.0	6.86E+00	1.14E+03	2.78E-04	4.64E-02	5.57E-05	9.28E-03
Bldg 5016 - pending	9-0510	2346	0.07%	5.7	7.85E+00	1.31E+03	3.18E-04	5.31E-02	6.37E-05	1.06E-02
Bldg 5046 - pending	9-0511	617	0.08%	6.7	2.43E+00	4.04E+02	9.84E-05	1.64E-02	1.97E-05	3.28E-03
BSS-01	9-0435	600	8.20%	718.5	2.53E+02	6.66E+03	1.03E-02	2.70E-01	2.05E-03	5.40E-02
UTF-01	9-0437	500	0.28%	24.6	7.21E+00	1.03E+03	2.93E-04	4.18E-02	5.85E-05	8.36E-03
0311-01	9-0419	600	0.12%	10.5	3.70E+00	6.16E+02	1.50E-04	2.50E-02	3.00E-05	5.00E-03
3147-A01	9-0491	670	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2202-01	9-0499	755	0.15%	13.5	5.98E+00	9.97E+02	2.43E-04	4.04E-02	4.85E-05	8.09E-03
3660-01	9-0500	643	0.17%	15.3	5.77E+00	9.62E+02	2.34E-04	3.90E-02	4.68E-05	7.81E-03
				Total	**1.00E+03**	**1.15E+05**	**4.06E-02**	**4.68E+00**	**8.12E-03**	**9.36E-01**

NOTES:
Capacity Factor is calculated as defined in 40 CFR 72.2.
The generator hours shown on Forms 2 and 3 are based on the maintenance schedule, while the hours shown in the table above are the actual operating hours for maintenance and emergency use during the calendar year.

Paint Spray Booth
#1 Log CY2023

Paint Spray Booth (PSB#1: Bldg 0525, 7-00525-A04, MDE Registration # 12-6-0162)

HAP/TAP Emissions				Tons/year		lbs/hr					
Material	Constituent	Constituent % by weight (expressed as a decimal)	Density (lb/gal)	Volatile Constituent Emissions (tpy)	Particulate Constituent Emissions (tpy)*	Volatile Constituent Emissions (lb/hr)	Particulate Constituent Emissions (lb/hr)	Reporting Threshold (lb/hr)	Reporting Threshold (tpy)	Report on Form 4 (tpy)	Report on Form 4 (lb/hr)
Epoxy Primer SW E90A229	Epoxy Polymer	0.0868	8.000		6.08E-05		1.46E-02				
	p-Chlorobenzotrifluoride	0.1174	8.000	2.35E-03		5.62E-01					
	Acetone	0.1011	8.000	2.02E-03		4.84E-01					
	t-Butyl Acetate	0.0584	8.000	1.17E-03		2.80E-01					
	Methyl Propyl Ketone	0.0000	8.000	0.00E+00		0.00E+00					
	Silica, Crystalline - Quartz	0.0000	8.000		0.00E+00		0.00E+00				
	Talc (no asbestos)	0.0000	8.000	0.00E+00		0.00E+00					
	Titanium Dioxide	0.1912	8.000		1.34E-04		3.21E-02				
	Zinc Oxide	0.0157	8.000		1.10E-05		2.63E-03	1.00E-02	1.00E-01	No	No
Epoxy Primer MIL-DTL-53022	Methyl Acetate	0.1500	11.980	1.80E-03		2.23E-01					
	Epoxy Resin	0.0750	11.980	8.99E-04		3.27E-01					
	Titanium Dioxide	0.0750	11.980		3.14E-05		1.14E-02				
	Diisobutyl Ketone	0.0750	11.980	8.99E-04		3.27E-01					
	Methyl Amyl Ketone	0.0300	11.980	3.59E-04		1.31E-01					
	Zinc Phosphate	0.0300	11.980		1.26E-05		4.57E-03	1.00E-02	1.00E-01	No	No
	Synthetic Amorphous Silica (precipitated)	0.0300	11.980		1.26E-05		4.57E-03				
	Butyl Acetate	0.0300	11.980	3.59E-04		1.31E-01					
	silicon dioxide	0.0050	11.980		2.10E-06		7.62E-04				
Green CARC 2 F93G0S116	p-Chlorobenzotrifluoride	0.3750	11.099	9.83E-02		3.39E+00					
	Hexamethylene Diisocyanate Polymer	0.1750	11.099	4.59E-02		1.58E+00		1.00E-04	1.00E-03	Yes	Yes
	Cobalt Chromite Green Spinel	0.1000	11.099		9.18E-04		3.16E-02	1.00E-04	1.00E-03	No	Yes
	Chromium Oxide	0.1000	11.099		9.18E-04		3.16E-02	1.00E-03	1.00E-02	No	Yes
	Magnesium Ferrite	0.0300	11.099		2.75E-04		9.49E-03				
	Polyester	0.0300	11.099		2.75E-04		9.49E-03				
	Light Aromatic Hydrocarbons	0.0300	11.099	7.87E-03		2.71E-01					
	n-Butyl Acetate	0.0300	11.099	7.87E-03		2.71E-01					
	trimethylbenzene	0.0100	11.099	2.62E-03		9.04E-02					
	Bis(pentamethyl-4-piperidyl)sebacate	0.0100	11.099	2.62E-03		9.04E-02					
	1,3,5-Trimethylbenzene	0.0100	11.099	2.62E-03		9.04E-02					
	1,2,4-Trimethylbenzene	0.0100	11.099	2.62E-03		9.04E-02					
	Pentamethyliperidyl Sebacate	0.0030	11.099	7.87E-04		2.71E-02					
	Xylene	0.0030	11.099	7.87E-04		2.71E-02		1.00E+00	1.00E+01	No	No
	1,2,3-Trimethylbenzene	0.0030	11.099	7.87E-04		2.71E-02					
	Cumene	0.0030	11.099	7.87E-04		2.71E-02		1.00E+00	1.00E+01	No	No
Green CARC 3 F93G704	p-Chlorobenzotrifluoride	0.3750	11.015	2.12E-02		4.03E+00					
	Hexamethylene Diisocyanate Polymer	0.1750	11.015	9.88E-03		1.88E+00		1.00E-04	1.00E-03	Yes	Yes
	Cobalt Chromite Green Spinel	0.1000	11.015		1.98E-04		3.76E-02	1.00E-04	1.00E-03	No	Yes
	Chromium Oxide	0.1000	11.015		1.98E-04		3.76E-02	1.00E-03	1.00E-02	No	Yes
	Magnesium Ferrite	0.0300	11.015		5.93E-05		1.13E-02				
	Light Aromatic Hydrocarbons	0.0300	11.015	1.69E-03		3.23E-01					
	n-Butyl Acetate	0.0300	11.015	1.69E-03		3.23E-01					
	trimethylbenzene	0.0100	11.015	5.65E-04		1.08E-01					
	1,2,4-Trimethylbenzene	0.0097	11.015	5.48E-04		1.04E-01					
	1,3,5-Trimethylbenzene	0.0097	11.015	5.48E-04		1.04E-01					
	Bis(pentamethyl-4-piperidyl)sebacate	0.0030	11.015	1.69E-04		3.23E-02					
	Heavy Aromatic Naphtha	0.0030	11.015	1.69E-04		3.23E-02					
	1-[2-(Dimethylamino)ethyl]-4-methylpiperazine	0.0030	11.015	1.69E-04		3.23E-02					
	Xylene	0.0029	11.015	1.64E-04		3.12E-02		1.00E+00	1.00E+01	No	No
	1,2,3-Trimethylbenzene	0.0029	11.015	1.64E-04		3.12E-02					
	Cumene	0.0029	11.015	1.64E-04		3.12E-02		1.00E+00	1.00E+01	No	No
400 Pearl Gray Ameron AK2-23/01	Tert-Butyl Acetate	0.1000	11.850	1.19E-03		7.90E-01					
	Titanium Dioxide	0.0500	11.850		2.07E-05		1.38E-02				
	Epoxy Resin	0.7500	11.850	8.89E-03		5.93E+00					
	Talc, not containing asbestiform fibers	0.5000	11.850		2.07E-04		1.38E-01				

Paint Spray Booth
#1 Log CY2023

Paint Spray Booth (PSB#1: Bldg 0525, 7-00525-A04, MDE Registration # 12-6-0162)

HAP/TAP Emissions				Tons/year		lbs/hr					
Material	**Constituent**	**Constituent % by weight (expressed as a decimal)**	**Density (lb/gal)**	**Volatile Constituent Emissions (tpy)**	**Particulate Constituent Emissions (tpy)***	**Volatile Constituent Emissions (lb/hr)**	**Particulate Constituent Emissions (lb/hr)**	**Reporting Threshold (lb/hr)**	**Reporting Threshold (tpy)**	**Report on Form 4 (tpy)**	**Report on Form 4 (lb/hr)**
Black CARC 2 F93B0S114	p-Chlorobenzotrifluoride	0.3750	9.847	5.54E-03		2.77E+00					
	Hexamethylene Diisocyanate Polymer	0.1750	9.847	2.58E-03		1.29E+00		1.00E-04	1.00E-03	Yes	Yes
	Polyester	0.0300	9.847		1.55E-05		7.75E-03				
	Light Aromatic Hydrocarbons	0.0300	9.847	4.43E-04		2.22E-01					
	n-Butyl Acetate	0.0300	9.847	4.43E-04		2.22E-01					
	trimethylbenzene	0.0100	9.847	1.48E-04		7.39E-02					
	Carbon Black	0.0100	9.847		5.17E-06		2.58E-03				
	Bis(pentamethyl-4-piperidyl)sebacate	0.0100	9.847	1.48E-04		7.39E-02					
	1,3,5-Trimethylbenzene	0.0100	9.847	1.48E-04		7.39E-02					
	1,2,4-Trimethylbenzene	0.0100	9.847	1.48E-04		7.39E-02					
	1,[2-(Dimethylamina)ethyl]-4-methylpiperazine	0.0030	9.847	4.43E-05		2.22E-02					
	Pentamethyliperidyl Sebacate	0.0030	9.847	4.43E-05		2.22E-02					
	Xylene	0.0030	9.847	4.43E-05		2.22E-02		1.00E+00	1.00E+01	No	No
	1,2,3-Trimethylbenzene	0.0030	9.847	4.43E-05		2.22E-02					
	Cumene	0.0030	9.847	4.43E-05		2.22E-02		1.00E+00	1.00E+01	No	No
Tan CARC 2 F93H0S124	p-Chlorobenzotrifluoride	0.3750	10.348	6.60E-03		3.52E+00					
	Hexamethylene Diisocyanate Polymer	0.1750	10.348	3.08E-03		1.64E+00		1.00E-04	1.00E-03	Yes	Yes
	Polyester	0.0300	10.348		1.85E-05		9.85E-03				
	Light Aromatic Hydrocarbons	0.0300	10.348	5.28E-04		2.81E-01					
	n-Butyl Acetate	0.0300	10.348	5.28E-04		2.81E-01					
	trimethylbenzene	0.0100	10.348	1.76E-04		9.38E-02					
	Titanium Dioxide	0.1750	10.348		1.08E-04		5.75E-02				
	Bis(pentamethyl-4-piperidyl)sebacate	0.0100	10.348	1.76E-04		9.38E-02					
	1,3,5-Trimethylbenzene	0.0100	10.348	1.76E-04		9.38E-02					
	1,2,4-Trimethylbenzene	0.0100	10.348	1.76E-04		9.38E-02					
	Isophorone Diisocyanate (max.)	0.0100	10.348	1.76E-04		9.38E-02					
	Pentamethyliperidyl Sebacate	0.0030	10.348	5.28E-05		2.81E-02					
	Xylene	0.0030	10.348	5.28E-05		2.81E-02		1.00E+00	1.00E+01	No	No
	1,2,3-Trimethylbenzene	0.0030	10.348	5.28E-05		2.81E-02					
	Cumene	0.0030	10.348	5.28E-05		2.81E-02		1.00E+00	1.00E+01	No	No
Tile Clad	Epoxy Polymer	0.3750	10.566		6.93E-05		1.39E-01				
	titanium dioxide	0.1750	10.566		3.24E-05		6.47E-02				
	2-propoxyethanol	0.1000	10.566	5.28E-04		1.06E+00					
	Light Aliphatic Hydrocarbon	0.0100	10.566	5.28E-05		1.06E-01					
			Totals	**2.53E-01**	**3.58E-03**						

* Conservative assumption that there is 35% overspray and the filter capture efficiency is 90%, so 10% of the overspray escapes the filters.

Paint Spray Booth
#2 Log CY2023

Paint Spray Booth (PSB#2: Bldg 0525, 7-00525-A06, MDE Registration # 12-6-0159)

HAP/TAP Emissions						lbs/hr					
Material	Constituent	Constituent % by weight (expressed as a decimal)	Density (lb/gal)	Volatile Constituent Emissions (tpy)	Particulate Constituent Emissions (tpy)*	Volatile Constituent Emissions (lb/hr)	Particulate Constituent Emissions (lb/hr)	Reporting Threshold (lb/hr)	Reporting Threshold (tpy)	Report on Form 4 (tpy)	Report on Form 4 (lb/hr)
Earl Gray B66W1151	Titanium Dioxide	0.1750	10.150		2.33E-05		4.66E-02				
	Benzophenone	0.0030	10.150	1.14E-05		2.28E-02					
	Cristobalite, respirable powder	0.0030	10.150		4.00E-07		7.99E-04				
Epoxy Primer SW E90A229	Epoxy Polymer	0.0868	8.000		1.70E-05		1.17E-02				
	p-Chlorobenzotrifluoride	0.1174	8.000	6.57E-04		4.53E-01					
	Acetone	0.1011	8.000	5.66E-04		3.90E-01					
	t-Butyl Acetate	0.0584	8.000	3.27E-04		2.26E-01					
	Methyl Propyl Ketone	0.0000	8.000	0.00E+00		0.00E+00					
	Silica, Crystalline - Quartz	0.0000	8.000		0.00E+00		0.00E+00				
	Talc (no asbestos)	0.0000	8.000	0.00E+00		0.00E+00					
	Titanium Dioxide	0.1912	8.000		3.75E-05		2.58E-02				
	Zinc Oxide	0.0157	8.000		3.08E-06		2.12E-03	1.00E-02	1.00E-01	No	No
Epoxy Primer MIL-DTL-53022	Methyl Acetate	0.1500	11.980	7.19E-04		5.99E-01					
	Epoxy Resin	0.0750	11.980	3.59E-04		3.00E-01					
	Titanium Dioxide	0.0750	11.980		1.26E-05		1.05E-02				
	Diisobutyl Ketone	0.0750	11.980	3.59E-04		3.00E-01					
	Methyl Amyl Ketone	0.0300	11.980	1.44E-04		1.20E-01					
	Zinc Phosphate	0.0300	11.980		5.03E-06		4.19E-03	1.00E-02	1.00E-01	No	No
	Synthetic Amorphous Silica (precipitated)	0.0300	11.980		5.03E-06		4.19E-03				
	Butyl Acetate	0.0300	11.980	1.44E-04		1.20E-01					
	silicon dioxide	0.0050	11.980		8.39E-07		6.99E-04				
Green CARC 2 F93G0S116	p-Chlorobenzotrifluoride	0.3750	11.099	3.69E-02		3.36E+00					
	Hexamethylene Diisocyanate Polymer	0.1750	11.099	1.72E-02		1.57E+00		1.00E-04	1.00E-03	Yes	Yes
	Cobalt Chromite Green Spinel	0.1000	11.099		3.45E-04		3.13E-02	1.00E-04	1.00E-03	No	Yes
	Chromium Oxide	0.1000	11.099		3.45E-04		3.13E-02	1.00E-03	1.00E-02	No	Yes
	Magnesium Ferrite	0.0300	11.099		1.03E-04		9.40E-03				
	Polyester	0.0300	11.099		1.03E-04		9.40E-03				
	Light Aromatic Hydrocarbons	0.0300	11.099	2.96E-03		2.69E-01					
	n-Butyl Acetate	0.0300	11.099	2.96E-03		2.69E-01					
	trimethylbenzene	0.0100	11.099	9.85E-04		8.95E-02					
	Bis(pentamethyl-4-piperidyl)sebacate	0.0100	11.099	9.85E-04		8.95E-02					
	1,3,5-Trimethylbenzene	0.0100	11.099	9.85E-04		8.95E-02					
	1,2,4-Trimethylbenzene	0.0100	11.099	9.85E-04		8.95E-02					
	Pentamethyliperidyl Sebacate	0.0030	11.099	2.96E-04		2.69E-02					
	Xylene	0.0030	11.099	2.96E-04		2.69E-02		1.00E+00	1.00E+01	No	No
	1,2,3-Trimethylbenzene	0.0030	11.099	2.96E-04		2.69E-02					
	Cumene	0.0030	11.099	2.96E-04		2.69E-02		1.00E+00	1.00E+01	No	No
400 Pearl Gray Ameron AK2-23/01	Tert-Butyl Acetate	0.10	11.850	0.00E+00		0.00E+00					
	Titanium Dioxide	0.05	11.850		0.00E+00		0.00E+00				
	Epoxy Resin	0.75	11.850		0.00E+00		0.00E+00				
	Talc, not containing asbestiform fibers	0.50	11.850		0.00E+00		0.00E+00				
Green CARC 3 F93G704	p-Chlorobenzotrifluoride	0.3750	11.015	2.07E-03		4.13E+00					
	Hexamethylene Diisocyanate Polymer	0.1750	11.015	9.64E-04		1.93E+00		1.00E-04	1.00E-03	No	Yes
	Cobalt Chromite Green Spinel	0.1000	11.015		1.93E-05		3.86E-02	1.00E-04	1.00E-03	No	Yes
	Chromium Oxide	0.1000	11.015		1.93E-05		3.86E-02	1.00E-03	1.00E-02	No	Yes
	Magnesium Ferrite	0.0300	11.015		5.78E-06		1.16E-02				
	Light Aromatic Hydrocarbons	0.0300	11.015	1.65E-04		3.30E-01					
	n-Butyl Acetate	0.0300	11.015	1.65E-04		3.30E-01					
	trimethylbenzene	0.0100	11.015	5.51E-05		1.10E-01					
	1,2,4-Trimethylbenzene	0.0097	11.015	5.34E-05		1.07E-01					
	1,3,5-Trimethylbenzene	0.0097	11.015	5.34E-05		1.07E-01					
	Bis(pentamethyl-4-piperidyl)sebacate	0.0030	11.015	1.65E-05		3.30E-02					
	Heavy Aromatic Naphtha	0.0030	11.015	1.65E-05		3.30E-02					
	1-[2-(Dimethylamino)ethyl]-4-methylpiperazine	0.0030	11.015	1.65E-05		3.30E-02					

Paint Spray Booth
#2 Log CY2023

Paint Spray Booth (PSB#2: Bldg 0525, 7-00525-A06, MDE Registration # 12-6-0159)

HAP/TAP Emissions						lbs/hr					
Material	Constituent	Constituent % by weight (expressed as a decimal)	Density (lb/gal)	Volatile Constituent Emissions (tpy)	Particulate Constituent Emissions (tpy)*	Volatile Constituent Emissions (lb/hr)	Particulate Constituent Emissions (lb/hr)	Reporting Threshold (lb/hr)	Reporting Threshold (tpy)	Report on Form 4 (tpy)	Report on Form 4 (lb/hr)
Green CARC 3 F93G704 (cont.)	Xylene	0.0029	11.015	1.60E-05		3.19E-02		1.00E+00	1.00E+01	No	No
	1,2,3-Trimethylbenzene	0.0029	11.015	1.60E-05		3.19E-02					
	Cumene	0.0029	11.015	1.60E-05		3.19E-02		1.00E+00	1.00E+01	No	No
Black CARC 2 F93B0S114	p-Chlorobenzotrifluoride	0.3750	9.847	1.85E-03		2.95E+00					
	Hexamethylene Diisocyanate Polymer	0.1750	9.847	8.62E-04		1.38E+00		1.00E-04	1.00E-03	No	Yes
	Polyester	0.0300	9.847		5.17E-06		8.27E-03				
	Light Aromatic Hydrocarbons	0.0300	9.847	1.48E-04		2.36E-01					
	n-Butyl Acetate	0.0300	9.847	1.48E-04		2.36E-01					
	trimethylbenzene	0.0100	9.847	4.92E-05		7.88E-02					
	Carbon Black	0.0100	9.847		1.72E-06		2.76E-03				
	Bis(pentamethyl-4-piperidyl)sebacate	0.0100	9.847	4.92E-05		7.88E-02					
	1,3,5-Trimethylbenzene	0.0100	9.847	4.92E-05		7.88E-02					
	1,2,4-Trimethylbenzene	0.0100	9.847	4.92E-05		7.88E-02					
	1,[2-(Dimethylamina)ethyl]-4-methylpiperazine	0.0030	9.847	1.48E-05		2.36E-02					
	Pentamethyliperidyl Sebacate	0.0030	9.847	1.48E-05		2.36E-02					
	Xylene	0.0030	9.847	1.48E-05		2.36E-02		1.00E+00	1.00E+01	No	No
	1,2,3-Trimethylbenzene	0.0030	9.847	1.48E-05		2.36E-02					
	Cumene	0.0030	9.847	1.48E-05		2.36E-02		1.00E+00	1.00E+01	No	No
Tan CARC 2 F93H0S124	p-Chlorobenzotrifluoride	0.3750	10.348	5.82E-03		3.88E+00					
	Hexamethylene Diisocyanate Polymer	0.1750	10.348	2.72E-03		1.81E+00		1.00E-04	1.00E-03	Yes	Yes
	Polyester	0.0300	10.348		1.63E-05		1.09E-02				
	Light Aromatic Hydrocarbons	0.0300	10.348	4.66E-04		3.10E-01					
	n-Butyl Acetate	0.0300	10.348	4.66E-04		3.10E-01					
	trimethylbenzene	0.0100	10.348	1.55E-04		1.03E-01					
	Titanium Dioxide	0.1750	10.348		9.51E-05		6.34E-02				
	Bis(pentamethyl-4-piperidyl)sebacate	0.0100	10.348	1.55E-04		1.03E-01					
	1,3,5-Trimethylbenzene	0.0100	10.348	1.55E-04		1.03E-01					
	1,2,4-Trimethylbenzene	0.0100	10.348	1.55E-04		1.03E-01					
	Isophorone Diisocyanate (max.)	0.0100	10.348	1.55E-04		1.03E-01					
	Pentamethyliperidyl Sebacate	0.0030	10.348	4.66E-05		3.10E-02					
	Xylene	0.0030	10.348	4.66E-05		3.10E-02		1.00E+00	1.00E+01	No	No
	1,2,3-Trimethylbenzene	0.0030	10.348	4.66E-05		3.10E-02					
	Cumene	0.0030	10.348	4.66E-05		3.10E-02		1.00E+00	1.00E+01	No	No
White Epoxy B67W201	Epoxy Polymer	0.25	14.090		1.54E-05		1.23E-01				
	Titanium Dioxide	0.26	14.090		1.60E-05		1.28E-01				
	Xylene	0.08	14.090	1.41E-04		1.13E+00		1.00E+00	1.00E+01	No	Yes
	1-Methoxy-2-Propanol Acetate	0.02	14.090	3.52E-05		2.82E-01					
	Ethyl Benzene	0.01	14.090	1.76E-05		1.41E-01		1.00E+00	1.00E+01	No	No
Red Oxide Primer	Titanium Dioxide	0.020	9.901		1.73E-06		3.47E-03				
	Carbon Black	0.002	9.901		1.73E-07		3.47E-04				
			Totals	**8.60E-02**	**1.20E-03**						

* Conservative assumption that there is 35% overspray and the filter capture efficiency is 90%, so 10% of the overspray escapes the filters.

Fire Test Lab (IFEL) Emissions (07-0525-A01, MDE Registration # 12-9-0216) - CY2023

Part 1 (fuel)

Fuel	Total used (gal)	
JP-8, gasoline, and fuel oil combined:	0.00	
Number of hours/year:	0.00	Assuming 8 hours/day
Number of days/year:	0.00	

Pollutant	Uncontrolled emission factor (lb/1000 gallons)	Control efficiency	Emissions (lbs/year)	Emissions (tons/year)	Emissions (lbs/day)	Emissions (lbs/hr)
Criteria air pollutants						
NOx	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SOx*	7.2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO	5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VOC	0.34	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM Filterable	2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM-10 Filterable	1.08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM-2.5 Filterable	0.83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM Condensable	1.3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Greenhouse gases						
CO2	22,300	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CH4	0.216	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
N2O	0.26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hazardous air pollutants						
Acenaphthene	2.11E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthylene	2.53E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Anthracene	1.22E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benz(a)anthracene	4.01E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene	2.14E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(b)fluoranthene	1.48E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(ghi)perylene	2.26E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(k)fluoranthene	1.48E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chrysene	2.38E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	1.67E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethyl Benzene	6.36E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluoranthene	4.84E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluorene	4.47E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Formaldehyde	3.30E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	2.14E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methyl chloroform	2.36E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene	1.13E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Phenanthrene	1.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pyrene	4.25E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	6.20E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene	1.09E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

* Based on 0.05% Sulfur

NOTES:

1. Emission Factor Source: Criteria Pollutant Emission Factors from Table 1.3-1, 1.3-2, 1.3-3, and 1.3-7 of AP-42.
2. GHG factors derived from oil combustion factors, Tables 1.3-3, 1.3-8, and 1.3-12.
3. HAPs emission factors for JP-8 not available, so boiler oil EFs used from AP-42 Vol I:1.3: Fuel Oil Combustion, Table 1.3-9.

Part 2 (agent)

Agent component which produces TAP	Component Formula	Component MW (g/mol)	Quantity of agent component (lbs)	Days/yr	Toxic air pollutants	lb TAP / lb agent (100% conversion)	% conversion (assumed)	% emitted (assumed)	TAP emission lbs/yr	TAP emission tons/yr	TAP emission lbs/day	TAP emission lbs/hour***
Potassium lactate*	C3H5KO3	128.17	0.00	0.00	K_2O**	0.367	90%	50%	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Opteon	C4H2F6	164.00	0.00	0.00	HF	0.73	90%	90%	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FM-200	C3HF7	170.03	0.00	0.00	HF	0.82	90%	90%	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Halon 1301	CBrF3	148.90	0.00	0.00	HF	0.40	90%	90%	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Halon 1301	CBrF3	148.90	0.00	0.00	HBr	0.54	90%	90%	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*Assuming 45% of total quantity is water and 55% of total quantity is potassium lactat***Assuming 8 hours/day

** Molecular weight of K2O = 94.2 g/mol

ECO Mobile Incinerator Emissions - CY2023

Part 1 (municipal waste)

Waste processed (lbs/year)	0.00	assumes 244 lbs/day - based on historical throughput
Waste processed (tons/year)	0.00	
Number of hours/year	0.00	assumed 8 hrs/day operated
Number of days:	0.00	

Pollutant	Uncontrolled emission factor (lb/ton)	Control efficiency	Emissions (lbs/year)	Emissions (tons/year)	Emissions (lbs/day)	Emissions (lbs/hr)
Criteria air pollutants						
PM Filterable	2.51E+01	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM-10 Filterable	2.51E+01	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM2.5 Filterable	2.51E+01	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM Condensable	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NOx	1.24E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SO_2	3.46E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VOC	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Greenhouse gases						
CO_2	1.97E+03	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toxic air pollutants						
As	4.37E-03	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd	1.09E-02	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr	8.97E-03	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg	5.60E-03	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni	7.85E-03	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb	2.13E-01	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HCl	6.40E+00	10.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

NOTES:

1. Control efficiency is assumed. The refractory in the breeches and ducts has material that absorbs the toxic components of the fumes generated from the process.
2. Emission factors from AP-42 Tables 2.1-2 and 2.1-7, for modular excess air combustors
3. No emission factors were available availble for Filterable and Condensable fractions of PM. It is assumed at PM Filterable = PM-10 Filterable = PM2.5 Filterable, and PM Consdensable is zero.

Part 2 (supplemental fuel)

Gallons of diesel per bur	0.00	assumes 1 gal/hr fuel consumption rate
Number of burns per yea	0.00	
Number of hours/year	0.00	
Number of days/year:	0.00	

Pollutant	Uncontrolled emission factor (lb/1000 gallons)	Control efficiency	Emissions (lbs/year)	Emissions (tons/year)	Emissions (lbs/day)	Emissions (lbs/hr)
Criteria air pollutants						
NOx	2.00E+01	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SOx*	7.20E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO	5.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VOC	3.40E-01	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM Filterable	2.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM-10 Filterable	1.08E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM-2.5 Filterable	8.30E-01	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PM Condensable	1.30E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Greenhouse gases						
CO_2	2.23E+04	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CH_4	2.16E-01	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
N_2O	2.60E-01	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toxic air pollutants						
Acenaphthene	2.11E-05	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthylene	2.53E-07	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Anthracene	1.22E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benz(a)anthracene	4.01E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene	2.14E-04	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(b)fluoranthene	1.48E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(ghi)perylene	2.26E+00	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(k)fluoranthene	1.48E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chrysene	2.38E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	1.67E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethyl Benzene	6.36E-05	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluoranthene	4.84E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fluorene	4.47E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Formaldehyde	3.30E-02	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	2.14E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methyl chloroform	2.36E-04	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene	1.13E-03	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Phenanthrene	1.05E-05	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pyrene	4.25E-06	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	6.20E-03	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene	1.09E-04	25.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

* Based on 0.05% Sulfur

NOTES:

1. Control efficiency is assumed. The refractory in the breeches and ducts has material that absorbs the toxic components of the fumes generated from the process.
2. Emission Factor Source: Criteria Pollutant Emission Factors from Table 1.3-1, 1.3-2 and 1.3-3 of AP-42.
3. GHG factors derived from oil combustion factors, Tables 1.3-3, 1.3-8, and 1.3-12.

Gasoline Storage Tanks - CY2023 (26-4029-A03 & A05, MDE Registration No. 12-9-012)

VOC Emissions Factor Source: AP-42, Table 5.2-7, 5th Ed., Vol. 1: Chap. 5 - Petroleum Industry, July 2008.

Emissions Factors (lb/1000 gal throughput)		
Type of Control	**Stage I Only**	**Stage I and II ***
Stage I balanced submerged filling	0.30	0.30
Tank breathing and emptying	1.00	1.00
Vehicle refueling losses	11.00	1.10
Spillage	0.70	0.70
Total EF	13.00	3.10

* Stage II VRS Decommissioned on 3/19/20, so use Stage I only Emission Factors for all of 2020 to be conservative.

VOC Emissions

Emissions Unit No.	MDE Reg. No.	EF (lb/1000 gal)	Throughput (gal/yr) (see table)	VOC Emissions (lb/day)	VOC Emissions (tpy)
26-4029-A03 & -05	12-9-0152	13.00	129704.00	4.62	0.84

HAP	Percent
Benzene	4.0%
Ethyl Benzene	2.0%
Toluene	22.0%
Xylene	10.0%

HAP Emissions

Emissions Unit No.	MDE Reg. No.	Benzene (tpy)	Ethyl Benzene (tpy)	Toluene (tpy)	Xylene (tpy)
26-4029-A03 & -05	12-9-0152	3.37E-02	1.69E-02	1.85E-01	8.43E-02

Emissions Unit No.	MDE Reg. No.	Benzene (lb/hr)	Ethyl Benzene (lb/hr)	Toluene (lb/hr)	Xylene (lb/hr)
26-4029-A03 & -05	12-9-0152	0.02	0.012	0.13	0.06

For worst case hourly emissions, 8 hr/day is used in the hourly emission calculations rather than 24 hr/day

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Boilers

HAP	*NG EF lb/MMscf	Oil EF lb/1000 gal
Acetaldehyde	4.30E-03	3.51E-01
Acenaphthene	1.80E-06	2.11E-05
Acenaphthylene	1.80E-06	2.53E-07
Acrolein	2.70E-03	3.51E-01
Anthracene	2.40E-06	1.22E-06
Arsenic	2.00E-04	1.60E-03
Benz(a)anthracene	1.80E-06	4.01E-06
Benzene	2.10E-03	2.14E-04
Benzo(a)pyrene	1.20E-06	
Benzo(b)fluoranthene	1.80E-06	1.48E-06
Benzo(ghi)perylene	1.20E-06	2.26E-06
Benzo(k)fluoranthene	1.80E-06	1.48E-06
Beryllium	1.20E-05	
1,3-Butadiene		1.48E-02
Cadmium	1.10E-03	1.50E-03
Chlorobenzene		2.00E-04
Chromium	1.40E-03	6.00E-04
Chrysene	1.80E-06	2.38E-06
Cobalt	8.40E-05	
Copper		4.10E-03
Dibenzo(a,h)anthracene	1.20E-06	1.67E-06
Dichlorobenzene	1.20E-03	
Ethyl Benzene	9.50E-03	6.36E-05
Fluoranthene	3.00E-06	4.84E-06
Fluorene	2.80E-06	4.47E-06
Formaldehyde	7.50E-02	3.30E-02
Hydrochloric Acid		1.86E-01
Indeno(1,2,3-cd)pyrene	1.80E-06	2.14E-06
Lead	5.00E-04	8.30E-03
Manganese	3.80E-04	3.10E-03
Mercury	2.60E-04	2.00E-03
Methyl Chloroform		2.36E-04
Naphthalene	6.10E-04	1.13E-03
Nickel	2.10E-03	3.90E-03
Phenanthrene	1.70E-05	1.05E-05
Pyrene	5.00E-06	4.25E-06
Selenium	2.40E-05	2.20E-03
Toluene	3.40E-03	6.20E-03
Xylene	2.72E-02	1.09E-04
Zinc		2.24E-02
Hexane	1.80E+00	3.50E-03

Emergency Generators Oil EF

HAP	≤600 HP lb/MMBtu	>600 HP lb/MMBtu
Acetaldehyde	7.67E-04	2.52E-05
Acenaphthene	1.42E-06	4.68E-06
Acenaphthylene	5.06E-06	9.23E-06
Acrolein	9.25E-05	7.88E-06
Anthracene	1.87E-06	1.23E-06
Arsenic	1.60E-03	1.60E-03
Benz(a)anthracene	1.68E-06	6.22E-07
Benzene	9.33E-04	7.76E-04
Benzo(a)pyrene	1.88E-07	2.57E-07
Benzo(b)fluoranthene	9.91E-08	1.11E-06
Benzo(ghi)perylene	4.89E-07	5.56E-07
Benzo(k)fluoranthene	1.55E-07	2.18E-07
Beryllium		
1,3-Butadiene	3.91E-05	2.17E-01
Cadmium	1.50E-03	1.50E-03
Chlorobenzene	2.00E-04	2.00E-04
Chromium	6.00E-04	6.00E-04
Chrysene	3.53E-07	1.53E-06
Cobalt		
Copper	4.10E-03	4.10E-03
Dibenzo(a,h)anthracene	5.83E-07	3.46E-07
Dichlorobenzene		
Ethyl Benzene	1.09E-02	1.09E-02
Fluoranthene	7.61E-06	4.03E-06
Fluorene	2.92E-05	1.28E-05
Formaldehyde	1.18E-03	7.89E-05
Hydrochloric Acid	1.86E-01	1.86E-01
Indeno(1,2,3-cd)pyrene	3.75E-07	4.14E-07
Lead	8.30E-03	8.30E-03
Manganese	3.10E-03	3.10E-03
Mercury	2.00E-03	2.00E-03
Methyl Chloroform		
Naphthalene	8.48E-05	1.30E-04
Nickel	3.90E-03	3.90E-03
Phenanthrene	2.94E-05	4.08E-05
Pyrene	4.78E-06	3.71E-06
Selenium	2.20E-03	2.20E-03
Toluene	4.09E-04	2.81E-04
Xylene	2.85E-04	1.93E-04
Zinc	2.24E-02	2.24E-02
Hexane	2.69E-02	2.69E-02

* No HAP emissions factors are available for Propane boilers, thus NG emission factors were used for Propane boilers
Emission calculation method is same as criteria pollutants calculated.

Notes: 1. Boiler NG EFs from AP-42 Vol. I:1.4: Natural Gas Combustion, Table 1.4-3.
2. Boiler Oil EFs from AP-42 Vol. I:1.3: Fuel Oil Combustion, Table 1.3-9.
3. Emergency Generator EFs from AP-42 Vol. I:3.3: Gasoline and Diesel Industrial Engines, Table 3.3-2. & AP-42 Vol. I3.4: Large Stationary Diesel and All Stationary Duel-fuel Engines, Tables 3.4-3 and 3.4-4
4. HAPs EF not available from AP-42 were replaced with factors from "*Ventura County Air Pollution Control District - AB 2588 Combustion Emission Factors, May 17, 2001*"

From MDE's Air Quality Compliance Program webpage: Beginning with the 2010 emissions year, ARA is requiring that all Title V facilities report emissions of HAPs from all registered equipment including fuel burning sources.

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emergency Generators Emissions (tpy)

Emissions Unit	Registration Number	HP	Hours	Acetaldehyde	Acenaphthene	Acenaphthylene	Acrolein	Anthracene	Arsenic	Benz(a)anthracene	Benzene	Benzo(a)pyrene
0120-01	9-0409	2922.0	14.0	3.71E-06	6.89E-07	1.36E-06	1.16E-06	1.81E-07	2.36E-04	9.16E-08	1.14E-04	3.78E-08
0120-02	9-0433	2922.0	18.6	4.93E-06	9.16E-07	1.81E-06	1.54E-06	2.41E-07	3.13E-04	1.22E-07	1.52E-04	5.03E-08
0120-03	9-0434	2922.0	13.0	3.45E-06	6.40E-07	1.26E-06	1.08E-06	1.68E-07	2.19E-04	8.51E-08	1.06E-04	3.51E-08
Bldg 120 - Gen. #1	9-0503	2922.0	13.7	3.63E-06	6.74E-07	1.33E-06	1.14E-06	1.77E-07	2.31E-04	8.96E-08	1.12E-04	3.70E-08
Bldg 120 - Gen. #2	9-0504	2922.0	13.1	3.47E-06	6.45E-07	1.27E-06	1.09E-06	1.69E-07	2.20E-04	8.57E-08	1.07E-04	3.54E-08
3090-01	9-0410	2923.0	35.5	9.41E-06	1.75E-06	3.45E-06	2.94E-06	4.59E-07	5.98E-04	2.32E-07	2.90E-04	9.60E-08
0316-01	9-0408	2922.0	12.0	3.18E-06	5.91E-07	1.17E-06	9.95E-07	1.55E-07	2.02E-04	7.85E-08	9.80E-05	3.24E-08
03-0328-A03	9-0418	804.6	11.0	8.03E-07	1.49E-07	2.94E-07	2.51E-07	3.92E-08	5.10E-05	1.98E-08	2.47E-05	8.19E-09
03-0328-A02	9-0414	670.5	14.0	8.52E-07	1.58E-07	3.12E-07	2.66E-07	4.16E-08	5.41E-05	2.10E-08	2.62E-05	8.68E-09
03-0328-A01	9-0229	1072.0	44.0	4.28E-06	7.95E-07	1.57E-06	1.34E-06	2.09E-07	2.72E-04	1.06E-07	1.32E-04	4.36E-08
03-0394-A01	9-0227	1341.0	49.0	5.96E-06	1.11E-06	2.18E-06	1.86E-06	2.91E-07	3.78E-04	1.47E-07	1.84E-04	6.08E-08
03-0394-A02	9-0228	1341.0	56.0	6.81E-06	1.27E-06	2.50E-06	2.13E-06	3.33E-07	4.33E-04	1.68E-07	2.10E-04	6.95E-08
03-0394-A03	9-0386	750.0	60.0	4.08E-06	7.58E-07	1.50E-06	1.28E-06	1.99E-07	2.59E-04	1.01E-07	1.26E-04	4.16E-08
03-0394-A04	9-0387	750.0	43.0	2.93E-06	5.43E-07	1.07E-06	9.15E-07	1.43E-07	1.86E-04	7.22E-08	9.01E-05	2.98E-08
03-0394-A05	9-0388	750.0	2.0	1.36E-07	2.53E-08	4.98E-08	4.26E-08	6.64E-09	8.64E-06	3.36E-09	4.19E-06	1.39E-09
03-0394-A06	9-0389	750.0	60.0	4.08E-06	7.58E-07	1.50E-06	1.28E-06	1.99E-07	2.59E-04	1.01E-07	1.26E-04	4.16E-08
03-0394-A07	9-0390	750.0	47.0	3.20E-06	5.94E-07	1.17E-06	1.00E-06	1.56E-07	2.03E-04	7.89E-08	9.85E-05	3.26E-08
03-4600-A04	9-0276	1877.0	27.3	4.65E-06	8.63E-07	1.70E-06	1.45E-06	2.27E-07	2.95E-04	1.15E-07	1.43E-04	4.74E-08
03-4600-A05	9-0277	1877.0	27.5	4.68E-06	8.70E-07	1.72E-06	1.46E-06	2.29E-07	2.97E-04	1.16E-07	1.44E-04	4.78E-08
6009-01	9-0412	1502.0	9.5	1.29E-06	2.40E-07	4.74E-07	4.05E-07	6.32E-08	8.22E-05	3.20E-08	3.99E-05	1.32E-08
6010-01	9-0411	2937.0	11.0	2.93E-06	5.44E-07	1.07E-06	9.16E-07	1.43E-07	1.86E-04	7.23E-08	9.03E-05	2.99E-08
6010-02	9-0411	2937.0	7.0	1.87E-06	3.46E-07	6.83E-07	5.83E-07	9.10E-08	1.18E-04	4.60E-08	5.74E-05	1.90E-08
LWE-01	9-0436	550.0	102.0	1.55E-04	2.87E-07	1.02E-06	1.87E-05	3.78E-07	3.23E-04	3.39E-07	1.88E-04	3.80E-08
LWE-02	9-0436	550.0	103.0	1.56E-04	2.90E-07	1.03E-06	1.89E-05	3.81E-07	3.26E-04	3.43E-07	1.90E-04	3.83E-08
LWE-03	9-0436	550.0	104.0	1.58E-04	2.92E-07	1.04E-06	1.90E-05	3.85E-07	3.29E-04	3.46E-07	1.92E-04	3.87E-08
LWE-04	9-0436	550.0	102.0	1.55E-04	2.87E-07	1.02E-06	1.87E-05	3.78E-07	3.23E-04	3.39E-07	1.88E-04	3.80E-08
LWE-05	9-0436	550.0	102.0	1.55E-04	2.87E-07	1.02E-06	1.87E-05	3.78E-07	3.23E-04	3.39E-07	1.88E-04	3.80E-08
26-GMS-Lab-A04	9-0393	3778.0	8.0	2.74E-06	5.09E-07	1.00E-06	8.57E-07	1.34E-07	1.74E-04	6.77E-08	8.44E-05	2.80E-08
26-C2CNTWest-A05	9-0394	2200.0	2.0	3.99E-07	7.41E-08	1.46E-07	1.25E-07	1.95E-08	2.53E-05	9.85E-09	1.23E-05	4.07E-09
26-GMS Tower-A04	9-0395	2200.0	2.0	3.99E-07	7.41E-08	1.46E-07	1.25E-07	1.95E-08	2.53E-05	9.85E-09	1.23E-05	4.07E-09
26-HQBuilding-A06	9-0396	2922.0	4.0	1.06E-06	1.97E-07	3.88E-07	3.32E-07	5.18E-08	6.73E-05	2.62E-08	3.27E-05	1.08E-08
Bldg 5016 - pending	9-0510	2346.0	5.7	1.21E-06	2.25E-07	4.44E-07	3.79E-07	5.92E-08	7.70E-05	2.99E-08	3.74E-05	1.24E-08
Bldg 5046 - pending	9-0511	617.0	6.7	3.75E-07	6.96E-08	1.37E-07	1.17E-07	1.83E-08	2.38E-05	9.26E-09	1.15E-05	3.82E-09
BSS-01	9-0435	600.0	718.5	1.19E-03	2.20E-06	7.85E-06	1.44E-04	2.90E-06	2.48E-03	2.61E-06	1.45E-03	2.92E-07
UTF-01	9-0437	500.0	24.6	3.39E-05	6.28E-08	2.24E-07	4.09E-06	8.27E-08	7.08E-05	7.43E-08	4.13E-05	8.31E-09
0311-01	9-0419	600.0	10.5	1.74E-05	3.22E-08	1.15E-07	2.10E-06	4.24E-08	3.63E-05	3.81E-08	2.12E-05	4.26E-09
3147-A01	9-0491	670.0	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2202-01	9-0499	755.0	13.5	9.25E-07	1.72E-07	3.39E-07	2.89E-07	4.51E-08	5.87E-05	2.28E-08	2.85E-05	9.43E-09
3660-01	9-0500	643.0	15.3	8.92E-07	1.66E-07	3.27E-07	2.79E-07	4.36E-08	5.67E-05	2.20E-08	2.75E-05	9.10E-09
			Totals	**2.11E-03**	**2.01E-05**	**4.57E-05**	**2.71E-04**	**9.24E-06**	**9.82E-03**	**6.61E-06**	**5.18E-03**	**1.40E-06**

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emergency Generators Emissions (tpy)

Emissions Unit	Registration Number	HP	Hours	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Beryllium	1,3-Butadiene	Cadmium	Chlorobenzene	Chromium	Chrysene	Cobalt
0120-01	9-0409	2922.0	14.0	1.63E-07	8.19E-08	3.21E-08	0.00E+00	3.20E-02	2.21E-04	2.95E-05	8.84E-05	2.25E-07	0.00E+00
0120-02	9-0433	2922.0	18.6	2.17E-07	1.09E-07	4.27E-08	0.00E+00	4.25E-02	2.93E-04	3.91E-05	1.17E-04	2.99E-07	0.00E+00
0120-03	9-0434	2922.0	13.0	1.52E-07	7.60E-08	2.98E-08	0.00E+00	2.97E-02	2.05E-04	2.73E-05	8.20E-05	2.09E-07	0.00E+00
Bldg 120 - Gen. #1	9-0503	2922.0	13.7	1.60E-07	8.01E-08	3.14E-08	0.00E+00	3.13E-02	2.16E-04	2.88E-05	8.65E-05	2.20E-07	0.00E+00
Bldg 120 - Gen. #2	9-0504	2922.0	13.1	1.53E-07	7.66E-08	3.00E-08	0.00E+00	3.00E-02	2.07E-04	2.76E-05	8.27E-05	2.11E-07	0.00E+00
3090-01	9-0410	2923.0	35.5	4.15E-07	2.08E-07	8.14E-08	0.00E+00	8.12E-02	5.60E-04	7.47E-05	2.24E-04	5.72E-07	0.00E+00
0316-01	9-0408	2922.0	12.0	1.40E-07	7.02E-08	2.75E-08	0.00E+00	2.74E-02	1.89E-04	2.52E-05	7.57E-05	1.93E-07	0.00E+00
03-0328-A03	9-0418	804.6	11.0	3.54E-08	1.77E-08	6.95E-09	0.00E+00	6.93E-03	4.78E-05	6.37E-06	1.91E-05	4.87E-08	0.00E+00
03-0328-A02	9-0414	670.5	14.0	3.75E-08	1.88E-08	7.37E-09	0.00E+00	7.35E-03	5.07E-05	6.76E-06	2.03E-05	5.17E-08	0.00E+00
03-0328-A01	9-0229	1072.0	44.0	1.88E-07	9.44E-08	3.70E-08	0.00E+00	3.69E-02	2.55E-04	3.40E-05	1.02E-04	2.60E-07	0.00E+00
03-0394-A01	9-0227	1341.0	49.0	2.63E-07	1.32E-07	5.16E-08	0.00E+00	5.14E-02	3.55E-04	4.73E-05	1.42E-04	3.62E-07	0.00E+00
03-0394-A02	9-0228	1341.0	56.0	3.00E-07	1.50E-07	5.89E-08	0.00E+00	5.88E-02	4.06E-04	5.41E-05	1.62E-04	4.14E-07	0.00E+00
03-0394-A03	9-0386	750.0	60.0	1.80E-07	9.01E-08	3.53E-08	0.00E+00	3.52E-02	2.43E-04	3.24E-05	9.72E-05	2.48E-07	0.00E+00
03-0394-A04	9-0387	750.0	43.0	1.29E-07	6.46E-08	2.53E-08	0.00E+00	2.52E-02	1.74E-04	2.32E-05	6.97E-05	1.78E-07	0.00E+00
03-0394-A05	9-0388	750.0	2.0	5.99E-09	3.00E-09	1.18E-09	0.00E+00	1.17E-03	8.10E-06	1.08E-06	3.24E-06	8.26E-09	0.00E+00
03-0394-A06	9-0389	750.0	60.0	1.80E-07	9.01E-08	3.53E-08	0.00E+00	3.52E-02	2.43E-04	3.24E-05	9.72E-05	2.48E-07	0.00E+00
03-0394-A07	9-0390	750.0	47.0	1.41E-07	7.06E-08	2.77E-08	0.00E+00	2.76E-02	1.90E-04	2.54E-05	7.61E-05	1.94E-07	0.00E+00
03-4600-A04	9-0276	1877.0	27.3	2.05E-07	1.03E-07	4.02E-08	0.00E+00	4.01E-02	2.77E-04	3.69E-05	1.11E-04	2.82E-07	0.00E+00
03-4600-A05	9-0277	1877.0	27.5	2.06E-07	1.03E-07	4.05E-08	0.00E+00	4.04E-02	2.79E-04	3.72E-05	1.11E-04	2.84E-07	0.00E+00
6009-01	9-0412	1502.0	9.5	5.70E-08	2.86E-08	1.12E-08	0.00E+00	1.12E-02	7.71E-05	1.03E-05	3.08E-05	7.86E-08	0.00E+00
6010-01	9-0411	2937.0	11.0	1.29E-07	6.47E-08	2.54E-08	0.00E+00	2.53E-02	1.74E-04	2.33E-05	6.98E-05	1.78E-07	0.00E+00
6010-02	9-0411	2937.0	7.0	8.22E-08	4.12E-08	1.61E-08	0.00E+00	1.61E-02	1.11E-04	1.48E-05	4.44E-05	1.13E-07	0.00E+00
LWE-01	9-0436	550.0	102.0	2.00E-08	9.88E-08	3.13E-08	0.00E+00	7.90E-06	3.03E-04	4.04E-05	1.21E-04	7.13E-08	0.00E+00
LWE-02	9-0436	550.0	103.0	2.02E-08	9.97E-08	3.16E-08	0.00E+00	7.97E-06	3.06E-04	4.08E-05	1.22E-04	7.20E-08	0.00E+00
LWE-03	9-0436	550.0	104.0	2.04E-08	1.01E-07	3.19E-08	0.00E+00	8.05E-06	3.09E-04	4.12E-05	1.24E-04	7.27E-08	0.00E+00
LWE-04	9-0436	550.0	102.0	2.00E-08	9.88E-08	3.13E-08	0.00E+00	7.90E-06	3.03E-04	4.04E-05	1.21E-04	7.13E-08	0.00E+00
LWE-05	9-0436	550.0	102.0	2.00E-08	9.88E-08	3.13E-08	0.00E+00	7.90E-06	3.03E-04	4.04E-05	1.21E-04	7.13E-08	0.00E+00
26-GMS-Lab-A04	9-0393	3778.0	8.0	1.21E-07	6.05E-08	2.37E-08	0.00E+00	2.37E-02	1.63E-04	2.18E-05	6.53E-05	1.66E-07	0.00E+00
26-C2CNTWest-A05	9-0394	2200.0	2.0	1.76E-08	8.81E-09	3.45E-09	0.00E+00	3.44E-03	2.38E-05	3.17E-06	9.50E-06	2.42E-08	0.00E+00
26-GMS Tower-A04	9-0395	2200.0	2.0	1.76E-08	8.81E-09	3.45E-09	0.00E+00	3.44E-03	2.38E-05	3.17E-06	9.50E-06	2.42E-08	0.00E+00
26-HQBuilding-A06	9-0396	2922.0	4.0	4.67E-08	2.34E-08	9.17E-09	0.00E+00	9.15E-03	6.31E-05	8.42E-06	2.52E-05	6.44E-08	0.00E+00
Bldg 5016 - pending	9-0510	2346.0	5.7	5.34E-08	2.68E-08	1.05E-08	0.00E+00	1.05E-02	7.22E-05	9.63E-06	2.89E-05	7.37E-08	0.00E+00
Bldg 5046 - pending	9-0511	617.0	6.7	1.65E-08	8.27E-09	3.24E-09	0.00E+00	3.24E-03	2.23E-05	2.98E-06	8.93E-06	2.28E-08	0.00E+00
BSS-01	9-0435	600.0	718.5	1.54E-07	7.59E-07	2.41E-07	0.00E+00	6.07E-05	2.33E-03	3.10E-04	9.31E-04	5.48E-07	0.00E+00
UTF-01	9-0437	500.0	24.6	4.38E-09	2.16E-08	6.86E-09	0.00E+00	1.73E-06	6.63E-05	8.85E-06	2.65E-05	1.56E-08	0.00E+00
0311-01	9-0419	600.0	10.5	2.25E-09	1.11E-08	3.52E-09	0.00E+00	8.87E-07	3.40E-05	4.54E-06	1.36E-05	8.01E-09	0.00E+00
3147-A01	9-0491	670.0	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2202-01	9-0499	755.0	13.5	4.07E-08	2.04E-08	8.00E-09	0.00E+00	7.98E-03	5.50E-05	7.34E-06	2.20E-05	5.61E-08	0.00E+00
3660-01	9-0500	643.0	15.3	3.93E-08	1.97E-08	7.72E-09	0.00E+00	7.70E-03	5.31E-05	7.08E-06	2.12E-05	5.42E-08	0.00E+00
			Totals	**4.15E-06**	**3.24E-06**	**1.17E-06**	**0.00E+00**	**7.62E-01**	**9.21E-03**	**1.23E-03**	**3.68E-03**	**6.29E-06**	**0.00E+00**

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emergency Generators Emissions (tpy)

Emissions Unit	Registration Number	HP	Hours	Copper	Dibenzo(a,h)anthracene	Dichlorobenzene	Ethyl Benzene	Fluoranthene	Fluorene	Formaldehyde	Hydrochloric Acid	Indeno(1,2,3-cd)pyrene	Lead	Manganese
0120-01	9-0409	2922.0	14.0	6.04E-04	5.10E-08	0.00E+00	1.61E-03	5.93E-07	1.89E-06	1.16E-05	2.74E-02	6.10E-08	1.22E-03	4.57E-04
0120-02	9-0433	2922.0	18.6	8.02E-04	6.77E-08	0.00E+00	2.13E-03	7.88E-07	2.50E-06	1.54E-05	3.65E-02	8.10E-08	1.62E-03	6.07E-04
0120-03	9-0434	2922.0	13.0	5.61E-04	4.73E-08	0.00E+00	1.49E-03	5.51E-07	1.75E-06	1.08E-05	2.55E-02	5.66E-08	1.14E-03	4.24E-04
Bldg 120 - Gen. #1	9-0503	2922.0	13.7	5.91E-04	4.99E-08	0.00E+00	1.57E-03	5.81E-07	1.84E-06	1.14E-05	2.68E-02	5.97E-08	1.20E-03	4.47E-04
Bldg 120 - Gen. #2	9-0504	2922.0	13.1	5.65E-04	4.77E-08	0.00E+00	1.50E-03	5.55E-07	1.76E-06	1.09E-05	2.57E-02	5.70E-08	1.14E-03	4.27E-04
3090-01	9-0410	2923.0	35.5	1.53E-03	1.29E-07	0.00E+00	4.07E-03	1.51E-06	4.78E-06	2.95E-05	6.96E-02	1.55E-07	3.10E-03	1.16E-03
0316-01	9-0408	2922.0	12.0	5.18E-04	4.37E-08	0.00E+00	1.38E-03	5.09E-07	1.62E-06	9.96E-06	2.35E-02	5.23E-08	1.05E-03	3.91E-04
03-0328-A03	9-0418	804.6	11.0	1.31E-04	1.10E-08	0.00E+00	3.47E-04	1.28E-07	4.08E-07	2.51E-06	5.94E-03	1.32E-08	2.64E-04	9.88E-05
03-0328-A02	9-0414	670.5	14.0	1.39E-04	1.17E-08	0.00E+00	3.68E-04	1.36E-07	4.33E-07	2.67E-06	6.30E-03	1.40E-08	2.80E-04	1.05E-04
03-0328-A01	9-0229	1072.0	44.0	6.96E-04	5.88E-08	0.00E+00	1.85E-03	6.84E-07	2.17E-06	1.34E-05	3.16E-02	7.03E-08	1.41E-03	5.26E-04
03-0394-A01	9-0227	1341.0	49.0	9.70E-04	8.18E-08	0.00E+00	2.58E-03	9.53E-07	3.03E-06	1.87E-05	4.41E-02	9.79E-08	1.96E-03	7.33E-04
03-0394-A02	9-0228	1341.0	56.0	1.11E-03	9.35E-08	0.00E+00	2.95E-03	1.09E-06	3.46E-06	2.13E-05	5.04E-02	1.12E-07	2.24E-03	8.38E-04
03-0394-A03	9-0386	750.0	60.0	6.64E-04	5.61E-08	0.00E+00	1.77E-03	6.53E-07	2.07E-06	1.28E-05	3.02E-02	6.71E-08	1.34E-03	5.02E-04
03-0394-A04	9-0387	750.0	43.0	4.76E-04	4.02E-08	0.00E+00	1.27E-03	4.68E-07	1.49E-06	9.16E-06	2.16E-02	4.81E-08	9.64E-04	3.60E-04
03-0394-A05	9-0388	750.0	2.0	2.21E-05	1.87E-09	0.00E+00	5.89E-05	2.18E-08	6.91E-08	4.26E-07	1.01E-03	2.24E-09	4.48E-05	1.67E-05
03-0394-A06	9-0389	750.0	60.0	6.64E-04	5.61E-08	0.00E+00	1.77E-03	6.53E-07	2.07E-06	1.28E-05	3.02E-02	6.71E-08	1.34E-03	5.02E-04
03-0394-A07	9-0390	750.0	47.0	5.20E-04	4.39E-08	0.00E+00	1.38E-03	5.11E-07	1.62E-06	1.00E-05	2.36E-02	5.25E-08	1.05E-03	3.93E-04
03-4600-A04	9-0276	1877.0	27.3	7.56E-04	6.38E-08	0.00E+00	2.01E-03	7.43E-07	2.36E-06	1.46E-05	3.44E-02	7.64E-08	1.53E-03	5.72E-04
03-4600-A05	9-0277	1877.0	27.5	7.62E-04	6.43E-08	0.00E+00	2.03E-03	7.49E-07	2.38E-06	1.47E-05	3.46E-02	7.69E-08	1.54E-03	5.76E-04
6009-01	9-0412	1502.0	9.5	2.11E-04	1.78E-08	0.00E+00	5.60E-04	2.07E-07	6.58E-07	4.05E-06	9.57E-03	2.13E-08	4.26E-04	1.59E-04
6010-01	9-0411	2937.0	11.0	4.77E-04	4.02E-08	0.00E+00	1.27E-03	4.69E-07	1.49E-06	9.18E-06	2.17E-02	4.82E-08	9.65E-04	3.61E-04
6010-02	9-0411	2937.0	7.0	3.03E-04	2.56E-08	0.00E+00	8.07E-04	2.98E-07	9.47E-07	5.84E-06	1.38E-02	3.06E-08	6.14E-04	2.29E-04
LWE-01	9-0436	550.0	102.0	8.28E-04	1.18E-07	0.00E+00	2.20E-03	1.54E-06	5.90E-06	2.38E-04	3.76E-02	7.57E-08	1.68E-03	6.26E-04
LWE-02	9-0436	550.0	103.0	8.36E-04	1.19E-07	0.00E+00	2.22E-03	1.55E-06	5.96E-06	2.41E-04	3.80E-02	7.65E-08	1.69E-03	6.32E-04
LWE-03	9-0436	550.0	104.0	8.44E-04	1.20E-07	0.00E+00	2.24E-03	1.57E-06	6.01E-06	2.43E-04	3.84E-02	7.72E-08	1.71E-03	6.38E-04
LWE-04	9-0436	550.0	102.0	8.28E-04	1.18E-07	0.00E+00	2.20E-03	1.54E-06	5.90E-06	2.38E-04	3.76E-02	7.57E-08	1.68E-03	6.26E-04
LWE-05	9-0436	550.0	102.0	8.28E-04	1.18E-07	0.00E+00	2.20E-03	1.54E-06	5.90E-06	2.38E-04	3.76E-02	7.57E-08	1.68E-03	6.26E-04
26-GMS-Lab-A04	9-0393	3778.0	8.0	4.46E-04	3.76E-08	0.00E+00	1.19E-03	4.38E-07	1.39E-06	8.58E-06	2.03E-02	4.50E-08	9.03E-04	3.37E-04
26-C2CNTWest-A05	9-0394	2200.0	2.0	6.49E-05	5.48E-09	0.00E+00	1.73E-04	6.38E-08	2.03E-07	1.25E-06	2.95E-03	6.56E-09	1.31E-04	4.91E-05
26-GMS Tower-A04	9-0395	2200.0	2.0	6.49E-05	5.48E-09	0.00E+00	1.73E-04	6.38E-08	2.03E-07	1.25E-06	2.95E-03	6.56E-09	1.31E-04	4.91E-05
26-HQBuilding-A06	9-0396	2922.0	4.0	1.73E-04	1.46E-08	0.00E+00	4.59E-04	1.70E-07	5.39E-07	3.32E-06	7.84E-03	1.74E-08	3.49E-04	1.30E-04
Bldg 5016 - pending	9-0510	2346.0	5.7	1.97E-04	1.67E-08	0.00E+00	5.25E-04	1.94E-07	6.16E-07	3.80E-06	8.97E-03	1.99E-08	4.00E-04	1.49E-04
Bldg 5046 - pending	9-0511	617.0	6.7	6.10E-05	5.15E-09	0.00E+00	1.62E-04	6.00E-08	1.90E-07	1.17E-06	2.77E-03	6.16E-09	1.24E-04	4.61E-05
BSS-01	9-0435	600.0	718.5	6.36E-03	9.05E-07	0.00E+00	1.69E-02	1.18E-05	4.53E-05	1.83E-03	2.89E-01	5.82E-07	1.29E-02	4.81E-03
UTF-01	9-0437	500.0	24.6	1.81E-04	2.58E-08	0.00E+00	4.82E-04	3.37E-07	1.29E-06	5.22E-05	8.24E-03	1.66E-08	3.67E-04	1.37E-04
0311-01	9-0419	600.0	10.5	9.30E-05	1.32E-08	0.00E+00	2.47E-04	1.73E-07	6.62E-07	2.68E-05	4.23E-03	8.51E-09	1.88E-04	7.03E-05
3147-A01	9-0491	670.0	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2202-01	9-0499	755.0	13.5	1.50E-04	1.27E-08	0.00E+00	4.00E-04	1.48E-07	4.70E-07	2.90E-06	6.84E-03	1.52E-08	3.05E-04	1.14E-04
3660-01	9-0500	643.0	15.3	1.45E-04	1.23E-08	0.00E+00	3.86E-04	1.43E-07	4.53E-07	2.79E-06	6.60E-03	1.47E-08	2.94E-04	1.10E-04
			Totals	**2.52E-02**	**2.75E-06**	**0.00E+00**	**6.69E-02**	**3.42E-05**	**1.22E-04**	**3.39E-03**	**1.14E+00**	**2.44E-06**	**5.10E-02**	**1.90E-02**

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emergency Generators Emissions (tpy)

Emissions Unit	Registration Number	HP	Hours	Mercury	Methyl Chloroform	Naphthalene	Nickel	Phenanthrene	Pyrene	Selenium	Toluene	Xylene	Zinc	Hexane
0120-01	9-0409	2922.0	14.0	2.95E-04	0.00E+00	1.91E-05	5.74E-04	6.01E-06	5.46E-07	3.24E-04	4.14E-05	2.84E-05	3.30E-03	3.96E-03
0120-02	9-0433	2922.0	18.6	3.91E-04	0.00E+00	2.54E-05	7.63E-04	7.98E-06	7.26E-07	4.30E-04	5.50E-05	3.78E-05	4.38E-03	5.26E-03
0120-03	9-0434	2922.0	13.0	2.73E-04	0.00E+00	1.78E-05	5.33E-04	5.58E-06	5.07E-07	3.01E-04	3.84E-05	2.64E-05	3.06E-03	3.68E-03
Bldg 120 - Gen. #1	9-0503	2922.0	13.7	2.88E-04	0.00E+00	1.87E-05	5.62E-04	5.88E-06	5.35E-07	3.17E-04	4.05E-05	2.78E-05	3.23E-03	3.88E-03
Bldg 120 - Gen. #2	9-0504	2922.0	13.1	2.76E-04	0.00E+00	1.79E-05	5.37E-04	5.62E-06	5.11E-07	3.03E-04	3.87E-05	2.66E-05	3.09E-03	3.71E-03
3090-01	9-0410	2923.0	35.5	7.47E-04	0.00E+00	4.86E-05	1.46E-03	1.52E-05	1.39E-06	8.22E-04	1.05E-04	7.21E-05	8.37E-03	1.00E-02
0316-01	9-0408	2922.0	12.0	2.52E-04	0.00E+00	1.64E-05	4.92E-04	5.15E-06	4.68E-07	2.78E-04	3.55E-05	2.44E-05	2.83E-03	3.40E-03
03-0328-A03	9-0418	804.6	11.0	6.37E-05	0.00E+00	4.14E-06	1.24E-04	1.30E-06	1.18E-07	7.01E-05	8.95E-06	6.15E-06	7.14E-04	8.57E-04
03-0328-A02	9-0414	670.5	14.0	6.76E-05	0.00E+00	4.39E-06	1.32E-04	1.38E-06	1.25E-07	7.43E-05	9.50E-06	6.52E-06	7.57E-04	9.09E-04
03-0328-A01	9-0229	1072.0	44.0	3.40E-04	0.00E+00	2.21E-05	6.62E-04	6.93E-06	6.30E-07	3.74E-04	4.77E-05	3.28E-05	3.80E-03	4.57E-03
03-0394-A01	9-0227	1341.0	49.0	4.73E-04	0.00E+00	3.08E-05	9.23E-04	9.65E-06	8.78E-07	5.20E-04	6.65E-05	4.57E-05	5.30E-03	6.36E-03
03-0394-A02	9-0228	1341.0	56.0	5.41E-04	0.00E+00	3.51E-05	1.05E-03	1.10E-05	1.00E-06	5.95E-04	7.60E-05	5.22E-05	6.06E-03	7.27E-03
03-0394-A03	9-0386	750.0	60.0	3.24E-04	0.00E+00	2.11E-05	6.32E-04	6.61E-06	6.01E-07	3.56E-04	4.55E-05	3.13E-05	3.63E-03	4.36E-03
03-0394-A04	9-0387	750.0	43.0	2.32E-04	0.00E+00	1.51E-05	4.53E-04	4.74E-06	4.31E-07	2.55E-04	3.26E-05	2.24E-05	2.60E-03	3.12E-03
03-0394-A05	9-0388	750.0	2.0	1.08E-05	0.00E+00	7.02E-07	2.11E-05	2.20E-07	2.00E-08	1.19E-05	1.52E-06	1.04E-06	1.21E-04	1.45E-04
03-0394-A06	9-0389	750.0	60.0	3.24E-04	0.00E+00	2.11E-05	6.32E-04	6.61E-06	6.01E-07	3.56E-04	4.55E-05	3.13E-05	3.63E-03	4.36E-03
03-0394-A07	9-0390	750.0	47.0	2.54E-04	0.00E+00	1.65E-05	4.95E-04	5.18E-06	4.71E-07	2.79E-04	3.57E-05	2.45E-05	2.84E-03	3.41E-03
03-4600-A04	9-0276	1877.0	27.3	3.69E-04	0.00E+00	2.40E-05	7.19E-04	7.53E-06	6.84E-07	4.06E-04	5.18E-05	3.56E-05	4.13E-03	4.96E-03
03-4600-A05	9-0277	1877.0	27.5	3.72E-04	0.00E+00	2.42E-05	7.25E-04	7.58E-06	6.89E-07	4.09E-04	5.22E-05	3.59E-05	4.16E-03	5.00E-03
6009-01	9-0412	1502.0	9.5	1.03E-04	0.00E+00	6.68E-06	2.00E-04	2.10E-06	1.91E-07	1.13E-04	1.44E-05	9.91E-06	1.15E-03	1.38E-03
6010-01	9-0411	2937.0	11.0	2.33E-04	0.00E+00	1.51E-05	4.54E-04	4.75E-06	4.31E-07	2.56E-04	3.27E-05	2.24E-05	2.61E-03	3.13E-03
6010-02	9-0411	2937.0	7.0	1.48E-04	0.00E+00	9.62E-06	2.89E-04	3.02E-06	2.75E-07	1.63E-04	2.08E-05	1.43E-05	1.66E-03	1.99E-03
LWE-01	9-0436	550.0	102.0	4.04E-04	0.00E+00	1.71E-05	7.88E-04	5.94E-06	9.65E-07	4.44E-04	8.26E-05	5.76E-05	4.52E-03	5.43E-03
LWE-02	9-0436	550.0	103.0	4.08E-04	0.00E+00	1.73E-05	7.95E-04	6.00E-06	9.75E-07	4.49E-04	8.34E-05	5.81E-05	4.57E-03	5.49E-03
LWE-03	9-0436	550.0	104.0	4.12E-04	0.00E+00	1.75E-05	8.03E-04	6.05E-06	9.84E-07	4.53E-04	8.42E-05	5.87E-05	4.61E-03	5.54E-03
LWE-04	9-0436	550.0	102.0	4.04E-04	0.00E+00	1.71E-05	7.88E-04	5.94E-06	9.65E-07	4.44E-04	8.26E-05	5.76E-05	4.52E-03	5.43E-03
LWE-05	9-0436	550.0	102.0	4.04E-04	0.00E+00	1.71E-05	7.88E-04	5.94E-06	9.65E-07	4.44E-04	8.26E-05	5.76E-05	4.52E-03	5.43E-03
26-GMS-Lab-A04	9-0393	3778.0	8.0	2.18E-04	0.00E+00	1.41E-05	4.24E-04	4.44E-06	4.04E-07	2.39E-04	3.06E-05	2.10E-05	2.44E-03	2.93E-03
26-C2CNTWest-A05	9-0394	2200.0	2.0	3.17E-05	0.00E+00	2.06E-06	6.18E-05	6.46E-07	5.88E-08	3.48E-05	4.45E-06	3.06E-06	3.55E-04	4.26E-04
26-GMS Tower-A04	9-0395	2200.0	2.0	3.17E-05	0.00E+00	2.06E-06	6.18E-05	6.46E-07	5.88E-08	3.48E-05	4.45E-06	3.06E-06	3.55E-04	4.26E-04
26-HQBuilding-A06	9-0396	2922.0	4.0	8.42E-05	0.00E+00	5.47E-06	1.64E-04	1.72E-06	1.56E-07	9.26E-05	1.18E-05	8.12E-06	9.43E-04	1.13E-03
Bldg 5016 - pending	9-0510	2346.0	5.7	9.63E-05	0.00E+00	6.26E-06	1.88E-04	1.96E-06	1.79E-07	1.06E-04	1.35E-05	9.29E-06	1.08E-03	1.29E-03
Bldg 5046 - pending	9-0511	617.0	6.7	2.98E-05	0.00E+00	1.93E-06	5.80E-05	6.07E-07	5.52E-08	3.27E-05	4.18E-06	2.87E-06	3.33E-04	4.00E-04
BSS-01	9-0435	600.0	718.5	3.10E-03	0.00E+00	1.32E-04	6.05E-03	4.56E-05	7.42E-06	3.41E-03	6.35E-04	4.42E-04	3.48E-02	4.17E-02
UTF-01	9-0437	500.0	24.6	8.85E-05	0.00E+00	3.75E-06	1.72E-04	1.30E-06	2.11E-07	9.73E-05	1.81E-05	1.26E-05	9.91E-04	1.19E-03
0311-01	9-0419	600.0	10.5	4.54E-05	0.00E+00	1.92E-06	8.85E-05	6.67E-07	1.08E-07	4.99E-05	9.28E-06	6.46E-06	5.08E-04	6.10E-04
3147-A01	9-0491	670.0	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2202-01	9-0499	755.0	13.5	7.34E-05	0.00E+00	4.77E-06	1.43E-04	1.50E-06	1.36E-07	8.07E-05	1.03E-05	7.08E-06	8.22E-04	9.87E-04
3660-01	9-0500	643.0	15.3	7.08E-05	0.00E+00	4.60E-06	1.38E-04	1.44E-06	1.31E-07	7.79E-05	9.95E-06	6.84E-06	7.93E-04	9.53E-04
			Totals	**1.23E-02**	**0.00E+00**	**6.79E-04**	**2.39E-02**	**2.20E-04**	**2.56E-05**	**1.35E-02**	**2.06E-03**	**1.43E-03**	**1.38E-01**	**1.65E-01**

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Boilers (tpy)

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Acetaldehyde	Acenaphthene	Acenaphthylene	Acrolein	Anthracene	Arsenic	Benz(a)anthracene	Benzene	Benzo(a)pyrene
26-3326-A02	5-0152	0.00	1.74	3.75E-06	1.57E-09	1.57E-09	2.35E-06	2.09E-09	1.74E-07	1.57E-09	1.83E-06	1.05E-09
0383A-A01 & A02	5-0376	0.00	4.18	8.98E-06	3.76E-09	3.76E-09	5.64E-06	5.01E-09	4.18E-07	3.76E-09	4.39E-06	2.51E-09
26-0459-A02	5-0337	0.00	1.07	2.31E-06	9.66E-10	9.66E-10	1.45E-06	1.29E-09	1.07E-07	9.66E-10	1.13E-06	6.44E-10
26-2202-A01	5-0322	0.00	2.80	6.02E-06	2.52E-09	2.52E-09	3.78E-06	3.36E-09	2.80E-07	2.52E-09	2.94E-06	1.68E-09
26-2202-A02	5-0322	0.00	2.80	6.02E-06	2.52E-09	2.52E-09	3.78E-06	3.36E-09	2.80E-07	2.52E-09	2.94E-06	1.68E-09
26-3300-A02	5-0152	0.00	0.66	1.42E-06	5.95E-10	5.95E-10	8.93E-07	7.94E-10	6.62E-08	5.95E-10	6.95E-07	3.97E-10
26-3300-A01	5-0152	0.00	0.66	1.42E-06	5.95E-10	5.95E-10	8.93E-07	7.94E-10	6.62E-08	5.95E-10	6.95E-07	3.97E-10
26-3144-A01	5-0152	0.00	6.11	1.31E-05	5.50E-09	5.50E-09	8.25E-06	7.34E-09	6.11E-07	5.50E-09	6.42E-06	3.67E-09
26-3660-A01	5-0371	0.00	1.10	2.36E-06	9.89E-10	9.89E-10	1.48E-06	1.32E-09	1.10E-07	9.89E-10	1.15E-06	6.60E-10
26-04119-A03	5-0336	0.00	2.40	5.16E-06	2.16E-09	2.16E-09	3.24E-06	2.88E-09	2.40E-07	2.16E-09	2.52E-06	1.44E-09
26-5100-A01	5-0310	0.00	4.93	1.06E-05	4.44E-09	4.44E-09	6.66E-06	5.92E-09	4.93E-07	4.44E-09	5.18E-06	2.96E-09
26-5100-A02	5-0309	0.00	4.93	1.06E-05	4.44E-09	4.44E-09	6.66E-06	5.92E-09	4.93E-07	4.44E-09	5.18E-06	2.96E-09
0339-A01	5-0710	0.00	0.77	1.66E-06	6.94E-10	6.94E-10	1.04E-06	9.25E-10	7.71E-08	6.94E-10	8.09E-07	4.62E-10
26-2485-A01	5-0367	0.00	1.17	2.52E-06	1.06E-09	1.06E-09	1.58E-06	1.41E-09	1.17E-07	1.06E-09	1.23E-06	7.03E-10
26-4304-A02	5-0152	0.00	0.86	1.86E-06	7.77E-10	7.77E-10	1.17E-06	1.04E-09	8.63E-08	7.77E-10	9.06E-07	5.18E-10
5046-A01	4-0619	0.00	0.53	1.14E-06	4.79E-10	4.79E-10	7.18E-07	6.38E-10	5.32E-08	4.79E-10	5.59E-07	3.19E-10
5046-A02	4-0619	0.00	0.53	1.14E-06	4.79E-10	4.79E-10	7.18E-07	6.38E-10	5.32E-08	4.79E-10	5.59E-07	3.19E-10
5046-A03	4-0619	0.00	0.53	1.14E-06	4.79E-10	4.79E-10	7.18E-07	6.38E-10	5.32E-08	4.79E-10	5.59E-07	3.19E-10
26-0436-A01	5-0152	0.00	3.20	6.88E-06	2.88E-09	2.88E-09	4.32E-06	3.84E-09	3.20E-07	2.88E-09	3.36E-06	1.92E-09
26-0436-A02	5-0152	0.00	3.20	6.88E-06	2.88E-09	2.88E-09	4.32E-06	3.84E-09	3.20E-07	2.88E-09	3.36E-06	1.92E-09
26-0120-A01	5-0152	0.00	1.17	2.52E-06	1.05E-09	1.05E-09	1.58E-06	1.40E-09	1.17E-07	1.05E-09	1.23E-06	7.02E-10
26-0120-A02	5-0152	0.00	1.17	2.52E-06	1.05E-09	1.05E-09	1.58E-06	1.40E-09	1.17E-07	1.05E-09	1.23E-06	7.02E-10
26-0402-A01	5-0152	0.00	0.43	9.18E-07	3.84E-10	3.84E-10	5.76E-07	5.12E-10	4.27E-08	3.84E-10	4.48E-07	2.56E-10
26-0402-A02	5-0152	0.00	0.43	9.18E-07	3.84E-10	3.84E-10	5.76E-07	5.12E-10	4.27E-08	3.84E-10	4.48E-07	2.56E-10
26-0455-A01	5-0152	2.17	0.27	3.81E-04	2.31E-08	5.16E-10	3.81E-04	1.65E-09	1.76E-06	4.59E-09	5.14E-07	1.61E-10
26-0455-A02	5-0152	2.17	0.27	3.81E-04	2.31E-08	5.16E-10	3.81E-04	1.65E-09	1.76E-06	4.59E-09	5.14E-07	1.61E-10
26-0525-A01	5-0335	0.00	3.87	8.31E-06	3.48E-09	3.48E-09	5.22E-06	4.64E-09	3.87E-07	3.48E-09	4.06E-06	2.32E-09
26-0525-A02	5-0315	0.00	3.87	8.31E-06	3.48E-09	3.48E-09	5.22E-06	4.64E-09	3.87E-07	3.48E-09	4.06E-06	2.32E-09
26-0525-A03	5-0334	0.00	3.87	8.31E-06	3.48E-09	3.48E-09	5.22E-06	4.64E-09	3.87E-07	3.48E-09	4.06E-06	2.32E-09
26-2352-A01	5-0152	1.50	7.16	2.79E-04	2.23E-08	6.63E-09	2.73E-04	9.51E-09	1.92E-06	9.46E-09	7.68E-06	4.30E-09
26-3245-A01	5-0152	0.00	1.45	3.12E-06	1.30E-09	1.30E-09	1.96E-06	1.74E-09	1.45E-07	1.30E-09	1.52E-06	8.69E-10
26-04119-A02	5-0152	1.42	2.40	2.54E-04	1.71E-08	2.34E-09	2.52E-04	3.74E-09	1.38E-06	5.00E-09	2.67E-06	1.44E-09
26-2401-A01	5-0152	0.00	1.38	2.96E-06	1.24E-09	1.24E-09	1.86E-06	1.65E-09	1.38E-07	1.24E-09	1.45E-06	8.27E-10
26-04219-A02	5-0552	0.00	1.35	2.91E-06	1.22E-09	1.22E-09	1.83E-06	1.62E-09	1.35E-07	1.22E-09	1.42E-06	8.12E-10
26-04219-A03	5-0308	0.00	1.35	2.91E-06	1.22E-09	1.22E-09	1.83E-06	1.62E-09	1.35E-07	1.22E-09	1.42E-06	8.12E-10
26-4312-A01	5-0364	0.00	2.94	6.33E-06	2.65E-09	2.65E-09	3.98E-06	3.53E-09	2.94E-07	2.65E-09	3.09E-06	1.77E-09
26-4312-A02	5-0364	0.00	2.94	6.33E-06	2.65E-09	2.65E-09	3.98E-06	3.53E-09	2.94E-07	2.65E-09	3.09E-06	1.77E-09
26-4404-A04	5-0152	0.00	37.93	8.15E-05	3.41E-08	3.41E-08	5.12E-05	4.55E-08	3.79E-06	3.41E-08	3.98E-05	2.28E-08
26-4404-A06	5-0152	0.00	37.93	8.15E-05	3.41E-08	3.41E-08	5.12E-05	4.55E-08	3.79E-06	3.41E-08	3.98E-05	2.28E-08
26-4727-A01	5-0152	0.00	2.47	5.31E-06	2.22E-09	2.22E-09	3.34E-06	2.97E-09	2.47E-07	2.22E-09	2.60E-06	1.48E-09
26-5014-A03	5-0152	0.00	1.25	2.69E-06	1.12E-09	1.12E-09	1.69E-06	1.50E-09	1.25E-07	1.12E-09	1.31E-06	7.50E-10
26-5016-A01	5-0152	0.00	0.93	2.00E-06	8.38E-10	8.38E-10	1.26E-06	1.12E-09	9.31E-08	8.38E-10	9.78E-07	5.59E-10
26-HQ Building-A01	5-0300	0.01	3.33	9.48E-06	3.14E-09	3.00E-09	6.81E-06	4.01E-09	3.44E-07	3.03E-09	3.50E-06	2.00E-09
26-HQ Building-A02	5-0300	0.01	3.33	9.48E-06	3.14E-09	3.00E-09	6.81E-06	4.01E-09	3.44E-07	3.03E-09	3.50E-06	2.00E-09
26-HQ Building-A03	5-0300	0.01	3.33	9.48E-06	3.14E-09	3.00E-09	6.81E-06	4.01E-09	3.44E-07	3.03E-09	3.50E-06	2.00E-09
26-HQ Building-A04	5-0300	0.01	3.33	9.48E-06	3.14E-09	3.00E-09	6.81E-06	4.01E-09	3.44E-07	3.03E-09	3.50E-06	2.00E-09
26-HQ Building-A05	5-0300	0.01	3.33	9.48E-06	3.14E-09	3.00E-09	6.81E-06	4.01E-09	3.44E-07	3.03E-09	3.50E-06	2.00E-09
26-GMS Lab-A01	5-0301	0.00	4.63	9.96E-06	4.17E-09	4.17E-09	6.25E-06	5.56E-09	4.63E-07	4.17E-09	4.86E-06	2.78E-09
26-GMS Lab-A02	5-0301	0.00	4.63	9.96E-06	4.17E-09	4.17E-09	6.25E-06	5.56E-09	4.63E-07	4.17E-09	4.86E-06	2.78E-09
26-GMS Lab-A03	5-0301	0.00	4.63	9.96E-06	4.17E-09	4.17E-09	6.25E-06	5.56E-09	4.63E-07	4.17E-09	4.86E-06	2.78E-09
26-GMS Tower-A01	5-0299	0.00	1.33	2.86E-06	1.20E-09	1.20E-09	1.80E-06	1.60E-09	1.33E-07	1.20E-09	1.40E-06	7.99E-10

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Acetaldehyde	Acenaphthene	Acenaphthylene	Acrolein	Anthracene	Arsenic	Benz(a)anthracene	Benzene	Benzo(a)pyrene
26-GMS Tower-A02	5-0299	0.00	1.33	2.86E-06	1.20E-09	1.20E-09	1.80E-06	1.60E-09	1.33E-07	1.20E-09	1.40E-06	7.99E-10
26-GMS Tower-A03	5-0299	0.00	1.33	2.86E-06	1.20E-09	1.20E-09	1.80E-06	1.60E-09	1.33E-07	1.20E-09	1.40E-06	7.99E-10
26-C2CNT West-A01	5-0298	0.00	3.20	6.88E-06	2.88E-09	2.88E-09	4.32E-06	3.84E-09	3.20E-07	2.88E-09	3.36E-06	1.92E-09
26-C2CNT West-A02	5-0298	0.00	3.20	6.88E-06	2.88E-09	2.88E-09	4.32E-06	3.84E-09	3.20E-07	2.88E-09	3.36E-06	1.92E-09
26-C2CNT West-A03	5-0298	0.00	3.20	6.88E-06	2.88E-09	2.88E-09	4.32E-06	3.84E-09	3.20E-07	2.88E-09	3.36E-06	1.92E-09
26-C2CNT West-A04	5-0298	0.00	3.20	6.88E-06	2.88E-09	2.88E-09	4.32E-06	3.84E-09	3.20E-07	2.88E-09	3.36E-06	1.92E-09
26-0345-A01	5-0079	172.81	21.38	3.03E-02	1.84E-06	4.11E-08	3.03E-02	1.31E-07	1.40E-04	3.66E-07	4.09E-05	1.28E-08
26-0345-A02	5-0080	172.81	21.38	3.03E-02	1.84E-06	4.11E-08	3.03E-02	1.31E-07	1.40E-04	3.66E-07	4.09E-05	1.28E-08
26-0345-A03	5-0081	172.81	21.38	3.03E-02	1.84E-06	4.11E-08	3.03E-02	1.31E-07	1.40E-04	3.66E-07	4.09E-05	1.28E-08
26-3062-A01	5-0152	0.00	3.48	7.48E-06	3.13E-09	3.13E-09	4.69E-06	4.17E-09	3.48E-07	3.13E-09	3.65E-06	2.09E-09
26-03062-A02	5-0167	0.00	3.48	7.48E-06	3.13E-09	3.13E-09	4.69E-06	4.17E-09	3.48E-07	3.13E-09	3.65E-06	2.09E-09
26-4600-A06	5-0085	0.00	24.70	5.31E-05	2.22E-08	2.22E-08	3.33E-05	2.96E-08	2.47E-06	2.22E-08	2.59E-05	1.48E-08
26-4600-A09	5-0370	0.00	24.70	5.31E-05	2.22E-08	2.22E-08	3.33E-05	2.96E-08	2.47E-06	2.22E-08	2.59E-05	1.48E-08
26-4600-A08	5-0087	24.70	24.70	4.38E-03	2.83E-07	2.54E-08	4.36E-03	4.47E-08	2.22E-05	7.18E-08	2.86E-05	1.48E-08
26-5014-A01	5-0164	1.25	1.25	2.22E-04	1.43E-08	1.28E-09	2.21E-04	2.26E-09	1.12E-06	3.63E-09	1.45E-06	7.50E-10
26-5014-A02	5-0165	1.25	1.25	2.22E-04	1.43E-08	1.28E-09	2.21E-04	2.26E-09	1.12E-06	3.63E-09	1.45E-06	7.50E-10
26-0030-A01	4-0619	2.40	0.00	4.21E-04	2.53E-08	3.04E-10	4.21E-04	1.46E-09	1.92E-06	4.81E-09	2.57E-07	0.00E+00
26-0030-A02	4-0619	2.40	0.00	4.21E-04	2.53E-08	3.04E-10	4.21E-04	1.46E-09	1.92E-06	4.81E-09	2.57E-07	0.00E+00
26-0045-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0322-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0384-A01	4-0619	2.33	0.00	4.09E-04	2.46E-08	2.95E-10	4.09E-04	1.42E-09	1.87E-06	4.68E-09	2.50E-07	0.00E+00
0390-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0402-A03	4-0619	1.54	0.00	2.70E-04	1.62E-08	1.95E-10	2.70E-04	9.39E-10	1.23E-06	3.09E-09	1.65E-07	0.00E+00
26-0392-A01	4-0709	2.97	0.00	5.20E-04	3.13E-08	3.76E-10	5.20E-04	1.81E-09	2.37E-06	5.95E-09	3.18E-07	0.00E+00
26-0394-A01	4-0708	10.07	0.00	1.77E-03	1.06E-07	1.27E-09	1.77E-03	6.14E-09	8.06E-06	2.02E-08	1.08E-06	0.00E+00
0400-A01	4-0546	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0439-A01	4-0619	2.02	0.00	3.54E-04	2.13E-08	2.55E-10	3.54E-04	1.23E-09	1.61E-06	4.05E-09	2.16E-07	0.00E+00
26-0445-A01	4-0707	2.45	0.00	4.30E-04	2.59E-08	3.10E-10	4.30E-04	1.50E-09	1.96E-06	4.91E-09	2.62E-07	0.00E+00
26-0449-A01	4-0706	2.77	0.00	4.86E-04	2.92E-08	3.51E-10	4.86E-04	1.69E-09	2.22E-06	5.56E-09	2.97E-07	0.00E+00
26-0456-A01	4-0619	0.55	0.00	9.55E-05	5.75E-09	6.89E-11	9.55E-05	3.32E-10	4.36E-07	1.09E-09	5.83E-08	0.00E+00
0507-A05	4-0717	19.80	0.00	3.47E-03	2.09E-07	2.50E-09	3.47E-03	1.21E-08	1.58E-05	3.97E-08	2.12E-06	0.00E+00
0507-A04	5-0104	19.80	0.00	3.47E-03	2.09E-07	2.50E-09	3.47E-03	1.21E-08	1.58E-05	3.97E-08	2.12E-06	0.00E+00
26-0642-A01	4-0689	4.33	0.00	7.59E-04	4.57E-08	5.48E-10	7.59E-04	2.64E-09	3.46E-06	8.68E-09	4.63E-07	0.00E+00
26-0643-A01	4-0721	2.93	0.00	5.14E-04	3.09E-08	3.71E-10	5.14E-04	1.79E-09	2.35E-06	5.88E-09	3.14E-07	0.00E+00
26-0644-A01	4-0619	2.44	0.00	4.28E-04	2.57E-08	3.09E-10	4.28E-04	1.49E-09	1.95E-06	4.89E-09	2.61E-07	0.00E+00
26-0670-A01	4-0719	3.24	0.00	5.67E-04	3.42E-08	4.09E-10	5.67E-04	1.97E-09	2.59E-06	6.49E-09	3.46E-07	0.00E+00
26-0688-A01	4-0720	0.71	0.00	1.25E-04	7.50E-09	8.99E-11	1.25E-04	4.34E-10	5.69E-07	1.43E-09	7.61E-08	0.00E+00
26-0699A-A01	4-0619	9.87	0.00	1.73E-03	1.04E-07	1.25E-09	1.73E-03	6.02E-09	7.89E-06	1.98E-08	1.06E-06	0.00E+00
26-0700-A01	4-0619	1.61	0.00	2.83E-04	1.70E-08	2.04E-10	2.83E-04	9.84E-10	1.29E-06	3.23E-09	1.73E-07	0.00E+00
26-0702-A01	4-0619	0.90	0.00	1.57E-04	9.47E-09	1.14E-10	1.57E-04	5.48E-10	7.18E-07	1.80E-09	9.61E-08	0.00E+00
26-0745A-A01	4-0619	0.13	0.00	2.24E-05	1.35E-09	1.62E-11	2.24E-05	7.81E-11	1.02E-07	2.57E-10	1.37E-08	0.00E+00
26-0860-A01	4-0619	1.29	0.00	2.25E-04	1.36E-08	1.63E-10	2.25E-04	7.84E-10	1.03E-06	2.58E-09	1.38E-07	0.00E+00
26-0896-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-1064-A01	4-0619	5.98	0.00	1.05E-03	6.31E-08	7.56E-10	1.05E-03	3.65E-09	4.78E-06	1.20E-08	6.40E-07	0.00E+00
26-1064-A02	4-0619	5.98	0.00	1.05E-03	6.31E-08	7.56E-10	1.05E-03	3.65E-09	4.78E-06	1.20E-08	6.40E-07	0.00E+00
26-1134-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2184-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2207-A03	4-0619	8.16	0.00	1.43E-03	8.61E-08	1.03E-09	1.43E-03	4.98E-09	6.53E-06	1.64E-08	8.73E-07	0.00E+00
26-2377-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2377-A02	4-0619	8.70	0.00	1.52E-03	9.18E-08	1.10E-09	1.52E-03	5.31E-09	6.96E-06	1.74E-08	9.31E-07	0.00E+00
26-2379-A01	4-0619	5.31	0.00	9.31E-04	5.60E-08	6.72E-10	9.31E-04	3.24E-09	4.25E-06	1.06E-08	5.68E-07	0.00E+00
26-0269B-A01	4-0619	3.60	0.00	6.31E-04	3.80E-08	4.55E-10	6.31E-04	2.19E-09	2.88E-06	7.21E-09	3.85E-07	0.00E+00
26-0280B-A01	4-0619	1.42	0.00	2.49E-04	1.50E-08	1.80E-10	2.49E-04	8.66E-10	1.14E-06	2.85E-09	1.52E-07	0.00E+00

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Acetaldehyde	Acenaphthene	Acenaphthylene	Acrolein	Anthracene	Arsenic	Benz(a)anthracene	Benzene	Benzo(a)pyrene
26-3011-A01	4-0619	1.64	0.00	2.88E-04	1.73E-08	2.08E-10	2.88E-04	1.00E-09	1.31E-06	3.29E-09	1.76E-07	0.00E+00
3070-A01	4-0619	17.24	0.00	3.02E-03	1.82E-07	2.18E-09	3.02E-03	1.05E-08	1.38E-05	3.46E-08	1.84E-06	0.00E+00
26-4725-A01	4-0619	3.25	0.00	5.70E-04	3.43E-08	4.11E-10	5.70E-04	1.98E-09	2.60E-06	6.52E-09	3.48E-07	0.00E+00
26-4728-A02	4-0619	5.19	0.00	9.10E-04	5.48E-08	6.57E-10	9.10E-04	3.17E-09	4.15E-06	1.04E-08	5.56E-07	0.00E+00
Bldg 906C - pending	4-0724	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5046-A01	4-0619	0.53	0.00	9.33E-05	5.61E-09	6.73E-11	9.33E-05	3.25E-10	4.26E-07	1.07E-09	5.69E-08	0.00E+00
26-5109-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-5116-A01	4-0619	1.03	0.00	1.80E-04	1.08E-08	1.30E-10	1.80E-04	6.27E-10	8.22E-07	2.06E-09	1.10E-07	0.00E+00
26-0733A-A01	4-0619	1.14	0.00	2.00E-04	1.20E-08	1.44E-10	2.00E-04	6.97E-10	9.14E-07	2.29E-09	1.22E-07	0.00E+00
26-0740B-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0740C-A01	4-0619	3.97	0.00	6.96E-04	4.19E-08	5.02E-10	6.96E-04	2.42E-09	3.18E-06	7.96E-09	4.25E-07	0.00E+00
26-1100F-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-745A-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2312-A02	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Atmospheric Burner #1	4-0692	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0367-A01	5-0352	1.82	0.00	3.18E-04	1.92E-08	2.30E-10	3.18E-04	1.11E-09	1.45E-06	3.64E-09	1.94E-07	0.00E+00
			Totals	**1.28E-01**	**7.96E-06**	**4.12E-07**	**1.27E-01**	**8.69E-07**	**6.15E-04**	**1.77E-06**	**4.51E-04**	**2.14E-07**

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Acetaldehyde	Acenaphthene	Acenaphthylene	Acrolein	Anthracene	Arsenic	Benz(a)anthracene	Benzene	Benzo(a)pyrene
Fire Test Lab - 07-0525-A01	12-9-0216	0.00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ECO Mobile Incinerator	N/A	0.00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Boilers (tpy)

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Beryllium	1,3-Butadiene	Cadmium	Chlorobenzene	Chromium	Chrysene	Cobalt
26-3326-A02	5-0152	0.00	1.74	1.57E-09	1.05E-09	1.57E-09	1.05E-08	0.00E+00	9.59E-07	0.00E+00	1.22E-06	1.57E-09	7.33E-08
0383A-A01 & A02	5-0376	0.00	4.18	3.76E-09	2.51E-09	3.76E-09	2.51E-08	0.00E+00	2.30E-06	0.00E+00	2.92E-06	3.76E-09	1.75E-07
26-0459-A02	5-0337	0.00	1.07	9.66E-10	6.44E-10	9.66E-10	6.44E-09	0.00E+00	5.90E-07	0.00E+00	7.51E-07	9.66E-10	4.51E-08
26-2202-A01	5-0322	0.00	2.80	2.52E-09	1.68E-09	2.52E-09	1.68E-08	0.00E+00	1.54E-06	0.00E+00	1.96E-06	2.52E-09	1.18E-07
26-2202-A02	5-0322	0.00	2.80	2.52E-09	1.68E-09	2.52E-09	1.68E-08	0.00E+00	1.54E-06	0.00E+00	1.96E-06	2.52E-09	1.18E-07
26-3300-A02	5-0152	0.00	0.66	5.95E-10	3.97E-10	5.95E-10	3.97E-09	0.00E+00	3.64E-07	0.00E+00	4.63E-07	5.95E-10	2.78E-08
26-3300-A01	5-0152	0.00	0.66	5.95E-10	3.97E-10	5.95E-10	3.97E-09	0.00E+00	3.64E-07	0.00E+00	4.63E-07	5.95E-10	2.78E-08
26-3144-A01	5-0152	0.00	6.11	5.50E-09	3.67E-09	5.50E-09	3.67E-08	0.00E+00	3.36E-06	0.00E+00	4.28E-06	5.50E-09	2.57E-07
26-3660-A01	5-0371	0.00	1.10	9.89E-10	6.60E-10	9.89E-10	6.60E-09	0.00E+00	6.05E-07	0.00E+00	7.70E-07	9.89E-10	4.62E-08
26-04119-A03	5-0336	0.00	2.40	2.16E-09	1.44E-09	2.16E-09	1.44E-08	0.00E+00	1.32E-06	0.00E+00	1.68E-06	2.16E-09	1.01E-07
26-5100-A01	5-0310	0.00	4.93	4.44E-09	2.96E-09	4.44E-09	2.96E-08	0.00E+00	2.71E-06	0.00E+00	3.45E-06	4.44E-09	2.07E-07
26-5100-A02	5-0309	0.00	4.93	4.44E-09	2.96E-09	4.44E-09	2.96E-08	0.00E+00	2.71E-06	0.00E+00	3.45E-06	4.44E-09	2.07E-07
0339-A01	5-0710	0.00	0.77	6.94E-10	4.62E-10	6.94E-10	4.62E-09	0.00E+00	4.24E-07	0.00E+00	5.39E-07	6.94E-10	3.24E-08
26-2485-A01	5-0367	0.00	1.17	1.06E-09	7.03E-10	1.06E-09	7.03E-09	0.00E+00	6.45E-07	0.00E+00	8.21E-07	1.06E-09	4.92E-08
26-4304-A02	5-0152	0.00	0.86	7.77E-10	5.18E-10	7.77E-10	5.18E-09	0.00E+00	4.75E-07	0.00E+00	6.04E-07	7.77E-10	3.63E-08
5046-A01	4-0619	0.00	0.53	4.79E-10	3.19E-10	4.79E-10	3.19E-09	0.00E+00	2.93E-07	0.00E+00	3.72E-07	4.79E-10	2.23E-08
5046-A02	4-0619	0.00	0.53	4.79E-10	3.19E-10	4.79E-10	3.19E-09	0.00E+00	2.93E-07	0.00E+00	3.72E-07	4.79E-10	2.23E-08
5046-A03	4-0619	0.00	0.53	4.79E-10	3.19E-10	4.79E-10	3.19E-09	0.00E+00	2.93E-07	0.00E+00	3.72E-07	4.79E-10	2.23E-08
26-0436-A01	5-0152	0.00	3.20	2.88E-09	1.92E-09	2.88E-09	1.92E-08	0.00E+00	1.76E-06	0.00E+00	2.24E-06	2.88E-09	1.34E-07
26-0436-A02	5-0152	0.00	3.20	2.88E-09	1.92E-09	2.88E-09	1.92E-08	0.00E+00	1.76E-06	0.00E+00	2.24E-06	2.88E-09	1.34E-07
26-0120-A01	5-0152	0.00	1.17	1.05E-09	7.02E-10	1.05E-09	7.02E-09	0.00E+00	6.43E-07	0.00E+00	8.19E-07	1.05E-09	4.91E-08
26-0120-A02	5-0152	0.00	1.17	1.05E-09	7.02E-10	1.05E-09	7.02E-09	0.00E+00	6.43E-07	0.00E+00	8.19E-07	1.05E-09	4.91E-08
26-0402-A01	5-0152	0.00	0.43	3.84E-10	2.56E-10	3.84E-10	2.56E-09	0.00E+00	2.35E-07	0.00E+00	2.99E-07	3.84E-10	1.79E-08
26-0402-A02	5-0152	0.00	0.43	3.84E-10	2.56E-10	3.84E-10	2.56E-09	0.00E+00	2.35E-07	0.00E+00	2.99E-07	3.84E-10	1.79E-08
26-0455-A01	5-0152	2.17	0.27	1.85E-09	2.61E-09	1.85E-09	1.61E-09	1.61E-05	1.78E-06	2.17E-07	8.39E-07	2.83E-09	1.13E-08
26-0455-A02	5-0152	2.17	0.27	1.85E-09	2.61E-09	1.85E-09	1.61E-09	1.61E-05	1.78E-06	2.17E-07	8.39E-07	2.83E-09	1.13E-08
26-0525-A01	5-0335	0.00	3.87	3.48E-09	2.32E-09	3.48E-09	2.32E-08	0.00E+00	2.13E-06	0.00E+00	2.71E-06	3.48E-09	1.62E-07
26-0525-A02	5-0315	0.00	3.87	3.48E-09	2.32E-09	3.48E-09	2.32E-08	0.00E+00	2.13E-06	0.00E+00	2.71E-06	3.48E-09	1.62E-07
26-0525-A03	5-0334	0.00	3.87	3.48E-09	2.32E-09	3.48E-09	2.32E-08	0.00E+00	2.13E-06	0.00E+00	2.71E-06	3.48E-09	1.62E-07
26-2352-A01	5-0152	1.50	7.16	7.56E-09	6.00E-09	7.56E-09	4.30E-08	1.11E-05	5.07E-06	1.50E-07	5.46E-06	8.23E-09	3.01E-07
26-3245-A01	5-0152	0.00	1.45	1.30E-09	8.69E-10	1.30E-09	8.69E-09	0.00E+00	7.97E-07	0.00E+00	1.01E-06	1.30E-09	6.09E-08
26-04119-A02	5-0152	1.42	2.40	3.21E-09	3.04E-09	3.21E-09	1.44E-08	1.05E-05	2.38E-06	1.42E-07	2.10E-06	3.85E-09	1.01E-07
26-2401-A01	5-0152	0.00	1.38	1.24E-09	8.27E-10	1.24E-09	8.27E-09	0.00E+00	7.58E-07	0.00E+00	9.65E-07	1.24E-09	5.79E-08
26-04219-A02	5-0552	0.00	1.35	1.22E-09	8.12E-10	1.22E-09	8.12E-09	0.00E+00	7.44E-07	0.00E+00	9.47E-07	1.22E-09	5.68E-08
26-04219-A03	5-0308	0.00	1.35	1.22E-09	8.12E-10	1.22E-09	8.12E-09	0.00E+00	7.44E-07	0.00E+00	9.47E-07	1.22E-09	5.68E-08
26-4312-A01	5-0364	0.00	2.94	2.65E-09	1.77E-09	2.65E-09	1.77E-08	0.00E+00	1.62E-06	0.00E+00	2.06E-06	2.65E-09	1.24E-07
26-4312-A02	5-0364	0.00	2.94	2.65E-09	1.77E-09	2.65E-09	1.77E-08	0.00E+00	1.62E-06	0.00E+00	2.06E-06	2.65E-09	1.24E-07
26-4404-A04	5-0152	0.00	37.93	3.41E-08	2.28E-08	3.41E-08	2.28E-07	0.00E+00	2.09E-05	0.00E+00	2.66E-05	3.41E-08	1.59E-06
26-4404-A06	5-0152	0.00	37.93	3.41E-08	2.28E-08	3.41E-08	2.28E-07	0.00E+00	2.09E-05	0.00E+00	2.66E-05	3.41E-08	1.59E-06
26-4727-A01	5-0152	0.00	2.47	2.22E-09	1.48E-09	2.22E-09	1.48E-08	0.00E+00	1.36E-06	0.00E+00	1.73E-06	2.22E-09	1.04E-07
26-5014-A03	5-0152	0.00	1.25	1.12E-09	7.50E-10	1.12E-09	7.50E-09	0.00E+00	6.87E-07	0.00E+00	8.74E-07	1.12E-09	5.25E-08
26-5016-A01	5-0152	0.00	0.93	8.38E-10	5.59E-10	8.38E-10	5.59E-09	0.00E+00	5.12E-07	0.00E+00	6.52E-07	8.38E-10	3.91E-08
26-HQ Building-A01	5-0300	0.01	3.33	3.01E-09	2.01E-09	3.01E-09	2.00E-08	9.77E-08	1.84E-06	1.32E-09	2.34E-06	3.02E-09	1.40E-07
26-HQ Building-A02	5-0300	0.01	3.33	3.01E-09	2.01E-09	3.01E-09	2.00E-08	9.77E-08	1.84E-06	1.32E-09	2.34E-06	3.02E-09	1.40E-07
26-HQ Building-A03	5-0300	0.01	3.33	3.01E-09	2.01E-09	3.01E-09	2.00E-08	9.77E-08	1.84E-06	1.32E-09	2.34E-06	3.02E-09	1.40E-07
26-HQ Building-A04	5-0300	0.01	3.33	3.01E-09	2.01E-09	3.01E-09	2.00E-08	9.77E-08	1.84E-06	1.32E-09	2.34E-06	3.02E-09	1.40E-07
26-HQ Building-A05	5-0300	0.01	3.33	3.01E-09	2.01E-09	3.01E-09	2.00E-08	9.77E-08	1.84E-06	1.32E-09	2.34E-06	3.02E-09	1.40E-07
26-GMS Lab-A01	5-0301	0.00	4.63	4.17E-09	2.78E-09	4.17E-09	2.78E-08	0.00E+00	2.55E-06	0.00E+00	3.24E-06	4.17E-09	1.94E-07
26-GMS Lab-A02	5-0301	0.00	4.63	4.17E-09	2.78E-09	4.17E-09	2.78E-08	0.00E+00	2.55E-06	0.00E+00	3.24E-06	4.17E-09	1.94E-07
26-GMS Lab-A03	5-0301	0.00	4.63	4.17E-09	2.78E-09	4.17E-09	2.78E-08	0.00E+00	2.55E-06	0.00E+00	3.24E-06	4.17E-09	1.94E-07
26-GMS Tower-A01	5-0299	0.00	1.33	1.20E-09	7.99E-10	1.20E-09	7.99E-09	0.00E+00	7.33E-07	0.00E+00	9.33E-07	1.20E-09	5.60E-08

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Beryllium	1,3-Butadiene	Cadmium	Chlorobenzene	Chromium	Chrysene	Cobalt
26-GMS Tower-A02	5-0299	0.00	1.33	1.20E-09	7.99E-10	1.20E-09	7.99E-09	0.00E+00	7.33E-07	0.00E+00	9.33E-07	1.20E-09	5.60E-08
26-GMS Tower-A03	5-0299	0.00	1.33	1.20E-09	7.99E-10	1.20E-09	7.99E-09	0.00E+00	7.33E-07	0.00E+00	9.33E-07	1.20E-09	5.60E-08
26-C2CNT West-A01	5-0298	0.00	3.20	2.88E-09	1.92E-09	2.88E-09	1.92E-08	0.00E+00	1.76E-06	0.00E+00	2.24E-06	2.88E-09	1.34E-07
26-C2CNT West-A02	5-0298	0.00	3.20	2.88E-09	1.92E-09	2.88E-09	1.92E-08	0.00E+00	1.76E-06	0.00E+00	2.24E-06	2.88E-09	1.34E-07
26-C2CNT West-A03	5-0298	0.00	3.20	2.88E-09	1.92E-09	2.88E-09	1.92E-08	0.00E+00	1.76E-06	0.00E+00	2.24E-06	2.88E-09	1.34E-07
26-C2CNT West-A04	5-0298	0.00	3.20	2.88E-09	1.92E-09	2.88E-09	1.92E-08	0.00E+00	1.76E-06	0.00E+00	2.24E-06	2.88E-09	1.34E-07
26-0345-A01	5-0079	172.81	21.38	1.47E-07	2.08E-07	1.47E-07	1.28E-07	1.28E-03	1.41E-04	1.73E-05	6.68E-05	2.25E-07	8.98E-07
26-0345-A02	5-0080	172.81	21.38	1.47E-07	2.08E-07	1.47E-07	1.28E-07	1.28E-03	1.41E-04	1.73E-05	6.68E-05	2.25E-07	8.98E-07
26-0345-A03	5-0081	172.81	21.38	1.47E-07	2.08E-07	1.47E-07	1.28E-07	1.28E-03	1.41E-04	1.73E-05	6.68E-05	2.25E-07	8.98E-07
26-3062-A01	5-0152	0.00	3.48	3.13E-09	2.09E-09	3.13E-09	2.09E-08	0.00E+00	1.91E-06	0.00E+00	2.43E-06	3.13E-09	1.46E-07
26-03062-A02	5-0167	0.00	3.48	3.13E-09	2.09E-09	3.13E-09	2.09E-08	0.00E+00	1.91E-06	0.00E+00	2.43E-06	3.13E-09	1.46E-07
26-4600-A06	5-0085	0.00	24.70	2.22E-08	1.48E-08	2.22E-08	1.48E-07	0.00E+00	1.36E-05	0.00E+00	1.73E-05	2.22E-08	1.04E-06
26-4600-A09	5-0370	0.00	24.70	2.22E-08	1.48E-08	2.22E-08	1.48E-07	0.00E+00	1.36E-05	0.00E+00	1.73E-05	2.22E-08	1.04E-06
26-4600-A08	5-0087	24.70	24.70	4.05E-08	4.27E-08	4.05E-08	1.48E-07	1.83E-04	3.21E-05	2.47E-06	2.47E-05	5.16E-08	1.04E-06
26-5014-A01	5-0164	1.25	1.25	2.05E-09	2.16E-09	2.05E-09	7.50E-09	9.24E-06	1.62E-06	1.25E-07	1.25E-06	2.61E-09	5.25E-08
26-5014-A02	5-0165	1.25	1.25	2.05E-09	2.16E-09	2.05E-09	7.50E-09	9.24E-06	1.62E-06	1.25E-07	1.25E-06	2.61E-09	5.25E-08
26-0030-A01	4-0619	2.40	0.00	1.78E-09	2.71E-09	1.78E-09	0.00E+00	1.78E-05	1.80E-06	2.40E-07	7.20E-07	2.86E-09	0.00E+00
26-0030-A02	4-0619	2.40	0.00	1.78E-09	2.71E-09	1.78E-09	0.00E+00	1.78E-05	1.80E-06	2.40E-07	7.20E-07	2.86E-09	0.00E+00
26-0045-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0322-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0384-A01	4-0619	2.33	0.00	1.73E-09	2.64E-09	1.73E-09	0.00E+00	1.73E-05	1.75E-06	2.33E-07	7.00E-07	2.78E-09	0.00E+00
0390-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0402-A03	4-0619	1.54	0.00	1.14E-09	1.74E-09	1.14E-09	0.00E+00	1.14E-05	1.15E-06	1.54E-07	4.62E-07	1.83E-09	0.00E+00
26-0392-A01	4-0709	2.97	0.00	2.20E-09	3.35E-09	2.20E-09	0.00E+00	2.20E-05	2.23E-06	2.97E-07	8.91E-07	3.53E-09	0.00E+00
26-0394-A01	4-0708	10.07	0.00	7.45E-09	1.14E-08	7.45E-09	0.00E+00	7.45E-05	7.55E-06	1.01E-06	3.02E-06	1.20E-08	0.00E+00
0400-A01	4-0546	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0439-A01	4-0619	2.02	0.00	1.49E-09	2.28E-09	1.49E-09	0.00E+00	1.49E-05	1.51E-06	2.02E-07	6.05E-07	2.40E-09	0.00E+00
26-0445-A01	4-0707	2.45	0.00	1.81E-09	2.77E-09	1.81E-09	0.00E+00	1.81E-05	1.84E-06	2.45E-07	7.35E-07	2.92E-09	0.00E+00
26-0449-A01	4-0706	2.77	0.00	2.05E-09	3.13E-09	2.05E-09	0.00E+00	2.05E-05	2.08E-06	2.77E-07	8.32E-07	3.30E-09	0.00E+00
26-0456-A01	4-0619	0.55	0.00	4.03E-10	6.16E-10	4.03E-10	0.00E+00	4.03E-06	4.09E-07	5.45E-08	1.64E-07	6.49E-10	0.00E+00
0507-A05	4-0717	19.80	0.00	1.46E-08	2.24E-08	1.46E-08	0.00E+00	1.46E-04	1.48E-05	1.98E-06	5.94E-06	2.36E-08	0.00E+00
0507-A04	5-0104	19.80	0.00	1.46E-08	2.24E-08	1.46E-08	0.00E+00	1.46E-04	1.48E-05	1.98E-06	5.94E-06	2.36E-08	0.00E+00
26-0642-A01	4-0689	4.33	0.00	3.20E-09	4.89E-09	3.20E-09	0.00E+00	3.20E-05	3.25E-06	4.33E-07	1.30E-06	5.15E-09	0.00E+00
26-0643-A01	4-0721	2.93	0.00	2.17E-09	3.31E-09	2.17E-09	0.00E+00	2.17E-05	2.20E-06	2.93E-07	8.80E-07	3.49E-09	0.00E+00
26-0644-A01	4-0619	2.44	0.00	1.80E-09	2.76E-09	1.80E-09	0.00E+00	1.80E-05	1.83E-06	2.44E-07	7.32E-07	2.90E-09	0.00E+00
26-0670-A01	4-0719	3.24	0.00	2.40E-09	3.66E-09	2.40E-09	0.00E+00	2.40E-05	2.43E-06	3.24E-07	9.71E-07	3.85E-09	0.00E+00
26-0688-A01	4-0720	0.71	0.00	5.26E-10	8.03E-10	5.26E-10	0.00E+00	5.26E-06	5.33E-07	7.11E-08	2.13E-07	8.46E-10	0.00E+00
26-0699A-A01	4-0619	9.87	0.00	7.30E-09	1.11E-08	7.30E-09	0.00E+00	7.30E-05	7.40E-06	9.87E-07	2.96E-06	1.17E-08	0.00E+00
26-0700-A01	4-0619	1.61	0.00	1.19E-09	1.82E-09	1.19E-09	0.00E+00	1.19E-05	1.21E-06	1.61E-07	4.84E-07	1.92E-09	0.00E+00
26-0702-A01	4-0619	0.90	0.00	6.65E-10	1.01E-09	6.65E-10	0.00E+00	6.65E-06	6.74E-07	8.98E-08	2.69E-07	1.07E-09	0.00E+00
26-0745A-A01	4-0619	0.13	0.00	9.47E-11	1.45E-10	9.47E-11	0.00E+00	9.47E-07	9.60E-08	1.28E-08	3.84E-08	1.52E-10	0.00E+00
26-0860-A01	4-0619	1.29	0.00	9.52E-10	1.45E-09	9.52E-10	0.00E+00	9.52E-06	9.65E-07	1.29E-07	3.86E-07	1.53E-09	0.00E+00
26-0896-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-1064-A01	4-0619	5.98	0.00	4.42E-09	6.75E-09	4.42E-09	0.00E+00	4.42E-05	4.48E-06	5.98E-07	1.79E-06	7.11E-09	0.00E+00
26-1064-A02	4-0619	5.98	0.00	4.42E-09	6.75E-09	4.42E-09	0.00E+00	4.42E-05	4.48E-06	5.98E-07	1.79E-06	7.11E-09	0.00E+00
26-1134-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2184-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2207-A03	4-0619	8.16	0.00	6.04E-09	9.22E-09	6.04E-09	0.00E+00	6.04E-05	6.12E-06	8.16E-07	2.45E-06	9.71E-09	0.00E+00
26-2377-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2377-A02	4-0619	8.70	0.00	6.44E-09	9.83E-09	6.44E-09	0.00E+00	6.44E-05	6.52E-06	8.70E-07	2.61E-06	1.04E-08	0.00E+00
26-2379-A01	4-0619	5.31	0.00	3.93E-09	6.00E-09	3.93E-09	0.00E+00	3.93E-05	3.98E-06	5.31E-07	1.59E-06	6.32E-09	0.00E+00
26-0269B-A01	4-0619	3.60	0.00	2.66E-09	4.07E-09	2.66E-09	0.00E+00	2.66E-05	2.70E-06	3.60E-07	1.08E-06	4.28E-09	0.00E+00
26-0280B-A01	4-0619	1.42	0.00	1.05E-09	1.60E-09	1.05E-09	0.00E+00	1.05E-05	1.06E-06	1.42E-07	4.26E-07	1.69E-09	0.00E+00

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Beryllium	1,3-Butadiene	Cadmium	Chlorobenzene	Chromium	Chrysene	Cobalt
26-3011-A01	4-0619	1.64	0.00	1.22E-09	1.86E-09	1.22E-09	0.00E+00	1.22E-05	1.23E-06	1.64E-07	4.93E-07	1.95E-09	0.00E+00
3070-A01	4-0619	17.24	0.00	1.28E-08	1.95E-08	1.28E-08	0.00E+00	1.28E-04	1.29E-05	1.72E-06	5.17E-06	2.05E-08	0.00E+00
26-4725-A01	4-0619	3.25	0.00	2.41E-09	3.67E-09	2.41E-09	0.00E+00	2.41E-05	2.44E-06	3.25E-07	9.75E-07	3.87E-09	0.00E+00
26-4728-A02	4-0619	5.19	0.00	3.84E-09	5.87E-09	3.84E-09	0.00E+00	3.84E-05	3.89E-06	5.19E-07	1.56E-06	6.18E-09	0.00E+00
Bldg 906C - pending	4-0724	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5046-A01	4-0619	0.53	0.00	3.94E-10	6.01E-10	3.94E-10	0.00E+00	3.94E-06	3.99E-07	5.32E-08	1.60E-07	6.33E-10	0.00E+00
26-5109-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-5116-A01	4-0619	1.03	0.00	7.60E-10	1.16E-09	7.60E-10	0.00E+00	7.60E-06	7.71E-07	1.03E-07	3.08E-07	1.22E-09	0.00E+00
26-0733A-A01	4-0619	1.14	0.00	8.45E-10	1.29E-09	8.45E-10	0.00E+00	8.45E-06	8.57E-07	1.14E-07	3.43E-07	1.36E-09	0.00E+00
26-0740B-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0740C-A01	4-0619	3.97	0.00	2.94E-09	4.49E-09	2.94E-09	0.00E+00	2.94E-05	2.98E-06	3.97E-07	1.19E-06	4.73E-09	0.00E+00
26-1100F-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-745A-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2312-A02	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Atmospheric Burner #1	4-0692	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0367-A01	5-0352	1.82	0.00	1.34E-09	2.05E-09	1.34E-09	0.00E+00	1.34E-05	1.36E-06	1.82E-07	5.45E-07	2.16E-09	0.00E+00
			Totals	**8.57E-07**	**1.03E-06**	**8.57E-07**	**2.14E-06**	**5.36E-03**	**7.39E-04**	**7.24E-05**	**4.67E-04**	**1.18E-06**	**1.50E-05**

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Beryllium	1,3-Butadiene	Cadmium	Chlorobenzene	Chromium	Chrysene	Cobalt
Fire Test Lab - 07-0525-A01	12-9-0216	0.00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ECO Mobile Incinerator	N/A	0.00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Boilers (tpy)

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Copper	Dibenzo(a,h)anthracene	Dichlorobenzene	Ethyl Benzene	Fluoranthene	Fluorene	Formaldehyde	Hydrochloric Acid	Indeno(1,2,3-cd)pyrene	Lead	Manganese
26-3326-A02	5-0152	0.00	1.74	0.00E+00	1.05E-09	1.05E-06	8.29E-06	2.62E-09	2.44E-09	6.54E-05	0.00E+00	1.57E-09	4.36E-07	3.31E-07
0383A-A01 & A02	5-0376	0.00	4.18	0.00E+00	2.51E-09	2.51E-06	1.98E-05	6.27E-09	5.85E-09	1.57E-04	0.00E+00	3.76E-09	1.04E-06	7.94E-07
26-0459-A02	5-0337	0.00	1.07	0.00E+00	6.44E-10	6.44E-07	5.10E-06	1.61E-09	1.50E-09	4.02E-05	0.00E+00	9.66E-10	2.68E-07	2.04E-07
26-2202-A01	5-0322	0.00	2.80	0.00E+00	1.68E-09	1.68E-06	1.33E-05	4.20E-09	3.92E-09	1.05E-04	0.00E+00	2.52E-09	7.00E-07	5.32E-07
26-2202-A02	5-0322	0.00	2.80	0.00E+00	1.68E-09	1.68E-06	1.33E-05	4.20E-09	3.92E-09	1.05E-04	0.00E+00	2.52E-09	7.00E-07	5.32E-07
26-3300-A02	5-0152	0.00	0.66	0.00E+00	3.97E-10	3.97E-07	3.14E-06	9.92E-10	9.26E-10	2.48E-05	0.00E+00	5.95E-10	1.65E-07	1.26E-07
26-3300-A01	5-0152	0.00	0.66	0.00E+00	3.97E-10	3.97E-07	3.14E-06	9.92E-10	9.26E-10	2.48E-05	0.00E+00	5.95E-10	1.65E-07	1.26E-07
26-3144-A01	5-0152	0.00	6.11	0.00E+00	3.67E-09	3.67E-06	2.90E-05	9.17E-09	8.56E-09	2.29E-04	0.00E+00	5.50E-09	1.53E-06	1.16E-06
26-3660-A01	5-0371	0.00	1.10	0.00E+00	6.60E-10	6.60E-07	5.22E-06	1.65E-09	1.54E-09	4.12E-05	0.00E+00	9.89E-10	2.75E-07	2.09E-07
26-04119-A03	5-0336	0.00	2.40	0.00E+00	1.44E-09	1.44E-06	1.14E-05	3.60E-09	3.36E-09	8.99E-05	0.00E+00	2.16E-09	6.00E-07	4.56E-07
26-5100-A01	5-0310	0.00	4.93	0.00E+00	2.96E-09	2.96E-06	2.34E-05	7.40E-09	6.90E-09	1.85E-04	0.00E+00	4.44E-09	1.23E-06	9.37E-07
26-5100-A02	5-0309	0.00	4.93	0.00E+00	2.96E-09	2.96E-06	2.34E-05	7.40E-09	6.90E-09	1.85E-04	0.00E+00	4.44E-09	1.23E-06	9.37E-07
0339-A01	5-0710	0.00	0.77	0.00E+00	4.62E-10	4.62E-07	3.66E-06	1.16E-09	1.08E-09	2.89E-05	0.00E+00	6.94E-10	1.93E-07	1.46E-07
26-2485-A01	5-0367	0.00	1.17	0.00E+00	7.03E-10	7.03E-07	5.57E-06	1.76E-09	1.64E-09	4.40E-05	0.00E+00	1.06E-09	2.93E-07	2.23E-07
26-4304-A02	5-0152	0.00	0.86	0.00E+00	5.18E-10	5.18E-07	4.10E-06	1.29E-09	1.21E-09	3.24E-05	0.00E+00	7.77E-10	2.16E-07	1.64E-07
5046-A01	4-0619	0.00	0.53	0.00E+00	3.19E-10	3.19E-07	2.53E-06	7.98E-10	7.45E-10	2.00E-05	0.00E+00	4.79E-10	1.33E-07	1.01E-07
5046-A02	4-0619	0.00	0.53	0.00E+00	3.19E-10	3.19E-07	2.53E-06	7.98E-10	7.45E-10	2.00E-05	0.00E+00	4.79E-10	1.33E-07	1.01E-07
5046-A03	4-0619	0.00	0.53	0.00E+00	3.19E-10	3.19E-07	2.53E-06	7.98E-10	7.45E-10	2.00E-05	0.00E+00	4.79E-10	1.33E-07	1.01E-07
26-0436-A01	5-0152	0.00	3.20	0.00E+00	1.92E-09	1.92E-06	1.52E-05	4.80E-09	4.48E-09	1.20E-04	0.00E+00	2.88E-09	8.01E-07	6.08E-07
26-0436-A02	5-0152	0.00	3.20	0.00E+00	1.92E-09	1.92E-06	1.52E-05	4.80E-09	4.48E-09	1.20E-04	0.00E+00	2.88E-09	8.01E-07	6.08E-07
26-0120-A01	5-0152	0.00	1.17	0.00E+00	7.02E-10	7.02E-07	5.56E-06	1.75E-09	1.64E-09	4.39E-05	0.00E+00	1.05E-09	2.92E-07	2.22E-07
26-0120-A02	5-0152	0.00	1.17	0.00E+00	7.02E-10	7.02E-07	5.56E-06	1.75E-09	1.64E-09	4.39E-05	0.00E+00	1.05E-09	2.92E-07	2.22E-07
26-0402-A01	5-0152	0.00	0.43	0.00E+00	2.56E-10	2.56E-07	2.03E-06	6.40E-10	5.98E-10	1.60E-05	0.00E+00	3.84E-10	1.07E-07	8.11E-08
26-0402-A02	5-0152	0.00	0.43	0.00E+00	2.56E-10	2.56E-07	2.03E-06	6.40E-10	5.98E-10	1.60E-05	0.00E+00	3.84E-10	1.07E-07	8.11E-08
26-0455-A01	5-0152	2.17	0.27	4.45E-06	1.97E-09	1.61E-07	1.35E-06	5.66E-09	5.23E-09	4.59E-05	2.02E-04	2.56E-09	9.08E-06	3.42E-06
26-0455-A02	5-0152	2.17	0.27	4.45E-06	1.97E-09	1.61E-07	1.35E-06	5.66E-09	5.23E-09	4.59E-05	2.02E-04	2.56E-09	9.08E-06	3.42E-06
26-0525-A01	5-0335	0.00	3.87	0.00E+00	2.32E-09	2.32E-06	1.84E-05	5.80E-09	5.41E-09	1.45E-04	0.00E+00	3.48E-09	9.66E-07	7.34E-07
26-0525-A02	5-0315	0.00	3.87	0.00E+00	2.32E-09	2.32E-06	1.84E-05	5.80E-09	5.41E-09	1.45E-04	0.00E+00	3.48E-09	9.66E-07	7.34E-07
26-0525-A03	5-0334	0.00	3.87	0.00E+00	2.32E-09	2.32E-06	1.84E-05	5.80E-09	5.41E-09	1.45E-04	0.00E+00	3.48E-09	9.66E-07	7.34E-07
26-2352-A01	5-0152	1.50	7.16	3.08E-06	5.55E-09	4.30E-06	3.41E-05	1.44E-08	1.34E-08	2.93E-04	1.40E-04	8.05E-09	8.03E-06	3.69E-06
26-3245-A01	5-0152	0.00	1.45	0.00E+00	8.69E-10	8.69E-07	6.88E-06	2.17E-09	2.03E-09	5.43E-05	0.00E+00	1.30E-09	3.62E-07	2.75E-07
26-04119-A02	5-0152	1.42	2.40	2.91E-06	2.62E-09	1.44E-06	1.14E-05	7.03E-09	6.53E-09	1.13E-04	1.32E-04	3.68E-09	6.49E-06	2.66E-06
26-2401-A01	5-0152	0.00	1.38	0.00E+00	8.27E-10	8.27E-07	6.55E-06	2.07E-09	1.93E-09	5.17E-05	0.00E+00	1.24E-09	3.45E-07	2.62E-07
26-04219-A02	5-0552	0.00	1.35	0.00E+00	8.12E-10	8.12E-07	6.43E-06	2.03E-09	1.89E-09	5.07E-05	0.00E+00	1.22E-09	3.38E-07	2.57E-07
26-04219-A03	5-0308	0.00	1.35	0.00E+00	8.12E-10	8.12E-07	6.43E-06	2.03E-09	1.89E-09	5.07E-05	0.00E+00	1.22E-09	3.38E-07	2.57E-07
26-4312-A01	5-0364	0.00	2.94	0.00E+00	1.77E-09	1.77E-06	1.40E-05	4.42E-09	4.12E-09	1.10E-04	0.00E+00	2.65E-09	7.36E-07	5.60E-07
26-4312-A02	5-0364	0.00	2.94	0.00E+00	1.77E-09	1.77E-06	1.40E-05	4.42E-09	4.12E-09	1.10E-04	0.00E+00	2.65E-09	7.36E-07	5.60E-07
26-4404-A04	5-0152	0.00	37.93	0.00E+00	2.28E-08	2.28E-05	1.80E-04	5.69E-08	5.31E-08	1.42E-03	0.00E+00	3.41E-08	9.48E-06	7.21E-06
26-4404-A06	5-0152	0.00	37.93	0.00E+00	2.28E-08	2.28E-05	1.80E-04	5.69E-08	5.31E-08	1.42E-03	0.00E+00	3.41E-08	9.48E-06	7.21E-06
26-4727-A01	5-0152	0.00	2.47	0.00E+00	1.48E-09	1.48E-06	1.17E-05	3.71E-09	3.46E-09	9.27E-05	0.00E+00	2.22E-09	6.18E-07	4.70E-07
26-5014-A03	5-0152	0.00	1.25	0.00E+00	7.50E-10	7.50E-07	5.93E-06	1.87E-09	1.75E-09	4.68E-05	0.00E+00	1.12E-09	3.12E-07	2.37E-07
26-5016-A01	5-0152	0.00	0.93	0.00E+00	5.59E-10	5.59E-07	4.42E-06	1.40E-09	1.30E-09	3.49E-05	0.00E+00	8.38E-10	2.33E-07	1.77E-07
26-HQ Building-A01	5-0300	0.01	3.33	2.71E-08	2.01E-09	2.00E-06	1.58E-05	5.03E-09	4.70E-09	1.25E-04	1.23E-06	3.01E-09	8.88E-07	6.54E-07
26-HQ Building-A02	5-0300	0.01	3.33	2.71E-08	2.01E-09	2.00E-06	1.58E-05	5.03E-09	4.70E-09	1.25E-04	1.23E-06	3.01E-09	8.88E-07	6.54E-07
26-HQ Building-A03	5-0300	0.01	3.33	2.71E-08	2.01E-09	2.00E-06	1.58E-05	5.03E-09	4.70E-09	1.25E-04	1.23E-06	3.01E-09	8.88E-07	6.54E-07
26-HQ Building-A04	5-0300	0.01	3.33	2.71E-08	2.01E-09	2.00E-06	1.58E-05	5.03E-09	4.70E-09	1.25E-04	1.23E-06	3.01E-09	8.88E-07	6.54E-07
26-HQ Building-A05	5-0300	0.01	3.33	2.71E-08	2.01E-09	2.00E-06	1.58E-05	5.03E-09	4.70E-09	1.25E-04	1.23E-06	3.01E-09	8.88E-07	6.54E-07
26-GMS Lab-A01	5-0301	0.00	4.63	0.00E+00	2.78E-09	2.78E-06	2.20E-05	6.95E-09	6.48E-09	1.74E-04	0.00E+00	4.17E-09	1.16E-06	8.80E-07
26-GMS Lab-A02	5-0301	0.00	4.63	0.00E+00	2.78E-09	2.78E-06	2.20E-05	6.95E-09	6.48E-09	1.74E-04	0.00E+00	4.17E-09	1.16E-06	8.80E-07
26-GMS Lab-A03	5-0301	0.00	4.63	0.00E+00	2.78E-09	2.78E-06	2.20E-05	6.95E-09	6.48E-09	1.74E-04	0.00E+00	4.17E-09	1.16E-06	8.80E-07
26-GMS Tower-A01	5-0299	0.00	1.33	0.00E+00	7.99E-10	7.99E-07	6.33E-06	2.00E-09	1.87E-09	5.00E-05	0.00E+00	1.20E-09	3.33E-07	2.53E-07

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Copper	Dibenzo(a,h)anthracene	Dichlorobenzene	Ethyl Benzene	Fluoranthene	Fluorene	Formaldehyde	Hydrochloric Acid	Indeno(1,2,3-cd)pyrene	Lead	Manganese
26-GMS Tower-A02	5-0299	0.00	1.33	0.00E+00	7.99E-10	7.99E-07	6.33E-06	2.00E-09	1.87E-09	5.00E-05	0.00E+00	1.20E-09	3.33E-07	2.53E-07
26-GMS Tower-A03	5-0299	0.00	1.33	0.00E+00	7.99E-10	7.99E-07	6.33E-06	2.00E-09	1.87E-09	5.00E-05	0.00E+00	1.20E-09	3.33E-07	2.53E-07
26-C2CNT West-A01	5-0298	0.00	3.20	0.00E+00	1.92E-09	1.92E-06	1.52E-05	4.80E-09	4.48E-09	1.20E-04	0.00E+00	2.88E-09	8.00E-07	6.08E-07
26-C2CNT West-A02	5-0298	0.00	3.20	0.00E+00	1.92E-09	1.92E-06	1.52E-05	4.80E-09	4.48E-09	1.20E-04	0.00E+00	2.88E-09	8.00E-07	6.08E-07
26-C2CNT West-A03	5-0298	0.00	3.20	0.00E+00	1.92E-09	1.92E-06	1.52E-05	4.80E-09	4.48E-09	1.20E-04	0.00E+00	2.88E-09	8.00E-07	6.08E-07
26-C2CNT West-A04	5-0298	0.00	3.20	0.00E+00	1.92E-09	1.92E-06	1.52E-05	4.80E-09	4.48E-09	1.20E-04	0.00E+00	2.88E-09	8.00E-07	6.08E-07
26-0345-A01	5-0079	172.81	21.38	3.54E-04	1.57E-07	1.28E-05	1.07E-04	4.50E-07	4.16E-07	3.65E-03	1.61E-02	2.04E-07	7.23E-04	2.72E-04
26-0345-A02	5-0080	172.81	21.38	3.54E-04	1.57E-07	1.28E-05	1.07E-04	4.50E-07	4.16E-07	3.65E-03	1.61E-02	2.04E-07	7.23E-04	2.72E-04
26-0345-A03	5-0081	172.81	21.38	3.54E-04	1.57E-07	1.28E-05	1.07E-04	4.50E-07	4.16E-07	3.65E-03	1.61E-02	2.04E-07	7.23E-04	2.72E-04
26-3062-A01	5-0152	0.00	3.48	0.00E+00	2.09E-09	2.09E-06	1.65E-05	5.22E-09	4.87E-09	1.30E-04	0.00E+00	3.13E-09	8.69E-07	6.61E-07
26-03062-A02	5-0167	0.00	3.48	0.00E+00	2.09E-09	2.09E-06	1.65E-05	5.22E-09	4.87E-09	1.30E-04	0.00E+00	3.13E-09	8.69E-07	6.61E-07
26-4600-A06	5-0085	0.00	24.70	0.00E+00	1.48E-08	1.48E-05	1.17E-04	3.71E-08	3.46E-08	9.26E-04	0.00E+00	2.22E-08	6.18E-06	4.69E-06
26-4600-A09	5-0370	0.00	24.70	0.00E+00	1.48E-08	1.48E-05	1.17E-04	3.71E-08	3.46E-08	9.26E-04	0.00E+00	2.22E-08	6.18E-06	4.69E-06
26-4600-A08	5-0087	24.70	24.70	5.06E-05	3.54E-08	1.48E-05	1.18E-04	9.68E-08	8.98E-08	1.33E-03	2.30E-03	4.87E-08	1.09E-04	4.30E-05
26-5014-A01	5-0164	1.25	1.25	2.56E-06	1.79E-09	7.50E-07	5.97E-06	4.90E-09	4.54E-09	6.75E-05	1.16E-04	2.46E-09	5.50E-06	2.17E-06
26-5014-A02	5-0165	1.25	1.25	2.56E-06	1.79E-09	7.50E-07	5.97E-06	4.90E-09	4.54E-09	6.75E-05	1.16E-04	2.46E-09	5.50E-06	2.17E-06
26-0030-A01	4-0619	2.40	0.00	4.92E-06	2.00E-09	0.00E+00	7.63E-08	5.81E-09	5.37E-09	3.96E-05	2.24E-04	2.57E-09	9.96E-06	3.72E-06
26-0030-A02	4-0619	2.40	0.00	4.92E-06	2.00E-09	0.00E+00	7.63E-08	5.81E-09	5.37E-09	3.96E-05	2.24E-04	2.57E-09	9.96E-06	3.72E-06
26-0045-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0322-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0384-A01	4-0619	2.33	0.00	4.78E-06	1.95E-09	0.00E+00	7.42E-08	5.65E-09	5.21E-09	3.85E-05	2.17E-04	2.50E-09	9.68E-06	3.62E-06
0390-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0402-A03	4-0619	1.54	0.00	3.16E-06	1.29E-09	0.00E+00	4.89E-08	3.73E-09	3.44E-09	2.54E-05	1.43E-04	1.65E-09	6.39E-06	2.39E-06
26-0392-A01	4-0709	2.97	0.00	6.09E-06	2.48E-09	0.00E+00	9.44E-08	7.18E-09	6.63E-09	4.90E-05	2.77E-04	3.18E-09	1.23E-05	4.60E-06
26-0394-A01	4-0708	10.07	0.00	2.06E-05	8.41E-09	0.00E+00	3.20E-07	2.44E-08	2.25E-08	1.66E-04	9.38E-04	1.08E-08	4.18E-05	1.56E-05
0400-A01	4-0546	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0439-A01	4-0619	2.02	0.00	4.14E-06	1.69E-09	0.00E+00	6.42E-08	4.88E-09	4.51E-09	3.33E-05	1.88E-04	2.16E-09	8.37E-06	3.13E-06
26-0445-A01	4-0707	2.45	0.00	5.02E-06	2.05E-09	0.00E+00	7.79E-08	5.93E-09	5.48E-09	4.04E-05	2.28E-04	2.62E-09	1.02E-05	3.80E-06
26-0449-A01	4-0706	2.77	0.00	5.68E-06	2.31E-09	0.00E+00	8.81E-08	6.71E-09	6.20E-09	4.57E-05	2.58E-04	2.97E-09	1.15E-05	4.30E-06
26-0456-A01	4-0619	0.55	0.00	1.12E-06	4.55E-10	0.00E+00	1.73E-08	1.32E-09	1.22E-09	8.99E-06	5.08E-05	5.83E-10	2.26E-06	8.45E-07
0507-A05	4-0717	19.80	0.00	4.06E-05	1.65E-08	0.00E+00	6.30E-07	4.79E-08	4.42E-08	3.27E-04	1.84E-03	2.12E-08	8.22E-05	3.07E-05
0507-A04	5-0104	19.80	0.00	4.06E-05	1.65E-08	0.00E+00	6.30E-07	4.79E-08	4.42E-08	3.27E-04	1.84E-03	2.12E-08	8.22E-05	3.07E-05
26-0642-A01	4-0689	4.33	0.00	8.88E-06	3.62E-09	0.00E+00	1.38E-07	1.05E-08	9.68E-09	7.14E-05	4.03E-04	4.63E-09	1.80E-05	6.71E-06
26-0643-A01	4-0721	2.93	0.00	6.01E-06	2.45E-09	0.00E+00	9.33E-08	7.10E-09	6.56E-09	4.84E-05	2.73E-04	3.14E-09	1.22E-05	4.55E-06
26-0644-A01	4-0619	2.44	0.00	5.00E-06	2.04E-09	0.00E+00	7.76E-08	5.90E-09	5.45E-09	4.02E-05	2.27E-04	2.61E-09	1.01E-05	3.78E-06
26-0670-A01	4-0719	3.24	0.00	6.64E-06	2.70E-09	0.00E+00	1.03E-07	7.83E-09	7.23E-09	5.34E-05	3.02E-04	3.46E-09	1.34E-05	5.02E-06
26-0688-A01	4-0720	0.71	0.00	1.46E-06	5.94E-10	0.00E+00	2.26E-08	1.72E-09	1.59E-09	1.17E-05	6.62E-05	7.61E-10	2.95E-06	1.10E-06
26-0699A-A01	4-0619	9.87	0.00	2.02E-05	8.24E-09	0.00E+00	3.14E-07	2.39E-08	2.21E-08	1.63E-04	9.19E-04	1.06E-08	4.09E-05	1.53E-05
26-0700-A01	4-0619	1.61	0.00	3.31E-06	1.35E-09	0.00E+00	5.13E-08	3.90E-09	3.61E-09	2.66E-05	1.50E-04	1.73E-09	6.69E-06	2.50E-06
26-0702-A01	4-0619	0.90	0.00	1.84E-06	7.50E-10	0.00E+00	2.86E-08	2.17E-09	2.01E-09	1.48E-05	8.36E-05	9.61E-10	3.73E-06	1.39E-06
26-0745A-A01	4-0619	0.13	0.00	2.62E-07	1.07E-10	0.00E+00	4.07E-09	3.10E-10	2.86E-10	2.11E-06	1.19E-05	1.37E-10	5.31E-07	1.98E-07
26-0860-A01	4-0619	1.29	0.00	2.64E-06	1.07E-09	0.00E+00	4.09E-08	3.11E-09	2.87E-09	2.12E-05	1.20E-04	1.38E-09	5.34E-06	1.99E-06
26-0896-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-1064-A01	4-0619	5.98	0.00	1.23E-05	4.99E-09	0.00E+00	1.90E-07	1.45E-08	1.34E-08	9.86E-05	5.57E-04	6.40E-09	2.48E-05	9.26E-06
26-1064-A02	4-0619	5.98	0.00	1.23E-05	4.99E-09	0.00E+00	1.90E-07	1.45E-08	1.34E-08	9.86E-05	5.57E-04	6.40E-09	2.48E-05	9.26E-06
26-1134-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2184-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2207-A03	4-0619	8.16	0.00	1.67E-05	6.82E-09	0.00E+00	2.60E-07	1.98E-08	1.82E-08	1.35E-04	7.60E-04	8.73E-09	3.39E-05	1.27E-05
26-2377-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2377-A02	4-0619	8.70	0.00	1.78E-05	7.26E-09	0.00E+00	2.77E-07	2.11E-08	1.94E-08	1.44E-04	8.10E-04	9.31E-09	3.61E-05	1.35E-05
26-2379-A01	4-0619	5.31	0.00	1.09E-05	4.43E-09	0.00E+00	1.69E-07	1.29E-08	1.19E-08	8.76E-05	4.95E-04	5.68E-09	2.20E-05	8.23E-06
26-0269B-A01	4-0619	3.60	0.00	7.38E-06	3.00E-09	0.00E+00	1.14E-07	8.71E-09	8.04E-09	5.94E-05	3.35E-04	3.85E-09	1.49E-05	5.58E-06
26-0280B-A01	4-0619	1.42	0.00	2.91E-06	1.19E-09	0.00E+00	4.51E-08	3.44E-09	3.17E-09	2.34E-05	1.32E-04	1.52E-09	5.89E-06	2.20E-06

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Copper	Dibenzo(a,h)anthracene	Dichlorobenzene	Ethyl Benzene	Fluoranthene	Fluorene	Formaldehyde	Hydrochloric Acid	Indeno(1,2,3-cd)pyrene	Lead	Manganese
26-3011-A01	4-0619	1.64	0.00	3.37E-06	1.37E-09	0.00E+00	5.22E-08	3.97E-09	3.67E-09	2.71E-05	1.53E-04	1.76E-09	6.81E-06	2.55E-06
3070-A01	4-0619	17.24	0.00	3.53E-05	1.44E-08	0.00E+00	5.48E-07	4.17E-08	3.85E-08	2.84E-04	1.61E-03	1.84E-08	7.16E-05	2.67E-05
26-4725-A01	4-0619	3.25	0.00	6.66E-06	2.71E-09	0.00E+00	1.03E-07	7.87E-09	7.27E-09	5.36E-05	3.03E-04	3.48E-09	1.35E-05	5.04E-06
26-4728-A02	4-0619	5.19	0.00	1.06E-05	4.34E-09	0.00E+00	1.65E-07	1.26E-08	1.16E-08	8.57E-05	4.84E-04	5.56E-09	2.15E-05	8.05E-06
Bldg 906C - pending	4-0724	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5046-A01	4-0619	0.53	0.00	1.09E-06	4.44E-10	0.00E+00	1.69E-08	1.29E-09	1.19E-09	8.78E-06	4.96E-05	5.69E-10	2.21E-06	8.25E-07
26-5109-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-5116-A01	4-0619	1.03	0.00	2.11E-06	8.58E-10	0.00E+00	3.27E-08	2.49E-09	2.30E-09	1.70E-05	9.57E-05	1.10E-09	4.26E-06	1.59E-06
26-0733A-A01	4-0619	1.14	0.00	2.34E-06	9.54E-10	0.00E+00	3.63E-08	2.76E-09	2.55E-09	1.88E-05	1.06E-04	1.22E-09	4.74E-06	1.77E-06
26-0740B-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0740C-A01	4-0619	3.97	0.00	8.14E-06	3.32E-09	0.00E+00	1.26E-07	9.61E-09	8.88E-09	6.55E-05	3.70E-04	4.25E-09	1.65E-05	6.16E-06
26-1100F-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-745A-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2312-A02	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Atmospheric Burner #1	4-0692	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0367-A01	5-0352	1.82	0.00	3.72E-06	1.52E-09	0.00E+00	5.77E-08	4.39E-09	4.06E-09	3.00E-05	1.69E-04	1.94E-09	7.54E-06	2.81E-06
			Totals	**1.49E-03**	**8.19E-07**	**2.14E-04**	**1.71E-03**	**2.29E-06**	**2.12E-06**	**2.53E-02**	**6.75E-02**	**1.10E-06**	**3.10E-03**	**1.19E-03**

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Copper	Dibenzo(a,h)anthracene	Dichlorobenzene	Ethyl Benzene	Fluoranthene	Fluorene	Formaldehyde	Hydrochloric Acid	Indeno(1,2,3-cd)pyrene	Lead	Manganese
Fire Test Lab - 07-0525-A01	12-9-0216	0.00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ECO Mobile Incinerator	N/A	0.00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Boilers (tpy)

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Mercury	Methyl Chloroform	Naphthalene	Nickel	Phenanthrene	Pyrene	Selenium	Toluene	Xylene	Zinc	Hexane
26-3326-A02	5-0152	0.00	1.74	2.27E-07	0.00E+00	5.32E-07	1.83E-06	1.48E-08	4.36E-09	2.09E-08	2.97E-06	2.37E-05	0.00E+00	1.57E-03
0383A-A01 & A02	5-0376	0.00	4.18	5.43E-07	0.00E+00	1.27E-06	4.39E-06	3.55E-08	1.04E-08	5.01E-08	7.10E-06	5.68E-05	0.00E+00	3.76E-03
26-0459-A02	5-0337	0.00	1.07	1.40E-07	0.00E+00	3.27E-07	1.13E-06	9.12E-09	2.68E-09	1.29E-08	1.82E-06	1.46E-05	0.00E+00	9.66E-04
26-2202-A01	5-0322	0.00	2.80	3.64E-07	0.00E+00	8.54E-07	2.94E-06	2.38E-08	7.00E-09	3.36E-08	4.76E-06	3.81E-05	0.00E+00	2.52E-03
26-2202-A02	5-0322	0.00	2.80	3.64E-07	0.00E+00	8.54E-07	2.94E-06	2.38E-08	7.00E-09	3.36E-08	4.76E-06	3.81E-05	0.00E+00	2.52E-03
26-3300-A02	5-0152	0.00	0.66	8.60E-08	0.00E+00	2.02E-07	6.95E-07	5.62E-09	1.65E-09	7.94E-09	1.12E-06	9.00E-06	0.00E+00	5.95E-04
26-3300-A01	5-0152	0.00	0.66	8.60E-08	0.00E+00	2.02E-07	6.95E-07	5.62E-09	1.65E-09	7.94E-09	1.12E-06	9.00E-06	0.00E+00	5.95E-04
26-3144-A01	5-0152	0.00	6.11	7.95E-07	0.00E+00	1.86E-06	6.42E-06	5.20E-08	1.53E-08	7.34E-08	1.04E-05	8.32E-05	0.00E+00	5.50E-03
26-3660-A01	5-0371	0.00	1.10	1.43E-07	0.00E+00	3.35E-07	1.15E-06	9.34E-09	2.75E-09	1.32E-08	1.87E-06	1.50E-05	0.00E+00	9.89E-04
26-04119-A03	5-0336	0.00	2.40	3.12E-07	0.00E+00	7.32E-07	2.52E-06	2.04E-08	6.00E-09	2.88E-08	4.08E-06	3.26E-05	0.00E+00	2.16E-03
26-5100-A01	5-0310	0.00	4.93	6.41E-07	0.00E+00	1.50E-06	5.18E-06	4.19E-08	1.23E-08	5.92E-08	8.38E-06	6.71E-05	0.00E+00	4.44E-03
26-5100-A02	5-0309	0.00	4.93	6.41E-07	0.00E+00	1.50E-06	5.18E-06	4.19E-08	1.23E-08	5.92E-08	8.38E-06	6.71E-05	0.00E+00	4.44E-03
0339-A01	5-0710	0.00	0.77	1.00E-07	0.00E+00	2.35E-07	8.09E-07	6.55E-09	1.93E-09	9.25E-09	1.31E-06	1.05E-05	0.00E+00	6.94E-04
26-2485-A01	5-0367	0.00	1.17	1.52E-07	0.00E+00	3.58E-07	1.23E-06	9.96E-09	2.93E-09	1.41E-08	1.99E-06	1.59E-05	0.00E+00	1.06E-03
26-4304-A02	5-0152	0.00	0.86	1.12E-07	0.00E+00	2.63E-07	9.06E-07	7.34E-09	2.16E-09	1.04E-08	1.47E-06	1.17E-05	0.00E+00	7.77E-04
5046-A01	4-0619	0.00	0.53	6.92E-08	0.00E+00	1.62E-07	5.59E-07	4.52E-09	1.33E-09	6.38E-09	9.04E-07	7.24E-06	0.00E+00	4.79E-04
5046-A02	4-0619	0.00	0.53	6.92E-08	0.00E+00	1.62E-07	5.59E-07	4.52E-09	1.33E-09	6.38E-09	9.04E-07	7.24E-06	0.00E+00	4.79E-04
5046-A03	4-0619	0.00	0.53	6.92E-08	0.00E+00	1.62E-07	5.59E-07	4.52E-09	1.33E-09	6.38E-09	9.04E-07	7.24E-06	0.00E+00	4.79E-04
26-0436-A01	5-0152	0.00	3.20	4.16E-07	2.88E-09	9.77E-07	3.36E-06	2.72E-08	8.01E-09	3.84E-08	5.44E-06	4.35E-05	0.00E+00	2.88E-03
26-0436-A02	5-0152	0.00	3.20	4.16E-07	2.88E-09	9.77E-07	3.36E-06	2.72E-08	8.01E-09	3.84E-08	5.44E-06	4.35E-05	0.00E+00	2.88E-03
26-0120-A01	5-0152	0.00	1.17	1.52E-07	1.05E-09	3.57E-07	1.23E-06	9.94E-09	2.92E-09	1.40E-08	1.99E-06	1.59E-05	0.00E+00	1.05E-03
26-0120-A02	5-0152	0.00	1.17	1.52E-07	1.05E-09	3.57E-07	1.23E-06	9.94E-09	2.92E-09	1.40E-08	1.99E-06	1.59E-05	0.00E+00	1.05E-03
26-0402-A01	5-0152	0.00	0.43	5.55E-08	3.84E-10	1.30E-07	4.48E-07	3.63E-09	1.07E-09	5.12E-09	7.26E-07	5.80E-06	0.00E+00	3.84E-04
26-0402-A02	5-0152	0.00	0.43	5.55E-08	3.84E-10	1.30E-07	4.48E-07	3.63E-09	1.07E-09	5.12E-09	7.26E-07	5.80E-06	0.00E+00	3.84E-04
26-0455-A01	5-0152	2.17	0.27	2.21E-06	2.56E-09	1.31E-06	4.52E-06	1.37E-08	5.28E-09	2.39E-06	7.19E-06	3.77E-06	2.43E-05	2.46E-04
26-0455-A02	5-0152	2.17	0.27	2.21E-06	2.56E-09	1.31E-06	4.52E-06	1.37E-08	5.28E-09	2.39E-06	7.19E-06	3.77E-06	2.43E-05	2.46E-04
26-0525-A01	5-0335	0.00	3.87	5.02E-07	3.48E-09	1.18E-06	4.06E-06	3.29E-08	9.66E-09	4.64E-08	6.57E-06	5.26E-05	0.00E+00	3.48E-03
26-0525-A02	5-0315	0.00	3.87	5.02E-07	3.48E-09	1.18E-06	4.06E-06	3.29E-08	9.66E-09	4.64E-08	6.57E-06	5.26E-05	0.00E+00	3.48E-03
26-0525-A03	5-0334	0.00	3.87	5.02E-07	3.48E-09	1.18E-06	4.06E-06	3.29E-08	9.66E-09	4.64E-08	6.57E-06	5.26E-05	0.00E+00	3.48E-03
26-2352-A01	5-0152	1.50	7.16	2.43E-06	8.05E-09	3.03E-06	1.05E-05	6.88E-08	2.11E-08	1.74E-06	1.68E-05	9.75E-05	1.68E-05	6.45E-03
26-3245-A01	5-0152	0.00	1.45	1.88E-07	1.30E-09	4.42E-07	1.52E-06	1.23E-08	3.62E-09	1.74E-08	2.46E-06	1.97E-05	0.00E+00	1.30E-03
26-04119-A02	5-0152	1.42	2.40	1.73E-06	3.68E-09	1.53E-06	5.29E-06	2.78E-08	9.01E-09	1.59E-06	8.48E-06	3.27E-05	1.59E-05	2.16E-03
26-2401-A01	5-0152	0.00	1.38	1.79E-07	1.24E-09	4.20E-07	1.45E-06	1.17E-08	3.45E-09	1.65E-08	2.34E-06	1.87E-05	0.00E+00	1.24E-03
26-04219-A02	5-0552	0.00	1.35	1.76E-07	1.22E-09	4.13E-07	1.42E-06	1.15E-08	3.38E-09	1.62E-08	2.30E-06	1.84E-05	0.00E+00	1.22E-03
26-04219-A03	5-0308	0.00	1.35	1.76E-07	1.22E-09	4.13E-07	1.42E-06	1.15E-08	3.38E-09	1.62E-08	2.30E-06	1.84E-05	0.00E+00	1.22E-03
26-4312-A01	5-0364	0.00	2.94	3.83E-07	2.65E-09	8.98E-07	3.09E-06	2.50E-08	7.36E-09	3.53E-08	5.01E-06	4.00E-05	0.00E+00	2.65E-03
26-4312-A02	5-0364	0.00	2.94	3.83E-07	2.65E-09	8.98E-07	3.09E-06	2.50E-08	7.36E-09	3.53E-08	5.01E-06	4.00E-05	0.00E+00	2.65E-03
26-4404-A04	5-0152	0.00	37.93	4.93E-06	3.41E-08	1.16E-05	3.98E-05	3.22E-07	9.48E-08	4.55E-07	6.45E-05	5.16E-04	0.00E+00	3.41E-02
26-4404-A06	5-0152	0.00	37.93	4.93E-06	3.41E-08	1.16E-05	3.98E-05	3.22E-07	9.48E-08	4.55E-07	6.45E-05	5.16E-04	0.00E+00	3.41E-02
26-4727-A01	5-0152	0.00	2.47	3.21E-07	2.22E-09	7.54E-07	2.60E-06	2.10E-08	6.18E-09	2.97E-08	4.20E-06	3.36E-05	0.00E+00	2.22E-03
26-5014-A03	5-0152	0.00	1.25	1.62E-07	1.12E-09	3.81E-07	1.31E-06	1.06E-08	3.12E-09	1.50E-08	2.12E-06	1.70E-05	0.00E+00	1.12E-03
26-5016-A01	5-0152	0.00	0.93	1.21E-07	8.38E-10	2.84E-07	9.78E-07	7.92E-09	2.33E-09	1.12E-08	1.58E-06	1.27E-05	0.00E+00	8.38E-04
26-HQ Building-A01	5-0300	0.01	3.33	4.46E-07	3.01E-09	1.02E-06	3.53E-06	2.84E-08	8.36E-09	5.45E-08	5.71E-06	4.53E-05	1.48E-07	3.00E-03
26-HQ Building-A02	5-0300	0.01	3.33	4.46E-07	3.01E-09	1.02E-06	3.53E-06	2.84E-08	8.36E-09	5.45E-08	5.71E-06	4.53E-05	1.48E-07	3.00E-03
26-HQ Building-A03	5-0300	0.01	3.33	4.46E-07	3.01E-09	1.02E-06	3.53E-06	2.84E-08	8.36E-09	5.45E-08	5.71E-06	4.53E-05	1.48E-07	3.00E-03
26-HQ Building-A04	5-0300	0.01	3.33	4.46E-07	3.01E-09	1.02E-06	3.53E-06	2.84E-08	8.36E-09	5.45E-08	5.71E-06	4.53E-05	1.48E-07	3.00E-03
26-HQ Building-A05	5-0300	0.01	3.33	4.46E-07	3.01E-09	1.02E-06	3.53E-06	2.84E-08	8.36E-09	5.45E-08	5.71E-06	4.53E-05	1.48E-07	3.00E-03
26-GMS Lab-A01	5-0301	0.00	4.63	6.02E-07	4.17E-09	1.41E-06	4.86E-06	3.94E-08	1.16E-08	5.56E-08	7.87E-06	6.30E-05	0.00E+00	4.17E-03
26-GMS Lab-A02	5-0301	0.00	4.63	6.02E-07	4.17E-09	1.41E-06	4.86E-06	3.94E-08	1.16E-08	5.56E-08	7.87E-06	6.30E-05	0.00E+00	4.17E-03
26-GMS Lab-A03	5-0301	0.00	4.63	6.02E-07	4.17E-09	1.41E-06	4.86E-06	3.94E-08	1.16E-08	5.56E-08	7.87E-06	6.30E-05	0.00E+00	4.17E-03
26-GMS Tower-A01	5-0299	0.00	1.33	1.73E-07	1.20E-09	4.06E-07	1.40E-06	1.13E-08	3.33E-09	1.60E-08	2.27E-06	1.81E-05	0.00E+00	1.20E-03

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Mercury	Methyl Chloroform	Naphthalene	Nickel	Phenanthrene	Pyrene	Selenium	Toluene	Xylene	Zinc	Hexane
26-GMS Tower-A02	5-0299	0.00	1.33	1.73E-07	1.20E-09	4.06E-07	1.40E-06	1.13E-08	3.33E-09	1.60E-08	2.27E-06	1.81E-05	0.00E+00	1.20E-03
26-GMS Tower-A03	5-0299	0.00	1.33	1.73E-07	1.20E-09	4.06E-07	1.40E-06	1.13E-08	3.33E-09	1.60E-08	2.27E-06	1.81E-05	0.00E+00	1.20E-03
26-C2CNT West-A01	5-0298	0.00	3.20	4.16E-07	2.88E-09	9.76E-07	3.36E-06	2.72E-08	8.00E-09	3.84E-08	5.44E-06	4.35E-05	0.00E+00	2.88E-03
26-C2CNT West-A02	5-0298	0.00	3.20	4.16E-07	2.88E-09	9.76E-07	3.36E-06	2.72E-08	8.00E-09	3.84E-08	5.44E-06	4.35E-05	0.00E+00	2.88E-03
26-C2CNT West-A03	5-0298	0.00	3.20	4.16E-07	2.88E-09	9.76E-07	3.36E-06	2.72E-08	8.00E-09	3.84E-08	5.44E-06	4.35E-05	0.00E+00	2.88E-03
26-C2CNT West-A04	5-0298	0.00	3.20	4.16E-07	2.88E-09	9.76E-07	3.36E-06	2.72E-08	8.00E-09	3.84E-08	5.44E-06	4.35E-05	0.00E+00	2.88E-03
26-0345-A01	5-0079	172.81	21.38	1.76E-04	2.04E-07	1.04E-04	3.59E-04	1.09E-06	4.21E-07	1.90E-04	5.72E-04	3.00E-04	1.94E-03	1.95E-02
26-0345-A02	5-0080	172.81	21.38	1.76E-04	2.04E-07	1.04E-04	3.59E-04	1.09E-06	4.21E-07	1.90E-04	5.72E-04	3.00E-04	1.94E-03	1.95E-02
26-0345-A03	5-0081	172.81	21.38	1.76E-04	2.04E-07	1.04E-04	3.59E-04	1.09E-06	4.21E-07	1.90E-04	5.72E-04	3.00E-04	1.94E-03	1.95E-02
26-3062-A01	5-0152	0.00	3.48	4.52E-07	3.13E-09	1.06E-06	3.65E-06	2.96E-08	8.69E-09	4.17E-08	5.91E-06	4.73E-05	0.00E+00	3.13E-03
26-03062-A02	5-0167	0.00	3.48	4.52E-07	3.13E-09	1.06E-06	3.65E-06	2.96E-08	8.69E-09	4.17E-08	5.91E-06	4.73E-05	0.00E+00	3.13E-03
26-4600-A06	5-0085	0.00	24.70	3.21E-06	2.22E-08	7.53E-06	2.59E-05	2.10E-07	6.18E-08	2.96E-07	4.20E-05	3.36E-04	0.00E+00	2.22E-02
26-4600-A09	5-0370	0.00	24.70	3.21E-06	2.22E-08	7.53E-06	2.59E-05	2.10E-07	6.18E-08	2.96E-07	4.20E-05	3.36E-04	0.00E+00	2.22E-02
26-4600-A08	5-0087	24.70	24.70	2.79E-05	4.87E-08	2.15E-05	7.41E-05	3.40E-07	1.14E-07	2.75E-05	1.19E-04	3.37E-04	2.77E-04	2.23E-02
26-5014-A01	5-0164	1.25	1.25	1.41E-06	2.46E-09	1.09E-06	3.75E-06	1.72E-08	5.78E-09	1.39E-06	6.00E-06	1.71E-05	1.40E-05	1.13E-03
26-5014-A02	5-0165	1.25	1.25	1.41E-06	2.46E-09	1.09E-06	3.75E-06	1.72E-08	5.78E-09	1.39E-06	6.00E-06	1.71E-05	1.40E-05	1.13E-03
26-0030-A01	4-0619	2.40	0.00	2.40E-06	2.83E-07	1.36E-06	4.68E-06	1.26E-08	5.10E-09	2.64E-06	7.44E-06	1.31E-07	2.69E-05	4.20E-06
26-0030-A02	4-0619	2.40	0.00	2.40E-06	2.83E-07	1.36E-06	4.68E-06	1.26E-08	5.10E-09	2.64E-06	7.44E-06	1.31E-07	2.69E-05	4.20E-06
26-0045-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0322-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0384-A01	4-0619	2.33	0.00	2.33E-06	2.75E-07	1.32E-06	4.55E-06	1.22E-08	4.96E-09	2.57E-06	7.23E-06	1.27E-07	2.61E-05	4.08E-06
0390-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0402-A03	4-0619	1.54	0.00	1.54E-06	1.82E-07	8.70E-07	3.00E-06	8.08E-09	3.27E-09	1.69E-06	4.77E-06	8.39E-08	1.72E-05	2.69E-06
26-0392-A01	4-0709	2.97	0.00	2.97E-06	3.50E-07	1.68E-06	5.79E-06	1.56E-08	6.31E-09	3.27E-06	9.20E-06	1.62E-07	3.32E-05	5.19E-06
26-0394-A01	4-0708	10.07	0.00	1.01E-05	1.19E-06	5.69E-06	1.96E-05	5.29E-08	2.14E-08	1.11E-05	3.12E-05	5.49E-07	1.13E-04	1.76E-05
0400-A01	4-0546	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0439-A01	4-0619	2.02	0.00	2.02E-06	2.38E-07	1.14E-06	3.94E-06	1.06E-08	4.29E-09	2.22E-06	6.26E-06	1.10E-07	2.26E-05	3.53E-06
26-0445-A01	4-0707	2.45	0.00	2.45E-06	2.89E-07	1.38E-06	4.78E-06	1.29E-08	5.21E-09	2.70E-06	7.60E-06	1.34E-07	2.75E-05	4.29E-06
26-0449-A01	4-0706	2.77	0.00	2.77E-06	3.27E-07	1.57E-06	5.41E-06	1.46E-08	5.89E-09	3.05E-06	8.59E-06	1.51E-07	3.10E-05	4.85E-06
26-0456-A01	4-0619	0.55	0.00	5.45E-07	6.43E-08	3.08E-07	1.06E-06	2.86E-09	1.16E-09	6.00E-07	1.69E-06	2.97E-08	6.10E-06	9.54E-07
0507-A05	4-0717	19.80	0.00	1.98E-05	2.34E-06	1.12E-05	3.86E-05	1.04E-07	4.21E-08	2.18E-05	6.14E-05	1.08E-06	2.22E-04	3.46E-05
0507-A04	5-0104	19.80	0.00	1.98E-05	2.34E-06	1.12E-05	3.86E-05	1.04E-07	4.21E-08	2.18E-05	6.14E-05	1.08E-06	2.22E-04	3.46E-05
26-0642-A01	4-0689	4.33	0.00	4.33E-06	5.11E-07	2.45E-06	8.44E-06	2.27E-08	9.20E-09	4.76E-06	1.34E-05	2.36E-07	4.85E-05	7.58E-06
26-0643-A01	4-0721	2.93	0.00	2.93E-06	3.46E-07	1.66E-06	5.72E-06	1.54E-08	6.23E-09	3.23E-06	9.09E-06	1.60E-07	3.29E-05	5.13E-06
26-0644-A01	4-0619	2.44	0.00	2.44E-06	2.88E-07	1.38E-06	4.76E-06	1.28E-08	5.18E-09	2.68E-06	7.56E-06	1.33E-07	2.73E-05	4.27E-06
26-0670-A01	4-0719	3.24	0.00	3.24E-06	3.82E-07	1.83E-06	6.31E-06	1.70E-08	6.88E-09	3.56E-06	1.00E-05	1.76E-07	3.63E-05	5.66E-06
26-0688-A01	4-0720	0.71	0.00	7.11E-07	8.39E-08	4.02E-07	1.39E-06	3.73E-09	1.51E-09	7.82E-07	2.20E-06	3.87E-08	7.96E-06	1.24E-06
26-0699A-A01	4-0619	9.87	0.00	9.87E-06	1.16E-06	5.57E-06	1.92E-05	5.18E-08	2.10E-08	1.09E-05	3.06E-05	5.38E-07	1.11E-04	1.73E-05
26-0700-A01	4-0619	1.61	0.00	1.61E-06	1.90E-07	9.11E-07	3.15E-06	8.47E-09	3.43E-09	1.77E-06	5.00E-06	8.79E-08	1.81E-05	2.82E-06
26-0702-A01	4-0619	0.90	0.00	8.98E-07	1.06E-07	5.07E-07	1.75E-06	4.71E-09	1.91E-09	9.88E-07	2.78E-06	4.89E-08	1.01E-05	1.57E-06
26-0745A-A01	4-0619	0.13	0.00	1.28E-07	1.51E-08	7.23E-08	2.50E-07	6.72E-10	2.72E-10	1.41E-07	3.97E-07	6.98E-09	1.43E-06	2.24E-07
26-0860-A01	4-0619	1.29	0.00	1.29E-06	1.52E-07	7.27E-07	2.51E-06	6.75E-09	2.73E-09	1.41E-06	3.99E-06	7.01E-08	1.44E-05	2.25E-06
26-0896-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-1064-A01	4-0619	5.98	0.00	5.98E-06	7.05E-07	3.38E-06	1.17E-05	3.14E-08	1.27E-08	6.58E-06	1.85E-05	3.26E-07	6.69E-05	1.05E-05
26-1064-A02	4-0619	5.98	0.00	5.98E-06	7.05E-07	3.38E-06	1.17E-05	3.14E-08	1.27E-08	6.58E-06	1.85E-05	3.26E-07	6.69E-05	1.05E-05
26-1134-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2184-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2207-A03	4-0619	8.16	0.00	8.16E-06	9.63E-07	4.61E-06	1.59E-05	4.29E-08	1.73E-08	8.98E-06	2.53E-05	4.45E-07	9.14E-05	1.43E-05
26-2377-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2377-A02	4-0619	8.70	0.00	8.70E-06	1.03E-06	4.91E-06	1.70E-05	4.57E-08	1.85E-08	9.57E-06	2.70E-05	4.74E-07	9.74E-05	1.52E-05
26-2379-A01	4-0619	5.31	0.00	5.31E-06	6.27E-07	3.00E-06	1.04E-05	2.79E-08	1.13E-08	5.84E-06	1.65E-05	2.89E-07	5.95E-05	9.29E-06
26-0269B-A01	4-0619	3.60	0.00	3.60E-06	4.25E-07	2.03E-06	7.02E-06	1.89E-08	7.65E-09	3.96E-06	1.12E-05	1.96E-07	4.03E-05	6.30E-06
26-0280B-A01	4-0619	1.42	0.00	1.42E-06	1.68E-07	8.02E-07	2.77E-06	7.45E-09	3.02E-09	1.56E-06	4.40E-06	7.74E-08	1.59E-05	2.48E-06

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Mercury	Methyl Chloroform	Naphthalene	Nickel	Phenanthrene	Pyrene	Selenium	Toluene	Xylene	Zinc	Hexane
26-3011-A01	4-0619	1.64	0.00	1.64E-06	1.94E-07	9.28E-07	3.20E-06	8.62E-09	3.49E-09	1.81E-06	5.09E-06	8.95E-08	1.84E-05	2.87E-06
3070-A01	4-0619	17.24	0.00	1.72E-05	2.03E-06	9.74E-06	3.36E-05	9.05E-08	3.66E-08	1.90E-05	5.35E-05	9.40E-07	1.93E-04	3.02E-05
26-4725-A01	4-0619	3.25	0.00	3.25E-06	3.84E-07	1.84E-06	6.34E-06	1.71E-08	6.91E-09	3.58E-06	1.01E-05	1.77E-07	3.64E-05	5.69E-06
26-4728-A02	4-0619	5.19	0.00	5.19E-06	6.13E-07	2.93E-06	1.01E-05	2.73E-08	1.10E-08	5.71E-06	1.61E-05	2.83E-07	5.82E-05	9.09E-06
Bldg 906C - pending	4-0724	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5046-A01	4-0619	0.53	0.00	5.32E-07	6.28E-08	3.01E-07	1.04E-06	2.79E-09	1.13E-09	5.85E-07	1.65E-06	2.90E-08	5.96E-06	9.31E-07
26-5109-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-5116-A01	4-0619	1.03	0.00	1.03E-06	1.21E-07	5.80E-07	2.00E-06	5.39E-09	2.18E-09	1.13E-06	3.18E-06	5.60E-08	1.15E-05	1.80E-06
26-0733A-A01	4-0619	1.14	0.00	1.14E-06	1.35E-07	6.45E-07	2.23E-06	6.00E-09	2.43E-09	1.26E-06	3.54E-06	6.22E-08	1.28E-05	2.00E-06
26-0740B-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-0740C-A01	4-0619	3.97	0.00	3.97E-06	4.69E-07	2.24E-06	7.75E-06	2.09E-08	8.44E-09	4.37E-06	1.23E-05	2.16E-07	4.45E-05	6.95E-06
26-1100F-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-745A-A01	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26-2312-A02	4-0619	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Atmospheric Burner #1	4-0692	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0367-A01	5-0352	1.82	0.00	1.82E-06	2.14E-07	1.03E-06	3.54E-06	9.53E-09	3.86E-09	2.00E-06	5.63E-06	9.90E-08	2.03E-05	3.18E-06
			Totals	**7.71E-04**	**2.11E-05**	**5.18E-04**	**1.79E-03**	**6.83E-06**	**2.43E-06**	**8.01E-04**	**2.85E-03**	**4.88E-03**	**8.11E-03**	**3.22E-01**

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Mercury	Methyl Chloroform	Naphthalene	Nickel	Phenanthrene	Pyrene	Selenium	Toluene	Xylene	Zinc	Hexane
Fire Test Lab - 07-0525-A01	12-9-0216	0.00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ECO Mobile Incinerator	N/A	0.00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CY2023 Summary of Criteria Pollutants, tons/yr

	Boilers	Generators	PSB/Gasoline Storage Tanks	Fire Test Lab	ECO Mobile Incinerator	Total
VOC	1.12E+00	4.96E-01	9.01E-01	0.00E+00	0.00E+00	2.52
NO_x	2.37E+01	1.95E+01		0.00E+00	0.00E+00	43.23
CO	1.71E+01	5.10E+00		0.00E+00	0.00E+00	22.20
PM Filterable	8.90E-01	3.81E-01		0.00E+00	0.00E+00	1.27
PM-10 Filterable	6.40E-01	3.05E-01		0.00E+00	0.00E+00	0.95
PM-2.5 Filterable	5.73E-01	2.94E-01		0.00E+00	0.00E+00	0.87
PM Condensable	1.39E+00	4.73E-02		0.00E+00	0.00E+00	1.44
PM			1.83E-02			0.02
SO_2	2.63E+00	9.30E-03		0.00E+00	0.00E+00	2.64
TOTAL	4.81E+01	2.61E+01	9.19E-01	0.00E+00	0.00E+00	7.51E+01

CY2023 Summary of Hazardous Air Pollutants (HAPs) and Toxic Air Pollutants (TAPs), tons/yr

	Boilers	Generators	PSB/Gasoline Storage Tanks	Fire Test Lab	ECO Mobile Incinerator	Total
Acetaldehyde	1.3E-01	2.1E-03		0.0E+00	0.0E+00	1.3E-01
Acenaphthene	8.0E-06	2.0E-05		0.0E+00	0.0E+00	2.8E-05
Acenaphthylene	4.1E-07	4.6E-05		0.0E+00	0.0E+00	4.6E-05
Acrolein	1.3E-01	2.7E-04		0.0E+00	0.0E+00	1.3E-01
Anthracene	8.7E-07	9.2E-06		0.0E+00	0.0E+00	1.0E-05
Arsenic	6.2E-04	9.8E-03			0.0E+00	1.0E-02
Benzo(a)anthracene	1.8E-06	6.6E-06		0.0E+00	0.0E+00	8.4E-06
Benzene	4.5E-04	5.2E-03	3.37E-02	0.0E+00	0.0E+00	3.9E-02
Benzo(a)pyrene	2.1E-07	1.4E-06				1.6E-06
Benzo(b)fluoranthene	8.6E-07	4.2E-06				5.0E-06
Benzo(ghi)perylene	1.0E-06	3.2E-06		0.0E+00	0.0E+00	4.3E-06
Benzo(k)fluoranthene	8.6E-07	1.2E-06				2.0E-06
Beryllium	2.1E-06	0.0E+00				2.1E-06
1,3-Butadiene	5.4E-03	0.0E+00				5.4E-03
Cadmium	7.4E-04	9.2E-03			0.0E+00	9.9E-03
Chlorobenzene	7.2E-05	1.2E-03				1.3E-03
Chromium	4.7E-04	3.7E-03	2.9E-03		0.0E+00	7.1E-03
Chrysene	1.2E-06	6.3E-06		0.0E+00	0.0E+00	7.5E-06
Cobalt	1.5E-05	0.0E+00	1.5E-03			1.5E-03
Copper	1.5E-03	2.5E-02				2.7E-02
Cumene			1.4E-03			1.4E-03
Dibenzo(a,h)anthracene	8.2E-07	2.7E-06		0.0E+00	0.0E+00	3.6E-06
Dichlorobenzene	2.1E-04	0.0E+00				2.1E-04
Ethyl Benzene	1.7E-03	6.7E-02	1.7E-02	0.0E+00	0.0E+00	8.6E-02
Fluoranthene	2.3E-06	3.4E-05				3.6E-05
Fluorene	2.1E-06	1.2E-04		0.0E+00	0.0E+00	1.2E-04
Formaldehyde	2.5E-02	3.4E-03		0.0E+00	0.0E+00	2.9E-02
Hexamethylene diisocyanate			1.1E-01			1.1E-01
Hydrochloric Acid	6.7E-02	1.1E+00			0.0E+00	1.2E+00
Hydrogen fluoride				0.0E+00		0.0E+00
Indeno(1,2,3-cd)pyrene	1.1E-06	2.4E-06		0.0E+00	0.0E+00	3.5E-06
Lead	3.1E-03	5.1E-02			0.0E+00	5.4E-02
Manganese	1.2E-03	1.9E-02				2.0E-02
Mercury	7.7E-04	1.2E-02			0.0E+00	1.3E-02
Methyl Chloroform	2.1E-05	0.0E+00				2.1E-05
Naphthalene	5.2E-04	6.8E-04		0.0E+00	0.0E+00	1.2E-03
Nickel	1.8E-03	2.4E-02			0.0E+00	2.6E-02
Phenanthrene	6.8E-06	2.2E-04		0.0E+00	0.0E+00	2.3E-04
Pyrene	2.4E-06	2.6E-05		0.0E+00	0.0E+00	2.8E-05
Selenium	8.0E-04	1.4E-02				1.4E-02
Toluene	2.9E-03	2.1E-03	1.9E-01	0.0E+00	0.0E+00	1.9E-01
Xylenes	4.9E-03	1.4E-03	8.6E-02	0.0E+00	0.0E+00	9.2E-02
Zinc	8.1E-03	1.4E-01	3.2E-05			1.5E-01
Hexane	3.2E-01	1.7E-01		0.0E+00	0.0E+00	4.9E-01
TOTAL HAPs	7.0E-01	1.7E+00	4.4E-01	0.0E+00	0.0E+00	2.8E+00

CY2023 Summary of Greenhouse Gases (GHGs), short tons/yr CO_2 Eq.

Intergovernmental Panel on Climate Change GHGs	Direct Emissions					Total	
	Combustion Sources		Fugitive Sources			short tons/yr CO_2 eq.*	metric tons/yr CO_2 eq.
	Boilers	Generators	PSB	Fire Test Lab	ECO Mobile Incinerator		
CO_2	2.97E+04	1.00E+03	0.00E+00	0.00E+00	0.00E+00	3.07E+04	2.79E+04
N_2O	4.94E-01	8.12E-03	0.00E+00	0.00E+00	0.00E+00	5.02E-01	4.55E-01
CH_4	4.96E-01	4.06E-02	0.00E+00	0.00E+00	0.00E+00	5.36E-01	4.87E-01
						3.09E+04	2.80E+04

*Based on GWP values from the IPCC Fifth Assessment Report - CH_4 =28; N_20 = 265

Summary of Consolidated Emission Units

Used for Forms 2 and 3 - Criteria Air Pollutants, Form 4 - TAPs and HAPs, and Form 6 - GHGs

MDE Reg. Number	Note	NOx (tpy)	SOx (tpy)	CO (tpy)	VOC (tpy)	CO_2 (tpy)	CH_4 (tpy)	N_2O (tpy)
4-0619	2	1.69E+00	5.34E-01	5.45E-01	3.67E-02	1.90E+03	2.08E-02	2.38E-02
5-0152	1	6.02E+00	6.18E-02	5.01E+00	3.28E-01	7.21E+03	1.38E-01	1.32E-01
5-0298	3	2.35E-01	3.92E-03	5.49E-01	3.59E-02	7.84E+02	1.50E-02	1.44E-02
5-0299	4	7.34E-02	1.22E-03	1.71E-01	1.12E-02	2.45E+02	4.69E-03	4.48E-03
5-0300	5	3.07E-01	5.34E-03	7.14E-01	4.68E-02	1.02E+03	1.96E-02	1.87E-02
5-0301	6	2.55E-01	4.25E-03	5.95E-01	3.90E-02	8.50E+02	1.63E-02	1.56E-02
5-0322	7	2.86E-01	1.71E-03	2.40E-01	1.57E-02	3.43E+02	6.57E-03	6.29E-03
9-0411	8	6.09E-01	2.88E-04	1.62E-01	1.56E-02	3.10E+01	1.26E-03	2.52E-04
9-0436	9	3.25E+00	1.54E-03	8.63E-01	8.32E-02	1.66E+02	6.72E-03	1.34E-03

Notes:

1. Consolidated emissions for 5-0152 into one entry
2. Consolidated emissions for 4-0619, 5-0164, 5-0165, 4-0721, 4-0546, 4-0717, and 5-0104
3. Consolidated emissions for 5-0298 into one entry
4. Consolidated emissions for 5-0299 into one entry
5. Consolidated emissions for 5-0300 into one entry
6. Consolidated emissions for 5-0301 into one entry
7. Consolidated emissions for 5-0322 into one entry
8. Consolidated emissions for 9-0411 into one entry
9. Consolidated emissions for 9-0436 into one entry

Emission Comparison (TPY)									
Pollutant	**2023**	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**
NOx	43.23	30.03	34.74	39.80	35.94	34.08	28.52	35.75	36.33
SOx	2.64	1.30	1.55	1.67	1.45	1.88	1.66	1.40	6.37
VOC	2.52	2.28	2.72	2.66	1.86	1.83	1.42	1.57	1.54
CO	22.20	16.41	18.86	19.40	20.03	20.75	17.79	20.20	20.95
PM Filterable	1.27	0.61	0.73	0.78					
PM-10 Filterable	0.95	0.52	0.62	0.66					
PM-2.5 Filterable	0.87	0.51	0.61	0.64					
PM Condensable	1.44	0.88	0.99	0.94					
PM					1.05	1.26	0.94	0.97	1.05
CO_2e	30,885.95	21,577.90	24,573.90	23,996.21	26,474.22	29,832.73	25,941.28	27,293.69	29,837.87
Total HAPs	2.84	1.08	1.22	0.74	0.53	0.25	0.35	0.37	0.39

Boilers - Aberdeen Proving Ground - C4ISR Research and Development

Assumed Heat Content for Natural Gas =	1,020	Btu/cf
Assumed Heat Content for No. 2 Fuel Oil =	140,000	Btu/gal
Natural Gas NOx for boilers (ppm):	30	ppm
Natural Gas Low NOx Emission Factor:	36	lb/MMcf

Natural Gas Combustion

Location	Dual-Fired Heating Units - Natural Gas[3] Heat Input Each (Btu/hr)	Total Natural Gas Consumption Limit (cf/yr)	NO_x Emission Factor ($lb/10^6$ cf)	NO_x Emissions (tpy)	CO Emission Factor ($lb/10^6$ cf)	CO Emissions (tpy)	VOC Emission Factor ($lb/10^6$ cf)	VOC Emissions (tpy)	PM Emission Factor ($lb/10^6$ cf)	PM Emissions (tpy)	SO_x Emission Factor ($lb/10^6$ cf)	SO_x Emissions (tpy)
Four (4) Boilers at C2CNT West Building	3,500,000	82,355,000	36	1.48	84	3.46	5.5	0.23	7.6	0.31	0.6	0.025
Three (3) Boilers at GMS Tower Building	3,500,000	61,765,000	36	1.11	84	2.59	5.5	0.17	7.6	0.23	0.6	0.019
Five (5) Boilers at HQ 1 Building[3]	3,500,000	102,942,000	36	1.85	84	4.32	5.5	0.28	7.6	0.39	0.6	0.031
Three (3) Boilers at GMS Lab Building	3,500,000	61,765,000	36	1.11	84	2.59	5.5	0.17	7.6	0.23	0.6	0.019
Total	-	308,827,000	-	5.56	-	12.97	-	0.85	-	1.17	-	0.09

Number 2 Fuel Oil Combustion

Location	Dual-Fired Heating Units - Fuel Oil[3] Heat Input (Btu/hr)	Total No. 2 Fuel Oil Consumption Limit (gal/yr)	NO_x Emission Factor ($lb/10^3$ gal)	NO_x Emissions (tpy)	CO Emission Factor ($lb/10^3$ gal)	CO Emissions (tpy)	VOC Emission Factor ($lb/10^3$ gal)	VOC Emissions (tpy)	PM Emission Factor ($lb/10^3$ gal)	PM Emissions (tpy)	SO_x Emission Factor ($lb/10^3$ gal)	SO_x Emissions (tpy)
Four (4) Boilers at C2CNT West Building	3,500,000	160,000	20	1.60	5	0.40	0.34	0.027	3.3	0.26	43.2	3.46
Three (3) Boilers at GMS Tower Building	3,500,000	120,000	20	1.20	5	0.30	0.34	0.020	3.3	0.20	43.2	2.59
Five (5) Boilers at HQ 1 Building[3]	3,500,000	200,000	20	2.00	5	0.50	0.34	0.034	3.3	0.33	43.2	4.32
Three (3) Boilers at GMS Lab Building	3,500,000	120,000	20	1.20	5	0.30	0.34	0.020	3.3	0.20	43.2	2.59
Total	-	600,000	-	6.00	-	1.50	-	0.10	-	0.99	-	12.96
TOTAL			-	11.56	-	14.47	-	0.95	-	2.16	-	13.05

1. For the boilers, natural gas emission factors for all pollutants except NO_x were obtained from U.S. EPA's AP-42, Section 1.4. The low NO_x burners reduce NO_x emissions to 30 ppm according to the information provided. Using a standard conversion: lb/MMBtu = ppm / 850, the NO_x emission factor appropriate for burning natural gas in the proposed burners is 0.035 lb/MMBtu or 36 lb/MMcf. (This conversion assumes that the NO_x concentration reflects 3% oxygen.) Conservatively assume that PM_{10} = PM.
2. Number 2 fuel oil emission factors for all pollutants were obtained from U.S. EPA's AP-42, Section 1.3. Conservatively assume that PM_{10} = PM. The SO_x emission factor uses a sulfur content of 0.3 wt%.
3. The boilers located at HQ1 building also heat the HQ2 building.

Generators - Aberdeen Proving Ground - C4ISR Research and Development

Emergency Generators	Potential Hours (Hours/yr)	Horse-power (hp)[5]	NOx Emission Factor (lb/hp-hr)	NOx Emissions (tpy)	CO Emission Factor (lb/hp-hr)	CO Emissions (tpy)	VOC Emission Factor (lb/hp-hr)	VOC Emissions (tpy)	PM Emission Factor (lb/hp-hr)	PM Emissions (tpy)	SOx Emission Factor (lb/hp-hr)	SOx Emissions (tpy)
C2CNT West (one 1,500 kW)[1]	135	2,200	0.015	2.28	5.29E-04	0.079	3.09E-04	0.046	2.20E-04	0.033	4.05E-04	0.060
GMS Tower (one 1,500 kW)[1]	135	2,200	0.015	2.28	5.29E-04	0.079	3.09E-04	0.046	2.20E-04	0.033	4.05E-04	0.060
HQ1 and HQ2 (one 2,000 kW located at HQ2)[2]	135	2,922	0.014	2.77	7.94E-04	0.16	4.19E-04	0.083	2.65E-04	0.052	4.05E-04	0.080
GMS Lab (one 2,500 kW)[3]	135	3,778	0.020	5.22	1.79E-03	0.46	4.19E-04	0.11	2.20E-04	0.056	4.05E-04	0.10
MTF (250 kW)[4]	135	399	0.010	0.28	8.82E-04	0.024	1.98E-04	5.34E-03	2.20E-04	5.94E-03	2.05E-03	0.055
FIFF (250 kW)[4]	135	399	0.010	0.28	8.82E-04	0.024	1.98E-04	5.34E-03	2.20E-04	5.94E-03	2.05E-03	0.055
TOTAL				13.10	-	0.82	-	0.29	-	0.19	-	0.41

1. Emission factors reflect Cummins not-to-exceed emissions data for a Tier 2, 1,500 kW standby generator. SOx emission factor provided by AP-42, assuming sulfur content of 0.05%.
2. Emission factors reflect Cummins not-to-exceed emissions data for a Tier 2, 2,000 kW standby generator. SOx emission factor provided by AP-42, assuming sulfur content of 0.05%.
3. Emission factors reflect Cummins not-to-exceed emissions data for a Tier 1, 2,500 kW standby generator. SOx emission factor provided by AP-42, assuming sulfur content of 0.05%.
4. Emission factors reflect Cummins not-to-exceed emissions data for a Tier 3, 250 kW standby generator. SOx emission factor provided by AP-42.
5. Brake horsepower (hp) was obtained from Cummins specification sheets.

Emissions in pounds per operating day (lb/day) per generator:

Location	NO_x Emissions (lb/day)	CO Emissions (lb/day)	VOC Emissions (lb/day)	PM Emissions (lb/day)	SO_x Emissions (lb/day)
C2CNT West (one 1,500 kW)	351	13	8	6	10
GMS Tower (one 1,500 kW)	351	13	8	6	10
HQ1 and HQ2 (one 2,000 kW located at HQ2)	426	25	13	9	13
GMS Lab (one 2,500 kW)	804	71	17	9	16
MTF (250 kW)	43	4	1	1	9
FIFF (250 kW)	43	4	1	1	9

To calculate lb/operating day emissions, the total annual emissions for each generator were divided by the estimated number of days of operation (13 days). The emissions in lb/day were then rounded up to nearest whole number.
Assumed PM10 = PM

From Permit Application	C2CNT and GMS	HQ1 and 2	GMS Lab	MTF and FIFF	AP-42	C2CNT and GMS	HQ1 and 2	GMS Lab	MTF and FIFF
Pollutant	**Fuel Oil lb/hp-hr**	**Fuel Oil lb/hp-hr**	**Fuel Oil lb/hp-hr**	**Fuel Oil lb/hp-hr**	**Fuel Oil lb/hp-hr**	**Ratio**	**Ratio**	**Ratio**	**Ratio**
NOx	0.015	0.014	0.020	0.010	0.024	0.63	0.58	0.83	0.42
SOx									
CO	5.29E-04	7.94E-04	1.79E-03	8.82E-04	5.50E-03	0.10	0.14	0.33	0.16
PM	2.20E-04	2.65E-04	2.20E-04	2.20E-04	7.00E-04	0.31	0.38	0.31	0.31
VOC	3.09E-04	4.19E-04	4.19E-04	1.98E-04	7.05E-04	0.44	0.59	0.59	0.28

Table 3.4-1. GASEOUS EMISSION FACTORS FOR LARGE STATIONARY DIESEL AND ALL STATIONARY DUAL-FUEL ENGINES[a]

Pollutant	Diesel Fuel (SCC 2-02-004-01)			Dual Fuel[b] (SCC 2-02-004-02)		
	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	EMISSION FACTOR RATING	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	EMISSION FACTOR RATING
NO_x						
Uncontrolled	0.024	3.2	B	0.018	2.7	D
Controlled	0.013[c]	1.9[c]	B	ND	ND	NA
CO	5.5 E-03	0.85	C	7.5 E-03	1.16	D
SO_x[d]	8.09 E-03S_1	1.01S_1	B	4.06 E-04S_1 + 9.57 E-03S_2	0.05S_1 + 0.895S_2	B
CO_2[e]	1.16	165	B	0.772	110	B
PM	0.0007[c]	0.1[c]	B	ND	ND	NA
TOC (as CH_4)	7.05 E-04	0.09	C	5.29 E-03	0.8	D
Methane	f	f	E	3.97 E-03	0.6	E
Nonmethane	f	f	E	1.32 E-03	0.2[g]	E

[a] Based on uncontrolled levels for each fuel, from References 2,6-7. When necessary, the average heating value of diesel was assumed to be 19,300 Btu/lb with a density of 7.1 lb/gallon. The power output and fuel input values were averaged independently from each other, because of the use of actual brake-specific fuel consumption (BSFC) values for each data point and of the use of data possibly sufficient to calculate only 1 of the 2 emission factors (e. g., enough information to calculate lb/MMBtu, but not lb/hp-hr). Factors are based on averages across all manufacturers and duty cycles. The actual emissions from a particular engine or manufacturer could vary considerably from these levels. To convert from lb/hp-hr to kg/kw-hr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code.

[b] Dual fuel assumes 95% natural gas and 5% diesel fuel.

[c] References 8-26. Controlled NO_x is by ignition timing retard.

[d] Assumes that all sulfur in the fuel is converted to SO_2. S_1 = % sulfur in fuel oil; S_2 = % sulfur in natural gas. For example, if sulfer content is 1.5%, then S = 1.5.

[e] Assumes 100% conversion of carbon in fuel to CO_2 with 87 weight % carbon in diesel, 70 weight % carbon in natural gas, dual-fuel mixture of 5% diesel with 95% natural gas, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and natural gas heating value of 1050 Btu/scf.

[f] Based on data from 1 engine, TOC is by weight 9% methane and 91% nonmethane.

[g] Assumes that nonmethane organic compounds are 25% of TOC emissions from dual-fuel engines. Molecular weight of nonmethane gas stream is assumed to be that of methane.

Pollutant	PLANT LEVEL Round to Nearest:	
	Lbs / hour	Tons/year
Acetaldehyde	1.00E-01	1.00E-01
Acetamide	1.00E-01	1.00E+00
Acetonirile	1.00E+00	1.00E+00
Acetophenone	1.00E-01	1.00E+00
2-Acetylaminofluorene	1.00E-02	1.00E-02
Acrolein	1.00E-03	1.00E-02
Acrylamide	1.00E-04	1.00E-04
Acrylic Acid	1.00E-01	1.00E-01
Acrylonitrile	1.00E-02	1.00E-02
Allyl chloride	1.00E-02	1.00E-01
4-Aminobiphenyl	1.00E-02	1.00E-01
Ammonia	1.00E-01	1.00E+00
Aniline	1.00E-01	1.00E-01
o-Anisidine	1.00E-03	1.00E-02
Antimony & compounds	1.00E-03	1.00E-02
Arsenic & compounds	1.00E-04	1.00E-04
Benzene	1.00E-02	1.00E-01
Benzidene	1.00E-02	1.00E-05
Benzotrichloride	1.00E-02	1.00E-04
Benzyl chloride	1.00E-02	1.00E-01
Beryllium & compounds	1.00E-05	1.00E-04
Biphenyl	1.00E-02	1.00E-01
Bis (2-ethylhexyl) phthalate	1.00E-02	1.00E-01
Bis (chloromethyl) ether	1.00E-05	1.00E-05
Bromoform	1.00E-02	1.00E-01
1,3-Butadiene	1.00E-02	1.00E-03
Cadmium & compounds	1.00E-04	1.00E-04
Calcium cyanamide	1.00E-03	1.00E-02
Captan	1.00E-02	1.00E-01
Carbaryl	1.00E-02	1.00E-01
Carbon disulfide	1.00E-01	1.00E+00
Carbon tetrachloride	1.00E-01	1.00E-02
Carbonyl sulfide	1.00E-01	1.00E+00
Catechol	1.00E-01	1.00E+00
Chloramben	1.00E-01	1.00E+00
Chlordane	1.00E-03	1.00E-02
Chlorine	1.00E-02	1.00E-01
Chlorine dioxide	1.00E-03	1.00E-02
Chloroacetic acid	1.00E-02	1.00E-01
2-Chloroacetophenone	1.00E-03	1.00E-02

Pollutant	PLANT LEVEL	
	Round to Nearest:	
	Lbs / hour	Tons/year
Chlorobenzene	1.00E-01	1.00E+00
Chlorobenzilate	1.00E-02	1.00E-01
Chloroform	1.00E-01	1.00E-02
Chloromethyl methyl ether	1.00E-02	1.00E-01
Chloroprene	1.00E-01	1.00E+00
Chromium (Elemental) Compounds	1.00E-03	1.00E-02
Chromium III Compounds	1.00E-03	1.00E-02
Chromium VI Compounds	1.00E-03	1.00E-05
Cobalt & compounds	1.00E-04	1.00E-03
Coke oven emissions	1.00E-03	1.00E-03
Copper	1.00E-03	1.00E-02
Cresol/Cresylic acid	1.00E-01	1.00E+00
0-Cresol	1.00E-01	1.00E+00
m-Cresol	1.00E-01	1.00E+00
p-Cresol	1.00E-01	1.00E+00
Cumene	1.00E+00	1.00E+01
Cyanide Compounds	1.00E-02	1.00E-01
2,4-D (including salts and esters)	1.00E-01	1.00E-01
DDE	1.00E-02	1.00E-01
Diazomethane	1.00E-03	1.00E-02
Dibenzofuran	1.00E-01	1.00E+00
1,2-Dibromo-3-chloropropane	1.00E-02	1.00E+00
Dibutyl phthalate	1.00E-02	1.00E-01
1,4-Dichlorobenzene(P)	1.00E+00	1.00E-01
3,3’-Dichlorobenzidine	1.00E-03	1.00E-03
Dichloroethyl ether	1.00E-01	1.00E+00
1,2-Dichloropropane	1.00E+00	1.00E+01
1,3-Dichloropropene	1.00E-02	1.00E-02
Dichlorvos	1.00E-02	1.00E-02
Dieldrin	1.00E-03	1.00E-02
Diethanolamine	1.00E-02	1.00E-01
Diethyl sulfate	1.00E-02	1.00E-01
3,3’-Dimethoxybenzidine	1.00E-01	1.00E-01

Pollutant	PLANT LEVEL	
	Round to Nearest:	
	Lbs / hour	Tons/year
4-Dimethylaminoazobenzene	1.00E-02	1.00E-02
N,N-Dimethylaniline	1.00E-01	1.00E+00
3,3’-Dimethylbenzidine	1.00E-01	1.00E-01
Dimethylcarbamoyl chloride	1.00E-02	1.00E-01
N,N-Dimethylformamide	1.00E-01	1.00E+00
1,1-Dimethylhydrazine	1.00E-04	1.00E-04
Dimethyl phthalate	1.00E-02	1.00E-01
Dimethyl sulfate	1.00E-03	1.00E-02
4,6-Dinitro-o-cresol (including salts)	1.00E-03	1.00E-02
2,4-Dinitrophenol	1.00E-03	1.00E-03
2,4-Dinitrotoluene	1.00E-02	1.00E-01
1,4-dioxane	1.00E+00	1.00E-01
1,2-Diphenylhydrazine	1.00E-02	1.00E-03
Epichlorohydrin	1.00E-02	1.00E-01
1,2-Epoxybutane	1.00E-02	1.00E-02
Ethyl arcylate	1.00E-01	1.00E-02
Ethyl benezene	1.00E+00	1.00E+01
Ethyl carbamate	1.00E-02	1.00E-01
Ethyl chloride	1.00E-03	1.00E-02
Ethylene dibromide	1.00E+00	1.00E-03
Ethylene dichloride	1.00E-01	1.00E-02
Ethylene glycol	1.00E+00	1.00E+00
Ethyleneimine	1.00E-02	1.00E-02
Ethylene oxide	1.00E-02	1.00E-03
Ethylene thiourea	1.00E-01	1.00E-02
Ethylidene dichloride	1.00E+00	1.00E+01
Formaldehyde	1.00E-03	1.00E-02
Glycol ethers	1.00E-01	1.00E+00
Heptachlor	1.00E-04	1.00E-03
Hexachlorobenzene	1.00E-05	1.00E-03
Hexachlorobutadiene	1.00E-03	1.00E-02
1,2,3,4,5,6-Hexachlorocyclyhexane (including all stereo isomers)	1.00E-03	1.00E-02
Hexachlorocyclopentadiene	1.00E-03	1.00E-03

Pollutant	PLANT LEVEL Round to Nearest:	
	Lbs / hour	Tons/year
Hexachloroethane	1.00E-01	1.00E-01
Hexamethylene diisocyanate	1.00E-04	1.00E-03
Hexamethylphosphoramide	1.00E-01	1.00E-01
n-Hexane	1.00E+00	1.00E+01
Hydrazine	1.00E-03	1.00E-03
Hydrochloric acid	1.00E-01	1.00E-01
Hydrogen fluoride	1.00E-02	1.00E-01
Hydroquinone	1.00E-02	1.00E-01
Isophorone	1.00E-01	1.00E+00
Lead & compounds	1.00E-04	1.00E-03
Maleic anhydride	1.00E-02	1.00E-02
Manganese & compounds	1.00E-03	1.00E-02
Mercury & compounds	1.00E-04	1.00E-03
Methanol	1.00E+00	1.00E+01
Methoxychlor	1.00E-01	1.00E-01
Methyl bromide	1.00E-02	1.00E-02
Methyl chloride	1.00E-01	1.00E-01
Methyl chloroform	1.00E+01	1.00E+01
Methyl ethyl ketone (MEK)	1.00E+01	1.00E+01
Methyl hydrazine	1.00E-04	1.00E-03
Methyl iodide	1.00E-01	1.00E-01
Methyl isobutyl ketone (MIBK)	1.00E+00	1.00E+01
Methyl isocyanate	1.00E-04	1.00E-03
Methyl methacrylate	1.00E+00	1.00E+01
Methyl tert-butyl ether (MTBE)	1.00E+00	1.00E+01
4,4’-Methylenebis(2-chloroaniline)	1.00E-03	1.00E-02
Methylene chloride	1.00E+00	1.00E+00
4,4’-Methylenediphenyl diisocyanate (MDI)	1.00E-04	1.00E-03
4,4’-Methylenedianiline	1.00E-02	1.00E-02
Naphthalene	1.00E-01	1.00E+00
Nickel & compounds	1.00E-03	1.00E-03
Nitrobenzene	1.00E-02	1.00E-01
4-Nitrobiphenyl	1.00E-01	1.00E-01

Pollutant	PLANT LEVEL Round to Nearest:	
	Lbs / hour	Tons/year
4-Nitrophenol	1.00E-02	1.00E-02
2-Nitropropane	1.00E-01	1.00E-04
N-Nitroso-N-methylurea	1.00E-03	1.00E-02
N-Nitrosodimethylamine	1.00E-03	1.00E-05
N-Nitrosomorpholine	1.00E-02	1.00E-02
Parathion	1.00E-03	1.00E-03
Pentachloronitrobenzene	1.00E-03	1.00E-02
Pentachlorophenol	1.00E-03	1.00E-02
Phenol	1.00E-01	1.00E+00
p-Phenylenediamine	1.00E-03	1.00E-03
Phosgene	1.00E-03	1.00E-02
Phosphine	1.00E-03	1.00E-02
Phosphorus	1.00E-03	1.00E-03
Phthalic anhydride	1.00E-01	1.00E-01
PCB	1.00E-02	1.00E-03
POM (PAHs)[a]	**As Individual Pollutant (See Below)**	
1,3-Propane sultone	1.00E+01	1.00E+01
Beta-Propiolactone	1.00E-02	1.00E-01
Propionaldehyde	1.00E-01	1.00E-01
Propoxur	1.00E-03	1.00E-02
Propylene oxide	1.00E-01	1.00E-01
1,2-Propylenimine	1.00E-02	1.00E-01
Quinoline	1.00E-02	1.00E-01
Quinone	1.00E-03	1.00E-02
Selenium & Compounds	1.00E-03	1.00E-02
Styrene	1.00E+00	1.00E+00
Stryene oxide	1.00E-01	1.00E-01
2,3,7,8,-TCDF/2,3,7,8-TCDD[b]	1.00E-07	1.00E-08
1,1,2,2-Tetrachloroethane	1.00E-01	1.00E-01
Tetrachloroethylene	1.00E+00	1.00E+01
Titanium Tetrachloride	1.00E-02	1.00E-01
Toluene	1.00E+00	1.00E+01
Toluene-2,4-damine	1.00E-04	1.00E-04
2,4-Toluene Diisocyanate	1.00E-04	1.00E-02

Pollutant	PLANT LEVEL Round to Nearest: Lbs / hour	 Tons/year
o-Toluidine	1.00E-01	1.00E-02
Toxaphene	1.00E-03	1.00E-03
1,2,4-Trichlorobenzene	1.00E-01	1.00E+00
1,1,2-Trichloroethane	1.00E-01	1.00E+00
Trichloroethylene	1.00E+00	1.00E+01
2,4,5-Trichlorophenol	1.00E-02	1.00E-01
2,4,6-Trichlorophenol	1.00E-02	1.00E-01
Triethylamine	1.00E-02	1.00E-01
Trifluranlin	1.00E-01	1.00E-01
2,2,4-Trimethylpentane	1.00E-01	1.00E+00
Vinyl acetate	1.00E-01	1.00E+00
Vinyl bromide	1.00E-01	1.00E+00
Vinyl chloride	1.00E-01	1.00E-02
Vinylidenen chloride	1.00E-01	1.00E+00
Xylenes	1.00E+00	1.00E+01
o-Xylene	1.00E+00	1.00E+01
m-Xylene	1.00E+00	1.00E+01
p-Xylene	1.00E+00	1.00E+01
Zinc compounds	1.00E-02	1.00E-01
[a]**POM includes:**		
Acenaphthene	1.00E-03	1.00E-02
Acenaphthylene	1.00E-02	1.00E-01
Anthracene	1.00E-03	1.00E-02
Benz(a)anthracene	1.00E-03	1.00E-03
Benzo(a)pyrene	1.00E-03	1.00E-04
Benzo(b)fluoranthene	1.00E-01	1.00E-03
Benzo(ghi)perylene	1.00E-03	1.00E-02
Benzo(k)fluoranthene	1.00E-02	1.00E-02
Chrysene	1.00E-03	1.00E-02
Dibenzo(a,h)anthracene	1.00E-04	1.00E-04
Fluoranthene	1.00E-01	1.00E-01
Fluorene	1.00E-03	1.00E-02
Indeno(1,2,3-cd)pyrene	1.00E-03	1.00E-03
Naphthalene	1.00E-01	1.00E+00
Phenanthrene	1.00E-02	1.00E-02
Pyrene	1.00E-03	1.00E-02
[b]2,3,7,8-Tetrachlorodibenzofuran/		

Pollutant	PLANT LEVEL	
	Round to Nearest:	
	Lbs / hour	Tons/year
2,3,7,8-Tetrachlorodibenzo-p-dioxin.		
Inventory these HAPS as toxic equivalents		
(TEQs)		

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APPENDIX B

2023 AIR EMISSIONS CERTIFICATION REPORT

FOR

EDGEWOOD AREA OF ABERDEEN PROVING GROUND

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DEPARTMENT OF THE ARMY
U.S. ARMY INSTALLATION MANAGEMENT COMMAND
U.S. ARMY GARRISON ABERDEEN PROVING GROUND
DPW ENVIRONMENTAL DIVISION BUILDING 4304, 6504 RODMAN RD
ABERDEEN PROVING GROUND MARYLAND 21005-1946

March 26, 2024

Mr. Alexander Holt
Air Quality Compliance Program
Air and Radiation Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 715
Baltimore, Maryland 21230-1720

Dear Mr. Holt:

As required by Code of Maryland Regulation 26.11.01.05-1, enclosed is a digital file in '.pdf' format of the Annual Emissions Certification Report for the Edgewood Area of Aberdeen Proving Ground, for calendar year 2023. The report includes the completed Maryland Department of the Environment emission reporting forms (Forms 1 through 6) and supporting calculations.

In accordance with the Title V Permit Section VI – State Only Enforceable Condition No. 2, Aberdeen Proving Ground performed a compliance demonstration for the emissions of toxic air pollutants in 2017. This demonstration showed that Aberdeen Proving Ground is compliant with respect to Maryland Air Toxic regulation COMAR 26.11.15 and is considered to be valid for calendar year 2023. There have been no significant changes at Aberdeen Proving Ground Edgewood Area in 2023 that would invalidate this demonstration. In September 2023, Aberdeen Proving Ground completed an updated compliance demonstration for the emissions of toxic air pollutants in Edgewood Area.

The point of contact for this matter in the Directorate of Public Works, Environmental Compliance Branch is Dr. Hazoor Khan at 410-306-2278, hazoor.b.khan.civ@army.mil.

Sincerely,

KRYSTON.SARAH.LISA.1298181980 Digitally signed by KRYSTON.SARAH.LISA.1298181980 Date: 2024.03.26 14:01:10 -04'00'

Sarah Kryston
Chief Environmental Compliance Branch
Directorate of Public Works

Enclosure

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MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard, Suite 715 Baltimore Maryland 21230-1720
(410) 537-3000 1-800-633-6101 http://www.mde.state.md.us
Air and Radiation Administration
Air Quality Compliance Program
(410) 537-3220

FORM 1

GENERAL FACILITY INFORMATION
EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

A. FACILITY IDENTIFICATION			Do Not Write in This Space
Facility Name Aberdeen Proving Ground - Edgewood Area 24-025-00082			Date Received Regional
Address DPW Environmental Division Building 4304, 6504 Rodman Rd ATTN: AMIM-APP-E			Date Received State
City Aberdeen Proving Ground	County Harford	Zip Code 21005-1946	AIRS Code
B. Briefly describe the major function of the facility Research/Development and Test/Evaluation of U.S. Army Material.			FINDS Code SIC Code
			Facility Number:
			TEMPO ID:
C. SEASONAL PRODUCTION (%, if applicable)			Reviewed by:
Winter *(Dec.-Feb)*	Spring *(Mar-May)*	Summer *(Jun-Aug)* / Fall *(Sept-Nov)*	Name Date

D. Explain any increases or decreases in emissions from the previous calendar year for each registration at this facility.

There are no significant increases or decreases in emissions from the previous calendar year.

E. CONTROL DEVICE INFORMATION (for NO_x and VOC sources only)

Control Device	Capture Efficiency	Removal Efficiency
Any information regarding control devices are		
included in the calculations section		

I am familiar with the facility and the installations and sources for which this report is submitted. I have personally examined the information in this report, which consists of 133 pages (including attachments), and certify that the information is correct to the best of my knowledge.

Sarah Kryston	Chief, Environmental Compliance Branch	3/25/2024
Name (Print/type)	Title	Date

Sarah Kryston

Signature

(410) 306-2270
Telephone Number

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Nitrogen Oxides (NOx) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0392	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	0	0	0	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0432	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0460	10300503	No. 2 Oil	s	1.29E+00	1.42E+01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0506	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	52	365	0.00	24.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0523	10300503	No. 2 Oil	s	7.27E-02	3.98E-01	24.00	7	52	365	0.40	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 4-0543	10300503	NG	s	0.00E+00	0.00E+00	24.00	7	52	365	0.00	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 4-0544	10300503	NG	s	4.90E+00	2.69E+01	24.00	7	52	365	26.86	24.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0545	10300503	No. 2 Oil	s	2.00E-02	2.20E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0559	10300503	No. 2 Oil	s	4.64E-01	5.10E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0560	10300503	No. 2 Oil	s	4.64E-01	5.10E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0568	10300502	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0570	10300503	No. 2 Oil	s	1.40E-01	1.54E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0571	10300503	No. 2 Oil	s	1.40E-01	1.54E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0572	10300503	No. 2 Oil	s	1.40E-01	1.54E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0626	10300503	No. 2 Oil	s	1.43E-02	1.57E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0627	10300503	No. 2 Oil	s	9.28E-02	1.02E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0650	10300503	No. 2 Oil	s	1.98E-02	2.17E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0660	10300503	No. 2 Oil	s	7.68E-02	8.44E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0663	10300603	No. 2 Oil	s	1.20E-01	1.32E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0664	10300503	No. 2 Oil	s	1.20E-01	1.32E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0665	10300503	No. 2 Oil	s	4.81E-02	5.28E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0668	10300503	No. 2 Oil	s	1.56E-01	1.72E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0669	10300503	No. 2 Oil	s	1.91E-01	2.10E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Nitrogen Oxides (NOx) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0670	10300503	No. 2 Oil	s	1.91E-01	2.10E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0681	10300503	No. 2 Oil	s	3.40E-02	3.73E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0684	10300503	No. 2 Oil	s	1.11E-01	1.22E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0695	10300503	No. 2 Oil	s	6.52E-02	7.16E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0700	10300503	No. 2 Oil	s	6.79E-02	7.46E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0701	10300503	No. 2 Oil	s	6.79E-02	7.46E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0702	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0703	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0704	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0716	10300503	No. 2 Oil	s	1.48E-01	1.63E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0723	10300503	No. 2 Oil	s	7.27E-02	7.99E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0306	10300602	NG	s	2.21E+00	1.21E+01	24.00	7	52	365	12.13	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0311	10300503	NG	s	1.38E-01	1.52E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0312	10300503	NG	s	1.38E-01	1.52E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0313	10300503	NG	s	1.38E-01	1.52E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0316	10300503	NG	s	9.24E-02	1.02E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0317	10300503	NG	s	9.24E-02	1.02E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0329	10300603	NG	s	9.24E-02	1.02E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0330	10300603	NG	s	9.24E-02	1.02E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0331	10300603	NG	s	9.24E-02	1.02E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0332	10300603	NG	s	9.24E-02	1.02E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0333	10300603	NG	s	9.24E-02	1.02E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0347	10300602	NG	s	1.59E-01	8.70E-01	24.00	7	52	365	0.87	24.00	NA	NA	C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Nitrogen Oxides (NOx) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Dual Fuel Boiler 5-0348	10300602	NG	s	1.59E-01	8.70E-01	24.00	7	52	365	0.87	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0349	10300602	NG	s	1.59E-01	8.70E-01	24.00	7	52	365	0.87	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0350	10300602	NG	s	1.59E-01	8.70E-01	24.00	7	52	365	0.87	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0351	10300602	NG	s	1.59E-01	8.70E-01	24.00	7	52	365	0.87	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0389	10300602	NG	s	2.64E-01	1.44E+00	24.00	7	52	365	1.44	24.00	NA	NA	C3
			f											
CHP Unit 5-0366	10200604	NG	s	3.35E+00	1.95E+01	24	7	49	344	19.50	0.00	NA	NA	C1, C3
			f											
Paint Spray Booth 6-0497	40202501	NA	s	0.00E+00	0.00E+00	1.67	1.2	5	6	0.00	1.67	NA	NA	C2
			f											
Paint Spray Booth 6-0498	40202501	NA	s	0.00E+00	0.00E+00	1.75	1.3	3	4	0.00	1.75	NA	NA	C2
			f											
Emergency Generator 9-0230	20200401	No. 2 Oil	s	6.18E-03	1.03E+00	0.04	1	12	12	1.03	0.04	NA	NA	C3
			f											
Emergency Generator 9-0231	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
			f											
Emergency Generator 9-0232	20200401	No. 2 Oil	s	7.31E-02	1.22E+01	0.47	1	12	12	12.18	0.47	NA	NA	C3
			f											
Emergency Generator 9-0278	20200401	No. 2 Oil	s	7.50E-02	1.25E+01	0.40	1	12	12	12.49	0.40	NA	NA	C3
			f											
Emergency Generator 9-0279	20200401	No. 2 Oil	s	7.48E-02	1.25E+01	0.40	1	12	12	12.47	0.40	NA	NA	C3
			f											
Emergency Generator 9-0280	20200401	No. 2 Oil	s	7.46E-02	1.24E+01	0.40	1	12	12	12.44	0.40	NA	NA	C3
			f											
Emergency Generator 9-0293	20200401	No. 2 Oil	s	3.07E-02	5.12E+00	0.35	1	12	12	5.12	0.35	NA	NA	C3
			f											
Emergency Generator 9-0339	20200401	No. 2 Oil	s	1.98E-01	3.30E+01	2.87	1	12	12	33.02	2.87	NA	NA	C3
			f											
Emergency Generator 9-0341	20200102	No. 2 Oil	s	3.43E-01	5.72E+01	2.76	1	12	12	57.23	2.76	NA	NA	C3
			f											
Emergency Generator 9-0355	20200401	No. 2 Oil	s	9.33E-01	1.55E+02	3.07	1	12	12	155.44	3.07	NA	NA	C3
			f											
Emergency Generator 9-0356	20200401	No. 2 Oil	s	1.24E-01	2.06E+01	0.49	1	12	12	20.59	0.49	NA	NA	C3
			f											
Emergency Generator 9-0369	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
			f											
Emergency Generator 9-0378	20200401	No. 2 Oil	s	8.64E-01	1.44E+02	2.83	1	12	12	144.01	2.83	NA	NA	C3
			f											
Emergency Generator 9-0379	20200401	No. 2 Oil	s	1.09E+00	1.82E+02	3.58	1	12	12	181.70	3.58	NA	NA	C3
			f											
Emergency Generator 9-0380	20200401	No. 2 Oil	s	1.65E-01	2.75E+01	0.54	1	12	12	27.53	0.54	NA	NA	C3
			f											
Emergency Generator 9-0402	20200401	No. 2 Oil	s	1.18E+00	1.97E+02	4.18	1	12	12	196.52	4.18	NA	NA	C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Nitrogen Oxides (NOx) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0442	20200401	No. 2 Oil	s	1.14E-01	1.91E+01	0.62	1	12	12	19.05	0.62	NA	NA	C3
			f											
Emergency Generator 9-0448	20200401	No. 2 Oil	s	5.50E-01	9.17E+01	2.12	1	12	12	91.73	2.12	NA	NA	C3
			f											
Emergency Generator 9-0453	20200401	No. 2 Oil	s	3.22E-01	5.36E+01	2.48	1	12	12	53.60	2.48	NA	NA	C3
			f											
Emergency Generator 9-0463	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
			f											
Emergency Generator 9-0464	20200401	No. 2 Oil	s	7.12E-01	1.19E+02	8.11	1	12	12	118.64	8.11	NA	NA	C3
			f											
Emergency Generator 9-0465	20200401	No. 2 Oil	s	2.12E-02	3.53E+00	0.23	1	12	12	3.53	0.23	NA	NA	C3
			f											
Emergency Generator 9-0484	20200401	No. 2 Oil	s	7.83E-02	1.30E+01	0.75	1	12	12	13.05	0.75	NA	NA	C3
			f											
Emergency Generator 9-0485	20200401	No. 2 Oil	s	5.05E-02	8.42E+00	0.13	1	12	12	8.42	0.13	NA	NA	C3
			f											
Emergency Generator 9-0486	20200401	No. 2 Oil	s	4.71E-02	7.86E+00	0.12	1	12	12	7.86	0.12	NA	NA	C3
			f											
Emergency Generator 5-0488	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
			f											
Emergency Generator 9-0506	20200401	No. 2 Oil	s	1.38E-01	2.30E+01	0.34	1	12	12	23.01	0.34	NA	NA	C3
			f											
Total				2.42E+01	1.33E+03					1275.37				

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are mos favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel

Emission Estimation Method
A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balance using engineering knowledge of the proce
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Edgewood Area

Facility ID #: 24-25-00082 **Pollutant:** Sulfur Oxides (as SO_2) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0392	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	0	0	0					C3
			f											
Fuel Oil Boiler 4-0432	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0460	10300503	No. 2 Oil	s	4.65E-01	5.11E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0506	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	52	365					C3
			f											
Fuel Oil Boiler 4-0523	10300503	No. 2 Oil	s	2.62E-02	1.43E-01	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 4-0543	10300503	NG	s	0.00E+00	0.00E+00	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 4-0544	10300503	NG	s	5.33E-01	2.92E+00	24.00	7	52	365					C3
			f											
Fuel Oil Boiler 4-0545	10300503	No. 2 Oil	s	7.19E-03	7.91E-02	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0559	10300503	No. 2 Oil	s	1.67E-01	1.84E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0560	10300503	No. 2 Oil	s	1.67E-01	1.84E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0568	10300502	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0570	10300503	No. 2 Oil	s	5.04E-02	5.54E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0571	10300503	No. 2 Oil	s	5.04E-02	5.54E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0572	10300503	No. 2 Oil	s	5.04E-02	5.54E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0626	10300503	No. 2 Oil	s	5.15E-03	5.66E-02	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0627	10300503	No. 2 Oil	s	3.34E-02	3.67E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0650	10300503	No. 2 Oil	s	7.11E-03	7.82E-02	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0660	10300503	No. 2 Oil	s	2.76E-02	3.04E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0663	10300603	No. 2 Oil	s	4.32E-02	4.75E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0664	10300503	No. 2 Oil	s	4.32E-02	4.75E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0665	10300503	No. 2 Oil	s	1.73E-02	1.90E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0668	10300503	No. 2 Oil	s	5.63E-02	6.19E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0669	10300503	No. 2 Oil	s	6.87E-02	7.55E-01	24.00	7	26	182					C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Edgewood Area

Facility ID #: 24-25-00082 **Pollutant:** Sulfur Oxides (as SO_2) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0670	10300503	No. 2 Oil	s	6.87E-02	7.55E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0681	10300503	No. 2 Oil	s	1.22E-02	1.34E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0684	10300503	No. 2 Oil	s	3.99E-02	4.39E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0695	10300503	No. 2 Oil	s	2.35E-02	2.58E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0700	10300503	No. 2 Oil	s	2.45E-02	2.69E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0701	10300503	No. 2 Oil	s	2.45E-02	2.69E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0702	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0703	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0704	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0716	10300503	No. 2 Oil	s	5.33E-02	5.86E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0723	10300503	No. 2 Oil	s	2.62E-02	2.88E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0306	10300602	NG	s	3.69E-02	2.02E-01	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 5-0311	10300503	NG	s	8.28E-04	9.10E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0312	10300503	NG	s	8.28E-04	9.10E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0313	10300503	NG	s	8.28E-04	9.10E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0316	10300503	NG	s	8.33E-04	9.16E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0317	10300503	NG	s	8.33E-04	9.16E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0329	10300603	NG	s	8.33E-04	9.16E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0330	10300603	NG	s	8.33E-04	9.16E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0331	10300603	NG	s	8.33E-04	9.16E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0332	10300603	NG	s	8.33E-04	9.16E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0333	10300603	NG	s	8.33E-04	9.16E-03	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0347	10300602	NG	s	2.65E-03	1.45E-02	24.00	7	52	365					C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground
Edgewood Area

Facility ID #: 24-25-00082 **Pollutant:** Sulfur Oxides (as SO_2) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Dual Fuel Boiler 5-0348	10300602	NG	s	2.65E-03	1.45E-02	24.00	7	52	365					C4
			f											
Dual Fuel Boiler 5-0349	10300602	NG	s	2.65E-03	1.45E-02	24.00	7	52	365					C5
			f											
Dual Fuel Boiler 5-0350	10300602	NG	s	2.65E-03	1.45E-02	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 5-0351	10300602	NG	s	2.65E-03	1.45E-02	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 5-0389	10300602	NG	s	4.39E-03	2.41E-02	24.00	7	52	365					C3
			f											
CHP Unit 5-0366	10200604	NG	s	1.05E+00	6.13E+00	24	7	49	344					C3
			f											
Paint Spray Booth 6-0497	40202501	NA	s	0.00E+00	0.00E+00	1.67	1.2	5	6					NA
			f											
Paint Spray Booth 6-0498	40202501	NA	s	0.00E+00	0.00E+00	1.75	1.3	3	4					NA
			f											
Emergency Generator 9-0230	20200401	No. 2 Oil	s	2.93E-06	4.88E-04	0.04	1	12	12					C3
			f											
Emergency Generator 9-0231	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
			f											
Emergency Generator 9-0232	20200401	No. 2 Oil	s	3.46E-05	5.77E-03	0.47	1	12	12					C3
			f											
Emergency Generator 9-0278	20200401	No. 2 Oil	s	3.55E-05	5.91E-03	0.40	1	12	12					C3
			f											
Emergency Generator 9-0279	20200401	No. 2 Oil	s	3.54E-05	5.90E-03	0.40	1	12	12					C3
			f											
Emergency Generator 9-0280	20200401	No. 2 Oil	s	3.53E-05	5.89E-03	0.40	1	12	12					C3
			f											
Emergency Generator 9-0293	20200401	No. 2 Oil	s	1.45E-05	2.42E-03	0.35	1	12	12					C3
			f											
Emergency Generator 9-0339	20200401	No. 2 Oil	s	9.38E-05	1.56E-02	2.87	1	12	12					C3
			f											
Emergency Generator 9-0341	20200102	No. 2 Oil	s	1.63E-04	2.71E-02	2.76	1	12	12					C3
			f											
Emergency Generator 9-0355	20200401	No. 2 Oil	s	4.42E-04	7.36E-02	3.07	1	12	12					C3
			f											
Emergency Generator 9-0356	20200401	No. 2 Oil	s	5.85E-05	9.75E-03	0.49	1	12	12					C3
			f											
Emergency Generator 9-0369	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
			f											
Emergency Generator 9-0378	20200401	No. 2 Oil	s	4.09E-04	6.82E-02	2.83	1	12	12					C3
			f											
Emergency Generator 9-0379	20200401	No. 2 Oil	s	5.16E-04	8.60E-02	3.58	1	12	12					C3
			f											
Emergency Generator 9-0380	20200401	No. 2 Oil	s	7.82E-05	1.30E-02	0.54	1	12	12					C3
			f											
Emergency Generator 9-0402	20200401	No. 2 Oil	s	1.00E-03	1.67E-01	4.18	1	12	12					C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Sulfur Oxides (as SO_2) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0442	20200401	No. 2 Oil	s	5.41E-05	9.02E-03	0.62	1	12	12					C3
			f											
Emergency Generator 9-0448	20200401	No. 2 Oil	s	2.61E-04	4.34E-02	2.12	1	12	12					C3
			f											
Emergency Generator 9-0453	20200401	No. 2 Oil	s	1.52E-04	2.54E-02	2.48	1	12	12					C3
			f											
Emergency Generator 9-0463	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
			f											
Emergency Generator 9-0464	20200401	No. 2 Oil	s	3.37E-04	5.62E-02	8.11	1	12	12					C3
			f											
Emergency Generator 9-0465	20200401	No. 2 Oil	s	1.00E-05	1.67E-03	0.23	1	12	12					C3
			f											
Emergency Generator 9-0484	20200401	No. 2 Oil	s	3.71E-05	6.18E-03	0.75	1	12	12					C3
			f											
Emergency Generator 9-0485	20200401	No. 2 Oil	s	2.39E-05	3.99E-03	0.13	1	12	12					C3
			f											
Emergency Generator 9-0486	20200401	No. 2 Oil	s	2.23E-05	3.72E-03	0.12	1	12	12					C3
			f											
Emergency Generator 5-0488	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
			f											
Emergency Generator 9-0506	20200401	No. 2 Oil	s	6.54E-05	1.09E-02	0.34	1	12	12					C3
			f											
Total				3.21E+00	2.71E+01					0.00				

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel.

Emission Estimation Method

A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balance using engineering knowledge of the proces
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Volatile organic Compounds (VOC) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0392	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	0	0	0	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0432	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0460	10300503	No. 2 Oil	s	2.20E-02	2.41E-01	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0506	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	52	365	0.00	24.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0523	10300503	No. 2 Oil	s	1.24E-03	6.77E-03	24.00	7	52	365	0.01	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 4-0543	10300503	NG	s	0.00E+00	0.00E+00	24.00	7	52	365	0.00	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 4-0544	10300503	NG	s	6.43E-01	3.52E+00	24.00	7	52	365	3.52	24.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0545	10300503	No. 2 Oil	s	3.40E-04	3.73E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0559	10300503	No. 2 Oil	s	7.89E-03	8.67E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0560	10300503	No. 2 Oil	s	7.89E-03	8.67E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0568	10300502	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0570	10300503	No. 2 Oil	s	2.38E-03	2.62E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0571	10300503	No. 2 Oil	s	2.38E-03	2.62E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0572	10300503	No. 2 Oil	s	2.38E-03	2.62E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0626	10300503	No. 2 Oil	s	2.43E-04	2.67E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0627	10300503	No. 2 Oil	s	1.58E-03	1.73E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0650	10300503	No. 2 Oil	s	3.36E-04	3.69E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0660	10300503	No. 2 Oil	s	1.31E-03	1.43E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0663	10300603	No. 2 Oil	s	2.04E-03	2.24E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0664	10300503	No. 2 Oil	s	2.04E-03	2.24E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0665	10300503	No. 2 Oil	s	8.17E-04	8.98E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0668	10300503	No. 2 Oil	s	2.66E-03	2.92E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0669	10300503	No. 2 Oil	s	3.25E-03	3.57E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0670	10300503	No. 2 Oil	s	3.25E-03	3.57E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Volatile organic Compounds (VOC) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0681	10300503	No. 2 Oil	s	5.78E-04	6.35E-03	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0684	10300503	No. 2 Oil	s	1.89E-03	2.07E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0695	10300503	No. 2 Oil	s	1.11E-03	1.22E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0700	10300503	No. 2 Oil	s	1.15E-03	1.27E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0701	10300503	No. 2 Oil	s	1.15E-03	1.27E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0702	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0703	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0704	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0716	10300503	No. 2 Oil	s	2.52E-03	2.77E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Fuel Oil Boiler 4-0723	10300503	No. 2 Oil	s	1.24E-03	1.36E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0306	10300602	NG	s	3.38E-01	1.85E+00	24.00	7	52	365	1.85	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0311	10300503	NG	s	7.59E-03	8.34E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0312	10300503	NG	s	7.59E-03	8.34E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0313	10300503	NG	s	7.59E-03	8.34E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0316	10300503	NG	s	5.05E-03	5.55E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0317	10300503	NG	s	5.05E-03	5.55E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0329	10300603	NG	s	5.05E-03	5.55E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0330	10300603	NG	s	5.05E-03	5.55E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0331	10300603	NG	s	5.05E-03	5.55E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0332	10300603	NG	s	5.05E-03	5.55E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0333	10300603	NG	s	5.05E-03	5.55E-02	24.00	7	26	182	0.00	0.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0347	10300602	NG	s	2.43E-02	1.33E-01	24.00	7	52	365	0.13	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0348	10300602	NG	s	2.43E-02	1.33E-01	24.00	7	52	365	0.13	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0349	10300602	NG	s	2.43E-02	1.33E-01	24.00	7	52	365	0.13	24.00	NA	NA	C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Volatile organic Compounds (VOC) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Dual Fuel Boiler 5-0350	10300602	NG	s	2.43E-02	1.33E-01	24.00	7	52	365	0.13	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0351	10300602	NG	s	2.43E-02	1.33E-01	24.00	7	52	365	0.13	24.00	NA	NA	C3
			f											
Dual Fuel Boiler 5-0389	10300602	NG	s	4.03E-02	2.21E-01	24.00	7	52	365	0.22	24.00	NA	NA	C3
			f											
CHP Unit 5-0366	10200604	NG	s	3.14E+00	1.82E+01	24	7	49	344	18.24	24.00	NA	NA	C1, C3
			f											
Paint Spray Booth 6-0497	40202501	NA	s	2.32E-02	7.73E+00	1.67	1.2	5	6	7.73	1.67	NA	NA	C2
			f											
Paint Spray Booth 6-0498	40202501	NA	s	6.89E-03	3.44E+00	1.75	1.3	3	4	3.44	1.75	NA	NA	C2
			f											
Emergency Generator 9-0230	20200401	No. 2 Oil	s	1.58E-04	2.64E-02	0.04	1	12	12	0.03	0.04	NA	NA	C3
			f											
Emergency Generator 9-0231	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
			f											
Emergency Generator 9-0232	20200401	No. 2 Oil	s	1.87E-03	3.12E-01	0.47	1	12	12	0.31	0.47	NA	NA	C3
			f											
Emergency Generator 9-0278	20200401	No. 2 Oil	s	1.92E-03	3.20E-01	0.40	1	12	12	0.32	0.40	NA	NA	C3
			f											
Emergency Generator 9-0279	20200401	No. 2 Oil	s	1.91E-03	3.19E-01	0.40	1	12	12	0.32	0.40	NA	NA	C3
			f											
Emergency Generator 9-0280	20200401	No. 2 Oil	s	1.91E-03	3.18E-01	0.40	1	12	12	0.32	0.40	NA	NA	C3
			f											
Emergency Generator 9-0293	20200401	No. 2 Oil	s	7.86E-04	1.31E-01	0.35	1	12	12	0.13	0.35	NA	NA	C3
			f											
Emergency Generator 9-0339	20200401	No. 2 Oil	s	5.07E-03	8.45E-01	2.87	1	12	12	0.85	2.87	NA	NA	C3
			f											
Emergency Generator 9-0341	20200102	No. 2 Oil	s	8.79E-03	1.46E+00	2.76	1	12	12	1.46	2.76	NA	NA	C3
			f											
Emergency Generator 9-0355	20200401	No. 2 Oil	s	2.39E-02	3.98E+00	3.07	1	12	12	3.98	3.07	NA	NA	C3
			f											
Emergency Generator 9-0356	20200401	No. 2 Oil	s	3.16E-03	5.27E-01	0.49	1	12	12	0.53	0.49	NA	NA	C3
			f											
Emergency Generator 9-0369	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
			f											
Emergency Generator 9-0378	20200401	No. 2 Oil	s	2.21E-02	3.69E+00	2.83	1	12	12	3.69	2.83	NA	NA	C3
			f											
Emergency Generator 9-0379	20200401	No. 2 Oil	s	2.79E-02	4.65E+00	3.58	1	12	12	4.65	3.58	NA	NA	C3
			f											
Emergency Generator 9-0380	20200401	No. 2 Oil	s	4.23E-03	7.05E-01	0.54	1	12	12	0.70	0.54	NA	NA	C3
			f											
Emergency Generator 9-0402	20200401	No. 2 Oil	s	2.28E-02	3.81E+00	4.18	1	12	12	3.81	4.18	NA	NA	C3
			f											
Emergency Generator 9-0442	20200401	No. 2 Oil	s	2.93E-03	4.88E-01	0.62	1	12	12	0.49	0.62	NA	NA	C3
			f											
Emergency Generator 9-0448	20200401	No. 2 Oil	s	1.41E-02	2.35E+00	2.12	1	12	12	2.35	2.12	NA	NA	C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Volatile organic Compounds (VOC) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0453	20200401	No. 2 Oil	s	8.23E-03	1.37E+00	2.48	1	12	12	1.37	2.48	NA	NA	C3
			f											
Emergency Generator 9-0463	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
			f											
Emergency Generator 9-0464	20200401	No. 2 Oil	s	1.82E-02	3.04E+00	8.11	1	12	12	3.04	8.11	NA	NA	C3
			f											
Emergency Generator 9-0465	20200401	No. 2 Oil	s	5.41E-04	9.02E-02	0.23	1	12	12	0.09	0.23	NA	NA	C3
			f											
Emergency Generator 9-0484	20200401	No. 2 Oil	s	2.00E-03	3.34E-01	0.75	1	12	12	0.33	0.75	NA	NA	C3
			f											
Emergency Generator 9-0485	20200401	No. 2 Oil	s	1.29E-03	2.15E-01	0.13	1	12	12	0.22	0.13	NA	NA	C3
			f											
Emergency Generator 9-0486	20200401	No. 2 Oil	s	1.21E-03	2.01E-01	0.12	1	12	12	0.20	0.12	NA	NA	C3
			f											
Emergency Generator 5-0488	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12	0.00	0.00	NA	NA	C3
			f											
Emergency Generator 9-0506	20200401	No. 2 Oil	s	3.53E-03	5.89E-01	0.34	1	12	12	0.59	0.34	NA	NA	C3
			f											
Total				4.62E+00	6.69E+01					65.44				

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel.

Emission Estimation Method

A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balance using engineering knowledge of the proces
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:

All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Carbon Monoxide (CO) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0392	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	0	0	0					C3
			f											
Fuel Oil Boiler 4-0432	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0460	10300503	No. 2 Oil	s	3.23E-01	3.55E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0506	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	52	365					C3
			f											
Fuel Oil Boiler 4-0523	10300503	No. 2 Oil	s	1.82E-02	9.96E-02	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 4-0543	10300503	NG	s	0.00E+00	0.00E+00	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 4-0544	10300503	NG	s	9.80E+00	5.37E+01	24.00	7	52	365					C3
			f											
Fuel Oil Boiler 4-0545	10300503	No. 2 Oil	s	5.00E-03	5.49E-02	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0559	10300503	No. 2 Oil	s	1.16E-01	1.27E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0560	10300503	No. 2 Oil	s	1.16E-01	1.27E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0568	10300502	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0570	10300503	No. 2 Oil	s	3.50E-02	3.85E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0571	10300503	No. 2 Oil	s	3.50E-02	3.85E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0572	10300503	No. 2 Oil	s	3.50E-02	3.85E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0626	10300503	No. 2 Oil	s	3.58E-03	3.93E-02	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0627	10300503	No. 2 Oil	s	2.32E-02	2.55E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0650	10300503	No. 2 Oil	s	4.94E-03	5.43E-02	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0660	10300503	No. 2 Oil	s	1.92E-02	2.11E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0663	10300603	No. 2 Oil	s	3.00E-02	3.30E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0664	10300503	No. 2 Oil	s	3.00E-02	3.30E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0665	10300503	No. 2 Oil	s	1.20E-02	1.32E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0668	10300503	No. 2 Oil	s	3.91E-02	4.30E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0669	10300503	No. 2 Oil	s	4.77E-02	5.25E-01	24.00	7	26	182					C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Carbon Monoxide (CO) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Fuel Oil Boiler 4-0670	10300503	No. 2 Oil	s	4.77E-02	5.25E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0681	10300503	No. 2 Oil	s	8.50E-03	9.34E-02	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0684	10300503	No. 2 Oil	s	2.77E-02	3.05E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0695	10300503	No. 2 Oil	s	1.63E-02	1.79E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0700	10300503	No. 2 Oil	s	1.70E-02	1.87E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0701	10300503	No. 2 Oil	s	1.70E-02	1.87E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0702	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0703	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0704	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0716	10300503	No. 2 Oil	s	3.70E-02	4.07E-01	24.00	7	26	182					C3
			f											
Fuel Oil Boiler 4-0723	10300503	No. 2 Oil	s	1.82E-02	2.00E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0306	10300602	NG	s	5.17E+00	2.83E+01	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 5-0311	10300503	NG	s	1.16E-01	1.27E+00	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0312	10300503	NG	s	1.16E-01	1.27E+00	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0313	10300503	NG	s	1.16E-01	1.27E+00	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0316	10300503	NG	s	7.71E-02	8.48E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0317	10300503	NG	s	7.71E-02	8.48E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0329	10300603	NG	s	7.71E-02	8.48E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0330	10300603	NG	s	7.71E-02	8.48E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0331	10300603	NG	s	7.71E-02	8.48E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0332	10300603	NG	s	7.71E-02	8.48E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0333	10300603	NG	s	7.71E-02	8.48E-01	24.00	7	26	182					C3
			f											
Dual Fuel Boiler 5-0347	10300602	NG	s	3.71E-01	2.03E+00	24.00	7	52	365					C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Carbon Monoxide (CO) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Dual Fuel Boiler 5-0348	10300602	NG	s	3.71E-01	2.03E+00	24.00	7	52	365					C4
			f											
Dual Fuel Boiler 5-0349	10300602	NG	s	3.71E-01	2.03E+00	24.00	7	52	365					C5
			f											
Dual Fuel Boiler 5-0350	10300602	NG	s	3.71E-01	2.03E+00	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 5-0351	10300602	NG	s	3.71E-01	2.03E+00	24.00	7	52	365					C3
			f											
Dual Fuel Boiler 5-0389	10300602	NG	s	6.15E-01	3.37E+00	24.00	7	52	365					C3
			f											
CHP Unit 5-0366	10200604	NG	s	2.24E+01	1.30E+02	24	7	49	344					C3
			f											
Paint Spray Booth 6-0497	40202501	NA	s	0.00E+00	0.00E+00	1.67	1.2	5	6					C2
			f											
Paint Spray Booth 6-0498	40202501	NA	s	0.00E+00	0.00E+00	1.75	1.3	3	4					C2
			f											
Emergency Generator 9-0230	20200401	No. 2 Oil	s	1.64E-03	2.74E-01	0.04	1	12	12					C3
			f											
Emergency Generator 9-0231	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
			f											
Emergency Generator 9-0232	20200401	No. 2 Oil	s	1.94E-02	3.24E+00	0.47	1	12	12					C3
			f											
Emergency Generator 9-0278	20200401	No. 2 Oil	s	1.99E-02	3.32E+00	0.40	1	12	12					C3
			f											
Emergency Generator 9-0279	20200401	No. 2 Oil	s	1.99E-02	3.31E+00	0.40	1	12	12					C3
			f											
Emergency Generator 9-0280	20200401	No. 2 Oil	s	1.98E-02	3.30E+00	0.40	1	12	12					C3
			f											
Emergency Generator 9-0293	20200401	No. 2 Oil	s	8.16E-03	1.36E+00	0.35	1	12	12					C3
			f											
Emergency Generator 9-0339	20200401	No. 2 Oil	s	5.26E-02	8.77E+00	2.87	1	12	12					C3
			f											
Emergency Generator 9-0341	20200102	No. 2 Oil	s	9.12E-02	1.52E+01	2.76	1	12	12					C3
			f											
Emergency Generator 9-0355	20200401	No. 2 Oil	s	2.48E-01	4.13E+01	3.07	1	12	12					C3
			f											
Emergency Generator 9-0356	20200401	No. 2 Oil	s	3.28E-02	5.47E+00	0.49	1	12	12					C3
			f											
Emergency Generator 9-0369	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
			f											
Emergency Generator 9-0378	20200401	No. 2 Oil	s	2.30E-01	3.83E+01	2.83	1	12	12					C3
			f											
Emergency Generator 9-0379	20200401	No. 2 Oil	s	2.90E-01	4.83E+01	3.58	1	12	12					C3
			f											
Emergency Generator 9-0380	20200401	No. 2 Oil	s	4.39E-02	7.31E+00	0.54	1	12	12					C3
			f											
Emergency Generator 9-0402	20200401	No. 2 Oil	s	1.66E-01	2.77E+01	4.18	1	12	12					C3
			f											

FORM 2

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Carbon Monoxide (CO) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		Actual Emissions		Operating Schedule (Actual)				TOSD	Operating Schedule			Estimation Method
				Tons/yr	lbs/dy	Hrs/dy	Dys/wk	Wk/yr	Dys/yr	lbs/dy	Hrs/dy	Start	End	
Emergency Generator 9-0442	20200401	No. 2 Oil	s	3.04E-02	5.06E+00	0.62	1	12	12					C3
			f											
Emergency Generator 9-0448	20200401	No. 2 Oil	s	1.46E-01	2.44E+01	2.12	1	12	12					C3
			f											
Emergency Generator 9-0453	20200401	No. 2 Oil	s	8.54E-02	1.42E+01	2.48	1	12	12					C3
			f											
Emergency Generator 9-0463	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
			f											
Emergency Generator 9-0464	20200401	No. 2 Oil	s	1.89E-01	3.15E+01	8.11	1	12	12					C3
			f											
Emergency Generator 9-0465	20200401	No. 2 Oil	s	5.62E-03	9.36E-01	0.23	1	12	12					C3
			f											
Emergency Generator 9-0484	20200401	No. 2 Oil	s	2.08E-02	3.47E+00	0.75	1	12	12					C3
			f											
Emergency Generator 9-0485	20200401	No. 2 Oil	s	1.34E-02	2.24E+00	0.13	1	12	12					C3
			f											
Emergency Generator 9-0486	20200401	No. 2 Oil	s	1.25E-02	2.09E+00	0.12	1	12	12					C3
			f											
Emergency Generator 5-0488	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00	1	12	12					C3
			f											
Emergency Generator 9-0506	20200401	No. 2 Oil	s	3.67E-02	6.11E+00	0.34	1	12	12					C3
			f											
Total				4.36E+01	5.44E+02					0.00				

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel.

Emission Estimation Method

A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balance using engineering knowledge of the proces
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 3: PM

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Particulate Matter (PM) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		PM - Filterable		PM 10 - Filterable		PM 2.5 - Filterable		PM Condensable		Operation	Estimation Method
				Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Days/yr	
Fuel Oil Boiler 4-0392	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	C3
			f										
Fuel Oil Boiler 4-0432	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	182	C3
			f										
Fuel Oil Boiler 4-0460	10300503	No. 2 Oil	s	1.29E-01	1.42E+00	6.97E-02	7.66E-01	5.36E-02	5.89E-01	8.39E-02	9.22E-01	182	C3
			f										
Fuel Oil Boiler 4-0506	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	365	C3
			f										
Fuel Oil Boiler 4-0523	10300503	No. 2 Oil	s	7.27E-03	3.98E-02	3.93E-03	2.15E-02	3.02E-03	1.65E-02	4.73E-03	2.59E-02	365	C3
			f										
Dual Fuel Boiler 4-0543	10300503	NG	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	365	C3
			f										
Dual Fuel Boiler 4-0544	10300503	NG	s	3.44E-01	1.88E+00	2.84E-01	1.56E+00	2.68E-01	1.47E+00	7.27E-01	3.98E+00	365	C3
			f										
Fuel Oil Boiler 4-0545	10300503	No. 2 Oil	s	2.00E-03	2.20E-02	1.08E-03	1.19E-02	8.29E-04	9.11E-03	1.30E-03	1.43E-02	182	C3
			f										
Fuel Oil Boiler 4-0559	10300503	No. 2 Oil	s	4.64E-02	5.10E-01	2.50E-02	2.75E-01	1.92E-02	2.12E-01	3.02E-02	3.31E-01	182	C3
			f										
Fuel Oil Boiler 4-0560	10300503	No. 2 Oil	s	4.64E-02	5.10E-01	2.50E-02	2.75E-01	1.92E-02	2.12E-01	3.02E-02	3.31E-01	182	C3
			f										
Fuel Oil Boiler 4-0568	10300502	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	182	C3
			f										
Fuel Oil Boiler 4-0570	10300503	No. 2 Oil	s	1.40E-02	1.54E-01	7.56E-03	8.31E-02	5.81E-03	6.39E-02	9.10E-03	1.00E-01	182	C3
			f										
Fuel Oil Boiler 4-0571	10300503	No. 2 Oil	s	1.40E-02	1.54E-01	7.56E-03	8.31E-02	5.81E-03	6.39E-02	9.10E-03	1.00E-01	182	C3
			f										
Fuel Oil Boiler 4-0572	10300503	No. 2 Oil	s	1.40E-02	1.54E-01	7.56E-03	8.31E-02	5.81E-03	6.39E-02	9.10E-03	1.00E-01	182	C3
			f										
Fuel Oil Boiler 4-0626	10300503	No. 2 Oil	s	1.43E-03	1.57E-02	7.72E-04	8.49E-03	5.93E-04	6.52E-03	9.30E-04	1.02E-02	182	C3
			f										
Fuel Oil Boiler 4-0627	10300503	No. 2 Oil	s	9.28E-03	1.02E-01	5.01E-03	5.51E-02	3.85E-03	4.23E-02	6.03E-03	6.63E-02	182	C3
			f										
Fuel Oil Boiler 4-0650	10300503	No. 2 Oil	s	1.98E-03	2.17E-02	1.07E-03	1.17E-02	8.20E-04	9.01E-03	1.28E-03	1.41E-02	182	C3
			f										
Fuel Oil Boiler 4-0660	10300503	No. 2 Oil	s	7.68E-03	8.44E-02	4.15E-03	4.56E-02	3.19E-03	3.50E-02	4.99E-03	5.49E-02	182	C3
			f										
Fuel Oil Boiler 4-0663	10300603	No. 2 Oil	s	1.20E-02	1.32E-01	6.48E-03	7.12E-02	4.98E-03	5.48E-02	7.80E-03	8.58E-02	182	C3
			f										
Fuel Oil Boiler 4-0664	10300503	No. 2 Oil	s	1.20E-02	1.32E-01	6.48E-03	7.12E-02	4.98E-03	5.48E-02	7.80E-03	8.58E-02	182	C3
			f										
Fuel Oil Boiler 4-0665	10300503	No. 2 Oil	s	4.81E-03	5.28E-02	2.59E-03	2.85E-02	1.99E-03	2.19E-02	3.12E-03	3.43E-02	182	C3
			f										
Fuel Oil Boiler 4-0668	10300503	No. 2 Oil	s	1.56E-02	1.72E-01	8.45E-03	9.28E-02	6.49E-03	7.13E-02	1.02E-02	1.12E-01	182	C3
			f										
Fuel Oil Boiler 4-0669	10300503	No. 2 Oil	s	1.91E-02	2.10E-01	1.03E-02	1.13E-01	7.92E-03	8.71E-02	1.24E-02	1.36E-01	182	C3
			f										

FORM 3: PM

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Particulate Matter (PM) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		PM - Filterable		PM 10 - Filterable		PM 2.5 - Filterable		PM Condensable		Operation	Estimation Method
				Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Days/yr	
Fuel Oil Boiler 4-0670	10300503	No. 2 Oil	s	1.91E-02	2.10E-01	1.03E-02	1.13E-01	7.92E-03	8.71E-02	1.24E-02	1.36E-01	182	C3
			f										
Fuel Oil Boiler 4-0681	10300503	No. 2 Oil	s	3.40E-03	3.73E-02	1.83E-03	2.02E-02	1.41E-03	1.55E-02	2.21E-03	2.43E-02	182	C3
			f										
Fuel Oil Boiler 4-0684	10300503	No. 2 Oil	s	1.11E-02	1.22E-01	5.99E-03	6.58E-02	4.60E-03	5.06E-02	7.21E-03	7.92E-02	182	C3
			f										
Fuel Oil Boiler 4-0695	10300503	No. 2 Oil	s	6.52E-03	7.16E-02	3.52E-03	3.87E-02	2.71E-03	2.97E-02	4.24E-03	4.66E-02	182	C3
			f										
Fuel Oil Boiler 4-0700	10300503	No. 2 Oil	s	6.79E-03	7.46E-02	3.67E-03	4.03E-02	2.82E-03	3.10E-02	4.42E-03	4.85E-02	182	C3
			f										
Fuel Oil Boiler 4-0701	10300503	No. 2 Oil	s	6.79E-03	7.46E-02	3.67E-03	4.03E-02	2.82E-03	3.10E-02	4.42E-03	4.85E-02	182	C3
			f										
Fuel Oil Boiler 4-0702	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	182	C3
			f										
Fuel Oil Boiler 4-0703	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	182	C3
			f										
Fuel Oil Boiler 4-0704	10300503	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	182	C3
			f										
Fuel Oil Boiler 4-0716	10300503	No. 2 Oil	s	1.48E-02	1.63E-01	8.00E-03	8.79E-02	6.14E-03	6.75E-02	9.62E-03	1.06E-01	182	C3
			f										
Fuel Oil Boiler 4-0723	10300503	No. 2 Oil	s	7.27E-03	7.99E-02	3.93E-03	4.31E-02	3.02E-03	3.32E-02	4.73E-03	5.19E-02	182	C3
			f										
Dual Fuel Boiler 5-0306	10300602	NG	s	1.17E-01	6.40E-01	1.17E-01	6.40E-01	1.17E-01	6.40E-01	3.51E-01	1.92E+00	365	C3
			f										
Dual Fuel Boiler 5-0311	10300503	NG	s	2.62E-03	2.88E-02	2.62E-03	2.88E-02	2.62E-03	2.88E-02	7.87E-03	8.65E-02	182	C3
			f										
Dual Fuel Boiler 5-0312	10300503	NG	s	2.62E-03	2.88E-02	2.62E-03	2.88E-02	2.62E-03	2.88E-02	7.87E-03	8.65E-02	182	C3
			f										
Dual Fuel Boiler 5-0313	10300503	NG	s	2.62E-03	2.88E-02	2.62E-03	2.88E-02	2.62E-03	2.88E-02	7.87E-03	8.65E-02	182	C3
			f										
Dual Fuel Boiler 5-0316	10300503	NG	s	1.82E-03	2.00E-02	1.78E-03	1.96E-02	1.77E-03	1.95E-02	5.27E-03	5.79E-02	182	C3
			f										
Dual Fuel Boiler 5-0317	10300503	NG	s	1.82E-03	2.00E-02	1.78E-03	1.96E-02	1.77E-03	1.95E-02	5.27E-03	5.79E-02	182	C3
			f										
Dual Fuel Boiler 5-0329	10300603	NG	s	1.82E-03	2.00E-02	1.78E-03	1.96E-02	1.77E-03	1.95E-02	5.27E-03	5.79E-02	182	C3
			f										
Dual Fuel Boiler 5-0330	10300603	NG	s	1.82E-03	2.00E-02	1.78E-03	1.96E-02	1.77E-03	1.95E-02	5.27E-03	5.79E-02	182	C3
			f										
Dual Fuel Boiler 5-0331	10300603	NG	s	1.82E-03	2.00E-02	1.78E-03	1.96E-02	1.77E-03	1.95E-02	5.27E-03	5.79E-02	182	C3
			f										
Dual Fuel Boiler 5-0332	10300603	NG	s	1.82E-03	2.00E-02	1.78E-03	1.96E-02	1.77E-03	1.95E-02	5.27E-03	5.79E-02	182	C3
			f										
Dual Fuel Boiler 5-0333	10300603	NG	s	1.82E-03	2.00E-02	1.78E-03	1.96E-02	1.77E-03	1.95E-02	5.27E-03	5.79E-02	182	C3
			f										
Dual Fuel Boiler 5-0347	10300602	NG	s	8.38E-03	4.59E-02	8.38E-03	4.59E-02	8.38E-03	4.59E-02	2.51E-02	1.38E-01	365	C3
			f										

FORM 3: PM

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Particulate Matter (PM) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		PM - Filterable		PM 10 - Filterable		PM 2.5 - Filterable		PM Condensable		Operation	Estimation Method
				Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Days/yr	
Dual Fuel Boiler 5-0348	10300602	NG	s	8.38E-03	4.59E-02	8.38E-03	4.59E-02	8.38E-03	4.59E-02	2.51E-02	1.38E-01	365	C3
			f										
Dual Fuel Boiler 5-0349	10300602	NG	s	8.38E-03	4.59E-02	8.38E-03	4.59E-02	8.38E-03	4.59E-02	2.51E-02	1.38E-01	365	C3
			f										
Dual Fuel Boiler 5-0350	10300602	NG	s	8.38E-03	4.59E-02	8.38E-03	4.59E-02	8.38E-03	4.59E-02	2.51E-02	1.38E-01	365	C3
			f										
Dual Fuel Boiler 5-0351	10300602	NG	s	8.38E-03	4.59E-02	8.38E-03	4.59E-02	8.38E-03	4.59E-02	2.51E-02	1.38E-01	365	C3
			f										
Dual Fuel Boiler 5-0389	10300602	NG	s	1.39E-02	7.62E-02	1.39E-02	7.62E-02	1.39E-02	7.62E-02	4.17E-02	2.29E-01	365	C3
			f										
CHP Unit 5-0366	10200604	NG	s	5.03E+00	2.93E+01	5.03E+00	2.93E+01	5.03E+00	2.93E+01	1.71E+00	9.92E+00	344	C3
			f										
Paint Spray Booth 6-0497	40202501	NA	s	3.60E-04	1.20E-01	NA	NA	NA	NA	NA	NA	6	NA
			f										
Paint Spray Booth 6-0498	40202501	NA	s	1.05E-04	5.26E-02	NA	NA	NA	NA	NA	NA	4	NA
			f										
Emergency Generator 9-0230	20200401	No. 2 Oil	s	1.20E-04	2.00E-02	9.58E-05	1.60E-02	9.25E-05	1.54E-02	1.49E-05	2.48E-03	12	C3
			f										
Emergency Generator 9-0231	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	12	C3
			f										
Emergency Generator 9-0232	20200401	No. 2 Oil	s	1.42E-03	2.36E-01	1.13E-03	1.89E-01	1.09E-03	1.82E-01	1.76E-04	2.93E-02	12	C3
			f										
Emergency Generator 9-0278	20200401	No. 2 Oil	s	1.45E-03	2.42E-01	1.16E-03	1.94E-01	1.12E-03	1.87E-01	1.80E-04	3.01E-02	12	C3
			f										
Emergency Generator 9-0279	20200401	No. 2 Oil	s	1.45E-03	2.42E-01	1.16E-03	1.93E-01	1.12E-03	1.87E-01	1.80E-04	3.00E-02	12	C3
			f										
Emergency Generator 9-0280	20200401	No. 2 Oil	s	1.45E-03	2.41E-01	1.16E-03	1.93E-01	1.12E-03	1.86E-01	1.80E-04	2.99E-02	12	C3
			f										
Emergency Generator 9-0293	20200401	No. 2 Oil	s	5.95E-04	9.92E-02	4.76E-04	7.94E-02	4.60E-04	7.66E-02	7.39E-05	1.23E-02	12	C3
			f										
Emergency Generator 9-0339	20200401	No. 2 Oil	s	3.84E-03	6.40E-01	3.07E-03	5.12E-01	2.97E-03	4.94E-01	4.77E-04	7.95E-02	12	C3
			f										
Emergency Generator 9-0341	20200102	No. 2 Oil	s	6.65E-03	1.11E+00	5.32E-03	8.87E-01	5.14E-03	8.57E-01	8.26E-04	1.38E-01	12	C3
			f										
Emergency Generator 9-0355	20200401	No. 2 Oil	s	1.81E-02	3.01E+00	1.45E-02	2.41E+00	1.40E-02	2.33E+00	2.24E-03	3.74E-01	12	C3
			f										
Emergency Generator 9-0356	20200401	No. 2 Oil	s	2.39E-03	3.99E-01	1.92E-03	3.19E-01	1.85E-03	3.08E-01	2.97E-04	4.96E-02	12	C3
			f										
Emergency Generator 9-0369	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	12	C3
			f										
Emergency Generator 9-0378	20200401	No. 2 Oil	s	1.67E-02	2.79E+00	1.34E-02	2.23E+00	1.29E-02	2.16E+00	2.08E-03	3.47E-01	12	C3
			f										
Emergency Generator 9-0379	20200401	No. 2 Oil	s	2.11E-02	3.52E+00	1.69E-02	2.82E+00	1.63E-02	2.72E+00	2.62E-03	4.37E-01	12	C3
			f										
Emergency Generator 9-0380	20200401	No. 2 Oil	s	3.20E-03	5.33E-01	2.56E-03	4.27E-01	2.47E-03	4.12E-01	3.97E-04	6.62E-02	12	C3
			f										
Emergency Generator 9-0402	20200401	No. 2 Oil	s	1.23E-01	2.05E+01	9.86E-02	1.64E+01	9.52E-02	1.59E+01	1.53E-02	2.55E+00	12	C3
			f										

FORM 3: PM

CRITERIA AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** Particulate Matter (PM) **Calendar Year:** 2023

Equipment Description/ Registration No.	SCC No.	Fuel		PM - Filterable		PM 10 - Filterable		PM 2.5 - Filterable		PM Condensable		Operation	Estimation Method
				Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Tons/yr	lbs/day	Days/yr	
Emergency Generator 9-0442	20200401	No. 2 Oil	s	2.21E-03	3.69E-01	1.77E-03	2.95E-01	1.71E-03	2.85E-01	2.75E-04	4.58E-02	12	C3
			f										
Emergency Generator 9-0448	20200401	No. 2 Oil	s	1.07E-02	1.78E+00	8.53E-03	1.42E+00	8.24E-03	1.37E+00	1.32E-03	2.21E-01	12	C3
			f										
Emergency Generator 9-0453	20200401	No. 2 Oil	s	6.23E-03	1.04E+00	4.99E-03	8.31E-01	4.81E-03	8.02E-01	7.74E-04	1.29E-01	12	C3
			f										
Emergency Generator 9-0463	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	12	C3
			f										
Emergency Generator 9-0464	20200401	No. 2 Oil	s	1.38E-02	2.30E+00	1.10E-02	1.84E+00	1.07E-02	1.78E+00	1.71E-03	2.85E-01	12	C3
			f										
Emergency Generator 9-0465	20200401	No. 2 Oil	s	4.10E-04	6.83E-02	3.28E-04	5.46E-02	3.17E-04	5.28E-02	5.09E-05	8.48E-03	12	C3
			f										
Emergency Generator 9-0484	20200401	No. 2 Oil	s	1.52E-03	2.53E-01	1.21E-03	2.02E-01	1.17E-03	1.95E-01	1.88E-04	3.14E-02	12	C3
			f										
Emergency Generator 9-0485	20200401	No. 2 Oil	s	9.79E-04	1.63E-01	7.83E-04	1.30E-01	7.56E-04	1.26E-01	1.22E-04	2.03E-02	12	C3
			f										
Emergency Generator 9-0486	20200401	No. 2 Oil	s	9.13E-04	1.52E-01	7.31E-04	1.22E-01	7.06E-04	1.18E-01	1.13E-04	1.89E-02	12	C3
			f										
Emergency Generator 5-0488	20200401	No. 2 Oil	s	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	12	C3
			f										
Emergency Generator 9-0506	20200401	No. 2 Oil	s	2.67E-03	4.46E-01	2.14E-03	3.57E-01	2.07E-03	3.44E-01	3.32E-04	5.54E-02	12	C3
			f										
Total				6.24	77.38	5.94	66.67	5.86	64.89	3.32	25.46		

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/dy) are lbs/operating day of the source.

TOSD - Typical Ozone Season Day means a typical day of that period of the year during which conditions for photochemical conditions are most favorable, which is generally during sustained periods of direct sunlight and warm temperatures (April-September). This sections needs to be completed only for VOC and NOx sources.

Fuel: Include emissions for each fuel used. If more than one fuel is used, calculate and list emission separately for each fuel.

Emission Estimation Method

A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
C1 - User calculated based on source test or other measurements
C2 - User calculated based on material balance using engineering knowledge of the proces
C3 - User calculated based on AP-42
C4 - User calculated by best guess/engineering judgement
C5 - User calculated based on a State or local agency emission factor
C6 - New construction, not operational
C7 - Source closed, operation ceased
C8 - Computer calculated based on standard

Operating Days:
All NSPS boilers are assumed to be 365 days
All space heating boilers are assumed to be 182 days.
All emergency generators are assumed to be 12 days

SCC: Source Classification Code

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Acetaldehyde **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	2.26E-02	2.49E-01	1.04E-02
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	1.27E-03	6.98E-03	2.91E-04
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	2.31E-02	1.27E-01	5.28E-03
Fuel Oil Boiler 4-0545	3.50E-04	3.85E-03	1.60E-04
Fuel Oil Boiler 4-0559	8.13E-03	8.94E-02	3.72E-03
Fuel Oil Boiler 4-0560	8.13E-03	8.94E-02	3.72E-03
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	2.46E-03	2.70E-02	1.12E-03
Fuel Oil Boiler 4-0571	2.46E-03	2.70E-02	1.12E-03
Fuel Oil Boiler 4-0572	2.46E-03	2.70E-02	1.12E-03
Fuel Oil Boiler 4-0626	2.51E-04	2.75E-03	1.15E-04
Fuel Oil Boiler 4-0627	1.63E-03	1.79E-02	7.45E-04
Fuel Oil Boiler 4-0650	3.46E-04	3.81E-03	1.59E-04
Fuel Oil Boiler 4-0660	1.35E-03	1.48E-02	6.16E-04
Fuel Oil Boiler 4-0663	2.10E-03	2.31E-02	9.64E-04
Fuel Oil Boiler 4-0664	2.10E-03	2.31E-02	9.64E-04
Fuel Oil Boiler 4-0665	8.42E-04	9.26E-03	3.86E-04

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Acetaldehyde **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	2.74E-03	3.01E-02	1.26E-03
Fuel Oil Boiler 4-0669	3.35E-03	3.68E-02	1.53E-03
Fuel Oil Boiler 4-0670	3.35E-03	3.68E-02	1.53E-03
Fuel Oil Boiler 4-0681	5.96E-04	6.55E-03	2.73E-04
Fuel Oil Boiler 4-0684	1.94E-03	2.14E-02	8.90E-04
Fuel Oil Boiler 4-0695	1.14E-03	1.26E-02	5.23E-04
Fuel Oil Boiler 4-0700	1.19E-03	1.31E-02	5.45E-04
Fuel Oil Boiler 4-0701	1.19E-03	1.31E-02	5.45E-04
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	2.60E-03	2.85E-02	1.19E-03
Fuel Oil Boiler 4-0723	1.27E-03	1.40E-02	5.84E-04
Dual Fuel Boiler 5-0306	2.59E-04	1.42E-03	5.92E-05
Dual Fuel Boiler 5-0311	5.82E-06	6.40E-05	2.66E-06
Dual Fuel Boiler 5-0312	5.82E-06	6.40E-05	2.66E-06
Dual Fuel Boiler 5-0313	5.82E-06	6.40E-05	2.66E-06
Dual Fuel Boiler 5-0316	1.77E-05	1.94E-04	8.09E-06
Dual Fuel Boiler 5-0317	1.77E-05	1.94E-04	8.09E-06
Dual Fuel Boiler 5-0329	1.77E-05	1.94E-04	8.09E-06
Dual Fuel Boiler 5-0330	1.77E-05	1.94E-04	8.09E-06
Dual Fuel Boiler 5-0331	1.77E-05	1.94E-04	8.09E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Acetaldehyde **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0332	1.77E-05	1.94E-04	8.09E-06
Dual Fuel Boiler 5-0333	1.77E-05	1.94E-04	8.09E-06
Dual Fuel Boiler 5-0347	1.86E-05	1.02E-04	4.25E-06
Dual Fuel Boiler 5-0348	1.86E-05	1.02E-04	4.25E-06
Dual Fuel Boiler 5-0349	1.86E-05	1.02E-04	4.25E-06
Dual Fuel Boiler 5-0350	1.86E-05	1.02E-04	4.25E-06
Dual Fuel Boiler 5-0351	1.86E-05	1.02E-04	4.25E-06
CHP Unit 5-0366	2.15E-02	4.50E+00	1.87E-01
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	1.48E-06	2.47E-04	5.93E-03
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	1.75E-05	2.92E-03	6.27E-03
Emergency Generator 9-0278	1.80E-05	2.99E-03	7.46E-03
Emergency Generator 9-0279	1.79E-05	2.99E-03	7.46E-03
Emergency Generator 9-0280	1.79E-05	2.98E-03	7.46E-03
Emergency Generator 9-0293	7.36E-06	1.23E-03	3.51E-03
Emergency Generator 9-0339	4.75E-05	7.92E-03	2.76E-03
Emergency Generator 9-0341	8.23E-05	1.37E-02	4.97E-03
Emergency Generator 9-0355	2.24E-04	3.73E-02	1.21E-02
Emergency Generator 9-0356	2.96E-05	4.94E-03	1.00E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	2.07E-04	3.45E-02	1.22E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Acetaldehyde **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	2.61E-04	4.36E-02	1.22E-02
Emergency Generator 9-0380	3.96E-05	6.60E-03	1.22E-02
Emergency Generator 9-0402	1.52E-03	2.54E-01	6.09E-02
Emergency Generator 9-0442	2.74E-05	4.57E-03	7.41E-03
Emergency Generator 9-0448	1.32E-04	2.20E-02	1.04E-02
Emergency Generator 9-0453	7.71E-05	1.28E-02	5.19E-03
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	1.71E-04	2.84E-02	3.51E-03
Emergency Generator 9-0465	5.07E-06	8.45E-04	3.76E-03
Emergency Generator 9-0484	1.88E-05	3.13E-03	4.17E-03
Emergency Generator 9-0485	1.21E-05	2.02E-03	1.61E-02
Emergency Generator 9-0486	1.13E-05	1.88E-03	1.61E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	3.31E-05	5.52E-03	1.61E-02
Total	1.24E-01	5.95E+00	4.76E-01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Acrolein **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	2.26E-02	2.49E-01	1.04E-02
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	1.27E-03	6.98E-03	2.91E-04
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	2.29E-02	1.26E-01	5.24E-03
Fuel Oil Boiler 4-0545	3.50E-04	3.85E-03	1.60E-04
Fuel Oil Boiler 4-0559	8.13E-03	8.94E-02	3.72E-03
Fuel Oil Boiler 4-0560	8.13E-03	8.94E-02	3.72E-03
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	2.46E-03	2.70E-02	1.12E-03
Fuel Oil Boiler 4-0571	2.46E-03	2.70E-02	1.12E-03
Fuel Oil Boiler 4-0572	2.46E-03	2.70E-02	1.12E-03
Fuel Oil Boiler 4-0626	2.51E-04	2.75E-03	1.15E-04
Fuel Oil Boiler 4-0627	1.63E-03	1.79E-02	7.45E-04
Fuel Oil Boiler 4-0650	3.46E-04	3.81E-03	1.59E-04
Fuel Oil Boiler 4-0660	1.35E-03	1.48E-02	6.16E-04
Fuel Oil Boiler 4-0663	2.10E-03	2.31E-02	9.64E-04
Fuel Oil Boiler 4-0664	2.10E-03	2.31E-02	9.64E-04
Fuel Oil Boiler 4-0665	8.42E-04	9.26E-03	3.86E-04

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Acrolein **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	2.74E-03	3.01E-02	1.26E-03
Fuel Oil Boiler 4-0669	3.35E-03	3.68E-02	1.53E-03
Fuel Oil Boiler 4-0670	3.35E-03	3.68E-02	1.53E-03
Fuel Oil Boiler 4-0681	5.96E-04	6.55E-03	2.73E-04
Fuel Oil Boiler 4-0684	1.94E-03	2.14E-02	8.90E-04
Fuel Oil Boiler 4-0695	1.14E-03	1.26E-02	5.23E-04
Fuel Oil Boiler 4-0700	1.19E-03	1.31E-02	5.45E-04
Fuel Oil Boiler 4-0701	1.19E-03	1.31E-02	5.45E-04
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	2.60E-03	2.85E-02	1.19E-03
Fuel Oil Boiler 4-0723	1.27E-03	1.40E-02	5.84E-04
Dual Fuel Boiler 5-0306	1.63E-04	8.92E-04	3.72E-05
Dual Fuel Boiler 5-0311	3.65E-06	4.02E-05	1.67E-06
Dual Fuel Boiler 5-0312	3.65E-06	4.02E-05	1.67E-06
Dual Fuel Boiler 5-0313	3.65E-06	4.02E-05	1.67E-06
Dual Fuel Boiler 5-0316	1.62E-05	1.78E-04	7.43E-06
Dual Fuel Boiler 5-0317	1.62E-05	1.78E-04	7.43E-06
Dual Fuel Boiler 5-0329	1.62E-05	1.78E-04	7.43E-06
Dual Fuel Boiler 5-0330	1.62E-05	1.78E-04	7.43E-06
Dual Fuel Boiler 5-0331	1.62E-05	1.78E-04	7.43E-06
Dual Fuel Boiler 5-0332	1.62E-05	1.78E-04	7.43E-06
Dual Fuel Boiler 5-0333	1.62E-05	1.78E-04	7.43E-06
Dual Fuel Boiler 5-0347	1.17E-05	6.40E-05	2.67E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Acrolein **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0348	1.17E-05	6.40E-05	2.67E-06
Dual Fuel Boiler 5-0349	1.17E-05	6.40E-05	2.67E-06
Dual Fuel Boiler 5-0350	1.17E-05	6.40E-05	2.67E-06
Dual Fuel Boiler 5-0351	1.17E-05	6.40E-05	2.67E-06
CHP Unit 5-0366	3.74E-03	4.37E+00	1.82E-01
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	1.79E-07	2.98E-05	7.15E-04
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	2.11E-06	3.52E-04	7.56E-04
Emergency Generator 9-0278	2.17E-06	3.61E-04	8.99E-04
Emergency Generator 9-0279	2.16E-06	3.60E-04	8.99E-04
Emergency Generator 9-0280	2.16E-06	3.60E-04	8.99E-04
Emergency Generator 9-0293	8.88E-07	1.48E-04	4.23E-04
Emergency Generator 9-0339	5.73E-06	9.55E-04	3.33E-04
Emergency Generator 9-0341	9.93E-06	1.65E-03	5.99E-04
Emergency Generator 9-0355	2.70E-05	4.49E-03	1.47E-03
Emergency Generator 9-0356	3.57E-06	5.95E-04	1.21E-03
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	2.50E-05	4.16E-03	1.47E-03

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Acrolein **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	3.15E-05	5.25E-03	1.47E-03
Emergency Generator 9-0380	4.77E-06	7.96E-04	1.47E-03
Emergency Generator 9-0402	1.84E-04	3.06E-02	7.34E-03
Emergency Generator 9-0442	3.30E-06	5.51E-04	8.93E-04
Emergency Generator 9-0448	1.59E-05	2.65E-03	1.25E-03
Emergency Generator 9-0453	9.30E-06	1.55E-03	6.26E-04
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	2.06E-05	3.43E-03	4.23E-04
Emergency Generator 9-0465	6.11E-07	1.02E-04	4.53E-04
Emergency Generator 9-0484	2.26E-06	3.77E-04	5.03E-04
Emergency Generator 9-0485	1.46E-06	2.43E-04	1.95E-03
Emergency Generator 9-0486	1.36E-06	2.27E-04	1.95E-03
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	3.99E-06	6.65E-04	1.95E-03
Total	1.03E-01	5.39E+00	2.52E-01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Arsenic **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	1.03E-04	1.14E-03	4.73E-05
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	5.82E-06	3.19E-05	1.33E-06
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	1.25E-04	6.87E-04	2.86E-05
Fuel Oil Boiler 4-0545	1.60E-06	1.76E-05	7.32E-07
Fuel Oil Boiler 4-0559	3.71E-05	4.08E-04	1.70E-05
Fuel Oil Boiler 4-0560	3.71E-05	4.08E-04	1.70E-05
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	1.12E-05	1.23E-04	5.13E-06
Fuel Oil Boiler 4-0571	1.12E-05	1.23E-04	5.13E-06
Fuel Oil Boiler 4-0572	1.12E-05	1.23E-04	5.13E-06
Fuel Oil Boiler 4-0626	1.14E-06	1.26E-05	5.24E-07
Fuel Oil Boiler 4-0627	7.42E-06	8.16E-05	3.40E-06
Fuel Oil Boiler 4-0650	1.58E-06	1.74E-05	7.24E-07
Fuel Oil Boiler 4-0660	6.14E-06	6.75E-05	2.81E-06
Fuel Oil Boiler 4-0663	9.60E-06	1.06E-04	4.40E-06
Fuel Oil Boiler 4-0664	9.60E-06	1.06E-04	4.40E-06
Fuel Oil Boiler 4-0665	3.84E-06	4.22E-05	1.76E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Arsenic **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	1.25E-05	1.38E-04	5.73E-06
Fuel Oil Boiler 4-0669	1.53E-05	1.68E-04	6.99E-06
Fuel Oil Boiler 4-0670	1.53E-05	1.68E-04	6.99E-06
Fuel Oil Boiler 4-0681	2.72E-06	2.99E-05	1.24E-06
Fuel Oil Boiler 4-0684	8.87E-06	9.75E-05	4.06E-06
Fuel Oil Boiler 4-0695	5.22E-06	5.73E-05	2.39E-06
Fuel Oil Boiler 4-0700	5.43E-06	5.97E-05	2.49E-06
Fuel Oil Boiler 4-0701	5.43E-06	5.97E-05	2.49E-06
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	1.18E-05	1.30E-04	5.42E-06
Fuel Oil Boiler 4-0723	5.82E-06	6.39E-05	2.66E-06
Dual Fuel Boiler 5-0306	1.21E-05	6.61E-05	2.75E-06
Dual Fuel Boiler 5-0311	2.71E-07	2.97E-06	1.24E-07
Dual Fuel Boiler 5-0312	2.71E-07	2.97E-06	1.24E-07
Dual Fuel Boiler 5-0313	2.71E-07	2.97E-06	1.24E-07
Dual Fuel Boiler 5-0316	2.43E-07	2.67E-06	1.11E-07
Dual Fuel Boiler 5-0317	2.43E-07	2.67E-06	1.11E-07
Dual Fuel Boiler 5-0329	2.43E-07	2.67E-06	1.11E-07
Dual Fuel Boiler 5-0330	2.43E-07	2.67E-06	1.11E-07
Dual Fuel Boiler 5-0331	2.43E-07	2.67E-06	1.11E-07
Dual Fuel Boiler 5-0332	2.43E-07	2.67E-06	1.11E-07
Dual Fuel Boiler 5-0333	2.43E-07	2.67E-06	1.11E-07
Dual Fuel Boiler 5-0347	8.65E-07	4.74E-06	1.97E-07

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Arsenic **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0348	8.65E-07	4.74E-06	1.97E-07
Dual Fuel Boiler 5-0349	8.65E-07	4.74E-06	1.97E-07
Dual Fuel Boiler 5-0350	8.65E-07	4.74E-06	1.97E-07
Dual Fuel Boiler 5-0351	8.65E-07	4.74E-06	1.97E-07
CHP Unit 5-0366	1.56E-06	0.00E+00	7.81E-04
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	3.09E-06	5.15E-04	1.24E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	3.65E-05	6.09E-03	1.31E-02
Emergency Generator 9-0278	3.75E-05	6.25E-03	1.56E-02
Emergency Generator 9-0279	3.74E-05	6.23E-03	1.56E-02
Emergency Generator 9-0280	3.73E-05	6.22E-03	1.56E-02
Emergency Generator 9-0293	1.54E-05	2.56E-03	7.32E-03
Emergency Generator 9-0339	9.91E-05	1.65E-02	5.76E-03
Emergency Generator 9-0341	1.72E-04	2.86E-02	1.04E-02
Emergency Generator 9-0355	4.66E-04	7.77E-02	2.53E-02
Emergency Generator 9-0356	6.18E-05	1.03E-02	2.09E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	4.32E-04	7.20E-02	2.54E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Arsenic **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	5.45E-04	9.09E-02	2.54E-02
Emergency Generator 9-0380	8.26E-05	1.38E-02	2.54E-02
Emergency Generator 9-0402	3.18E-03	5.30E-01	1.27E-01
Emergency Generator 9-0442	5.72E-05	9.53E-03	1.54E-02
Emergency Generator 9-0448	2.75E-04	4.59E-02	2.17E-02
Emergency Generator 9-0453	1.61E-04	2.68E-02	1.08E-02
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	3.56E-04	5.93E-02	7.32E-03
Emergency Generator 9-0465	1.06E-05	1.76E-03	7.83E-03
Emergency Generator 9-0484	3.91E-05	6.52E-03	8.70E-03
Emergency Generator 9-0485	2.53E-05	4.21E-03	3.37E-02
Emergency Generator 9-0486	2.36E-05	3.93E-03	3.37E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	6.90E-05	1.15E-02	3.37E-02
Total	6.71E-03	1.04E+00	5.19E-01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: 1,3-Butadiene **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	9.56E-04	1.05E-02	4.38E-04
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	5.38E-05	2.95E-04	1.23E-05
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	9.56E-04	5.24E-03	2.18E-04
Fuel Oil Boiler 4-0545	1.48E-05	1.63E-04	6.77E-06
Fuel Oil Boiler 4-0559	3.43E-04	3.77E-03	1.57E-04
Fuel Oil Boiler 4-0560	3.43E-04	3.77E-03	1.57E-04
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	1.04E-04	1.14E-03	4.75E-05
Fuel Oil Boiler 4-0571	1.04E-04	1.14E-03	4.75E-05
Fuel Oil Boiler 4-0572	1.04E-04	1.14E-03	4.75E-05
Fuel Oil Boiler 4-0626	1.06E-05	1.16E-04	4.85E-06
Fuel Oil Boiler 4-0627	6.86E-05	7.54E-04	3.14E-05
Fuel Oil Boiler 4-0650	1.46E-05	1.61E-04	6.69E-06
Fuel Oil Boiler 4-0660	5.68E-05	6.24E-04	2.60E-05
Fuel Oil Boiler 4-0663	8.88E-05	9.76E-04	4.07E-05
Fuel Oil Boiler 4-0664	8.88E-05	9.76E-04	4.07E-05

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: 1,3-Butadiene **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0665	3.56E-05	3.91E-04	1.63E-05
Fuel Oil Boiler 4-0668	1.16E-04	1.27E-03	5.30E-05
Fuel Oil Boiler 4-0669	1.41E-04	1.55E-03	6.47E-05
Fuel Oil Boiler 4-0670	1.41E-04	1.55E-03	6.47E-05
Fuel Oil Boiler 4-0681	2.51E-05	2.76E-04	1.15E-05
Fuel Oil Boiler 4-0684	8.21E-05	9.02E-04	3.76E-05
Fuel Oil Boiler 4-0695	4.82E-05	5.30E-04	2.21E-05
Fuel Oil Boiler 4-0700	5.03E-05	5.52E-04	2.30E-05
Fuel Oil Boiler 4-0701	5.03E-05	5.52E-04	2.30E-05
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	1.10E-04	1.20E-03	5.02E-05
Fuel Oil Boiler 4-0723	5.38E-05	5.91E-04	2.46E-05
Dual Fuel Boiler 5-0306	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0311	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0312	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0313	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0316	5.83E-07	6.40E-06	2.67E-07
Dual Fuel Boiler 5-0317	5.83E-07	6.40E-06	2.67E-07
Dual Fuel Boiler 5-0329	5.83E-07	6.40E-06	2.67E-07
Dual Fuel Boiler 5-0330	5.83E-07	6.40E-06	2.67E-07
Dual Fuel Boiler 5-0331	5.83E-07	6.40E-06	2.67E-07
Dual Fuel Boiler 5-0332	5.83E-07	6.40E-06	2.67E-07
Dual Fuel Boiler 5-0333	5.83E-07	6.40E-06	2.67E-07

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: 1,3-Butadiene **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0347	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0348	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0349	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0350	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0351	0.00E+00	0.00E+00	0.00E+00
CHP Unit 5-0366	2.29E-04	0.00E+00	1.20E-03
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	7.55E-08	1.26E-05	3.02E-04
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	8.93E-07	1.49E-04	3.20E-04
Emergency Generator 9-0278	9.16E-07	1.53E-04	3.80E-04
Emergency Generator 9-0279	9.14E-07	1.52E-04	3.80E-04
Emergency Generator 9-0280	9.12E-07	1.52E-04	3.80E-04
Emergency Generator 9-0293	3.75E-07	6.26E-05	1.79E-04
Emergency Generator 9-0339	2.42E-06	4.04E-04	1.41E-04
Emergency Generator 9-0341	4.20E-06	6.99E-04	2.53E-04
Emergency Generator 9-0355	1.14E-05	1.90E-03	6.19E-04
Emergency Generator 9-0356	1.51E-06	2.52E-04	5.12E-04
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	1.06E-05	1.76E-03	6.21E-04
Emergency Generator 9-0379	1.33E-05	2.22E-03	6.21E-04
Emergency Generator 9-0380	2.02E-06	3.36E-04	6.21E-04
Emergency Generator 9-0402	7.77E-05	1.30E-02	3.10E-03
Emergency Generator 9-0442	1.40E-06	2.33E-04	3.78E-04

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: 1,3-Butadiene **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0448	6.73E-06	1.12E-03	5.30E-04
Emergency Generator 9-0453	3.93E-06	6.55E-04	2.65E-04
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	8.70E-06	1.45E-03	1.79E-04
Emergency Generator 9-0465	2.58E-07	4.31E-05	1.91E-04
Emergency Generator 9-0484	9.56E-07	1.59E-04	2.13E-04
Emergency Generator 9-0485	6.17E-07	1.03E-04	8.23E-04
Emergency Generator 9-0486	5.76E-07	9.60E-05	8.23E-04
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	1.69E-06	2.81E-04	8.23E-04
Total	4.54E-03	6.55E-02	1.55E-02

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Cadmium **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	9.69E-05	1.06E-03	4.43E-05
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	5.45E-06	2.99E-05	1.25E-06
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	2.19E-04	1.20E-03	4.99E-05
Fuel Oil Boiler 4-0545	1.50E-06	1.65E-05	6.86E-07
Fuel Oil Boiler 4-0559	3.48E-05	3.82E-04	1.59E-05
Fuel Oil Boiler 4-0560	3.48E-05	3.82E-04	1.59E-05
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	1.05E-05	1.15E-04	4.81E-06
Fuel Oil Boiler 4-0571	1.05E-05	1.15E-04	4.81E-06
Fuel Oil Boiler 4-0572	1.05E-05	1.15E-04	4.81E-06
Fuel Oil Boiler 4-0626	1.07E-06	1.18E-05	4.91E-07
Fuel Oil Boiler 4-0627	6.96E-06	7.65E-05	3.19E-06
Fuel Oil Boiler 4-0650	1.48E-06	1.63E-05	6.78E-07
Fuel Oil Boiler 4-0660	5.76E-06	6.33E-05	2.64E-06
Fuel Oil Boiler 4-0663	9.00E-06	9.90E-05	4.12E-06
Fuel Oil Boiler 4-0664	9.00E-06	9.90E-05	4.12E-06
Fuel Oil Boiler 4-0665	3.60E-06	3.96E-05	1.65E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Cadmium **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	1.17E-05	1.29E-04	5.37E-06
Fuel Oil Boiler 4-0669	1.43E-05	1.57E-04	6.56E-06
Fuel Oil Boiler 4-0670	1.43E-05	1.57E-04	6.56E-06
Fuel Oil Boiler 4-0681	2.55E-06	2.80E-05	1.17E-06
Fuel Oil Boiler 4-0684	8.32E-06	9.14E-05	3.81E-06
Fuel Oil Boiler 4-0695	4.89E-06	5.37E-05	2.24E-06
Fuel Oil Boiler 4-0700	5.09E-06	5.60E-05	2.33E-06
Fuel Oil Boiler 4-0701	5.09E-06	5.60E-05	2.33E-06
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	1.11E-05	1.22E-04	5.08E-06
Fuel Oil Boiler 4-0723	5.45E-06	5.99E-05	2.50E-06
Dual Fuel Boiler 5-0306	6.63E-05	3.63E-04	1.51E-05
Dual Fuel Boiler 5-0311	1.49E-06	1.64E-05	6.82E-07
Dual Fuel Boiler 5-0312	1.49E-06	1.64E-05	6.82E-07
Dual Fuel Boiler 5-0313	1.49E-06	1.64E-05	6.82E-07
Dual Fuel Boiler 5-0316	1.05E-06	1.15E-05	4.79E-07
Dual Fuel Boiler 5-0317	1.05E-06	1.15E-05	4.79E-07
Dual Fuel Boiler 5-0329	1.05E-06	1.15E-05	4.79E-07
Dual Fuel Boiler 5-0330	1.05E-06	1.15E-05	4.79E-07
Dual Fuel Boiler 5-0331	1.05E-06	1.15E-05	4.79E-07
Dual Fuel Boiler 5-0332	1.05E-06	1.15E-05	4.79E-07
Dual Fuel Boiler 5-0333	1.05E-06	1.15E-05	4.79E-07
Dual Fuel Boiler 5-0347	4.76E-06	2.61E-05	1.09E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Cadmium **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0348	4.76E-06	2.61E-05	1.09E-06
Dual Fuel Boiler 5-0349	4.76E-06	2.61E-05	1.09E-06
Dual Fuel Boiler 5-0350	4.76E-06	2.61E-05	1.09E-06
Dual Fuel Boiler 5-0351	4.76E-06	2.61E-05	1.09E-06
CHP Unit 5-0366	6.81E-07	0.00E+00	3.41E-04
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	2.90E-06	4.83E-04	1.16E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	3.43E-05	5.71E-03	1.23E-02
Emergency Generator 9-0278	3.51E-05	5.86E-03	1.46E-02
Emergency Generator 9-0279	3.51E-05	5.84E-03	1.46E-02
Emergency Generator 9-0280	3.50E-05	5.83E-03	1.46E-02
Emergency Generator 9-0293	1.44E-05	2.40E-03	6.86E-03
Emergency Generator 9-0339	9.29E-05	1.55E-02	5.40E-03
Emergency Generator 9-0341	1.61E-04	2.68E-02	9.72E-03
Emergency Generator 9-0355	4.37E-04	7.29E-02	2.38E-02
Emergency Generator 9-0356	5.79E-05	9.65E-03	1.96E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	4.05E-04	6.75E-02	2.38E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Cadmium **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	5.11E-04	8.52E-02	2.38E-02
Emergency Generator 9-0380	7.74E-05	1.29E-02	2.38E-02
Emergency Generator 9-0402	2.98E-03	4.97E-01	1.19E-01
Emergency Generator 9-0442	5.36E-05	8.93E-03	1.45E-02
Emergency Generator 9-0448	2.58E-04	4.30E-02	2.03E-02
Emergency Generator 9-0453	1.51E-04	2.51E-02	1.02E-02
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	3.34E-04	5.56E-02	6.86E-03
Emergency Generator 9-0465	9.91E-06	1.65E-03	7.34E-03
Emergency Generator 9-0484	3.67E-05	6.12E-03	8.15E-03
Emergency Generator 9-0485	2.37E-05	3.95E-03	3.16E-02
Emergency Generator 9-0486	2.21E-05	3.68E-03	3.16E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	6.47E-05	1.08E-02	3.16E-02
Total	6.48E-03	9.78E-01	4.86E-01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Copper **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	2.65E-04	2.91E-03	1.21E-04
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	1.49E-05	8.17E-05	3.40E-06
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	2.65E-04	1.45E-03	6.04E-05
Fuel Oil Boiler 4-0545	4.10E-06	4.50E-05	1.88E-06
Fuel Oil Boiler 4-0559	9.51E-05	1.04E-03	4.35E-05
Fuel Oil Boiler 4-0560	9.51E-05	1.04E-03	4.35E-05
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	2.87E-05	3.16E-04	1.31E-05
Fuel Oil Boiler 4-0571	2.87E-05	3.16E-04	1.31E-05
Fuel Oil Boiler 4-0572	2.87E-05	3.16E-04	1.31E-05
Fuel Oil Boiler 4-0626	2.93E-06	3.22E-05	1.34E-06
Fuel Oil Boiler 4-0627	1.90E-05	2.09E-04	8.71E-06
Fuel Oil Boiler 4-0650	4.05E-06	4.45E-05	1.85E-06
Fuel Oil Boiler 4-0660	1.57E-05	1.73E-04	7.21E-06
Fuel Oil Boiler 4-0663	2.46E-05	2.70E-04	1.13E-05
Fuel Oil Boiler 4-0664	2.46E-05	2.70E-04	1.13E-05
Fuel Oil Boiler 4-0665	9.85E-06	1.08E-04	4.51E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Copper **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	3.21E-05	3.52E-04	1.47E-05
Fuel Oil Boiler 4-0669	3.91E-05	4.30E-04	1.79E-05
Fuel Oil Boiler 4-0670	3.91E-05	4.30E-04	1.79E-05
Fuel Oil Boiler 4-0681	6.97E-06	7.66E-05	3.19E-06
Fuel Oil Boiler 4-0684	2.27E-05	2.50E-04	1.04E-05
Fuel Oil Boiler 4-0695	1.34E-05	1.47E-04	6.12E-06
Fuel Oil Boiler 4-0700	1.39E-05	1.53E-04	6.38E-06
Fuel Oil Boiler 4-0701	1.39E-05	1.53E-04	6.38E-06
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	3.04E-05	3.34E-04	1.39E-05
Fuel Oil Boiler 4-0723	1.49E-05	1.64E-04	6.82E-06
Dual Fuel Boiler 5-0306	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0311	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0312	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0313	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0316	1.61E-07	1.77E-06	7.39E-08
Dual Fuel Boiler 5-0317	1.61E-07	1.77E-06	7.39E-08
Dual Fuel Boiler 5-0329	1.61E-07	1.77E-06	7.39E-08
Dual Fuel Boiler 5-0330	1.61E-07	1.77E-06	7.39E-08
Dual Fuel Boiler 5-0331	1.61E-07	1.77E-06	7.39E-08
Dual Fuel Boiler 5-0332	1.61E-07	1.77E-06	7.39E-08
Dual Fuel Boiler 5-0333	1.61E-07	1.77E-06	7.39E-08
Dual Fuel Boiler 5-0347	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Copper **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0348	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0349	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0350	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0351	0.00E+00	0.00E+00	0.00E+00
CHP Unit 5-0366	4.24E-06	0.00E+00	2.12E-03
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	7.92E-06	1.32E-03	3.17E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	9.36E-05	1.56E-02	3.35E-02
Emergency Generator 9-0278	9.60E-05	1.60E-02	3.99E-02
Emergency Generator 9-0279	9.58E-05	1.60E-02	3.99E-02
Emergency Generator 9-0280	9.56E-05	1.59E-02	3.99E-02
Emergency Generator 9-0293	3.94E-05	6.56E-03	1.87E-02
Emergency Generator 9-0339	2.54E-04	4.23E-02	1.48E-02
Emergency Generator 9-0341	4.40E-04	7.33E-02	2.66E-02
Emergency Generator 9-0355	1.19E-03	1.99E-01	6.49E-02
Emergency Generator 9-0356	1.58E-04	2.64E-02	5.37E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	1.11E-03	1.85E-01	6.51E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Copper **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	1.40E-03	2.33E-01	6.51E-02
Emergency Generator 9-0380	2.12E-04	3.53E-02	6.51E-02
Emergency Generator 9-0402	8.15E-03	1.36E+00	3.25E-01
Emergency Generator 9-0442	1.46E-04	2.44E-02	3.96E-02
Emergency Generator 9-0448	7.05E-04	1.18E-01	5.55E-02
Emergency Generator 9-0453	4.12E-04	6.87E-02	2.77E-02
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	9.12E-04	1.52E-01	1.87E-02
Emergency Generator 9-0465	2.71E-05	4.52E-03	2.01E-02
Emergency Generator 9-0484	1.00E-04	1.67E-02	2.23E-02
Emergency Generator 9-0485	6.47E-05	1.08E-02	8.63E-02
Emergency Generator 9-0486	6.04E-05	1.01E-02	8.63E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	1.77E-04	2.95E-02	8.63E-02
Total	1.71E-02	2.67E+00	1.33E+00

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Formaldehyde **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	2.13E-03	2.34E-02	9.76E-04
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	1.20E-04	6.57E-04	2.74E-05
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	1.04E-02	5.71E-02	2.38E-03
Fuel Oil Boiler 4-0545	3.30E-05	3.62E-04	1.51E-05
Fuel Oil Boiler 4-0559	7.65E-04	8.41E-03	3.50E-04
Fuel Oil Boiler 4-0560	7.65E-04	8.41E-03	3.50E-04
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	2.31E-04	2.54E-03	1.06E-04
Fuel Oil Boiler 4-0571	2.31E-04	2.54E-03	1.06E-04
Fuel Oil Boiler 4-0572	2.31E-04	2.54E-03	1.06E-04
Fuel Oil Boiler 4-0626	2.36E-05	2.59E-04	1.08E-05
Fuel Oil Boiler 4-0627	1.53E-04	1.68E-03	7.01E-05
Fuel Oil Boiler 4-0650	3.26E-05	3.58E-04	1.49E-05
Fuel Oil Boiler 4-0660	1.27E-04	1.39E-03	5.80E-05
Fuel Oil Boiler 4-0663	1.98E-04	2.18E-03	9.07E-05
Fuel Oil Boiler 4-0664	1.98E-04	2.18E-03	9.07E-05
Fuel Oil Boiler 4-0665	7.93E-05	8.71E-04	3.63E-05

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Formaldehyde **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	2.58E-04	2.84E-03	1.18E-04
Fuel Oil Boiler 4-0669	3.15E-04	3.46E-03	1.44E-04
Fuel Oil Boiler 4-0670	3.15E-04	3.46E-03	1.44E-04
Fuel Oil Boiler 4-0681	5.61E-05	6.16E-04	2.57E-05
Fuel Oil Boiler 4-0684	1.83E-04	2.01E-03	8.38E-05
Fuel Oil Boiler 4-0695	1.08E-04	1.18E-03	4.92E-05
Fuel Oil Boiler 4-0700	1.12E-04	1.23E-03	5.13E-05
Fuel Oil Boiler 4-0701	1.12E-04	1.23E-03	5.13E-05
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	2.44E-04	2.68E-03	1.12E-04
Fuel Oil Boiler 4-0723	1.20E-04	1.32E-03	5.49E-05
Dual Fuel Boiler 5-0306	4.52E-03	2.48E-02	1.03E-03
Dual Fuel Boiler 5-0311	1.02E-04	1.12E-03	4.65E-05
Dual Fuel Boiler 5-0312	1.02E-04	1.12E-03	4.65E-05
Dual Fuel Boiler 5-0313	1.02E-04	1.12E-03	4.65E-05
Dual Fuel Boiler 5-0316	6.87E-05	7.54E-04	3.14E-05
Dual Fuel Boiler 5-0317	6.87E-05	7.54E-04	3.14E-05
Dual Fuel Boiler 5-0329	6.87E-05	7.54E-04	3.14E-05
Dual Fuel Boiler 5-0330	6.87E-05	7.54E-04	3.14E-05
Dual Fuel Boiler 5-0331	6.87E-05	7.54E-04	3.14E-05
Dual Fuel Boiler 5-0332	6.87E-05	7.54E-04	3.14E-05
Dual Fuel Boiler 5-0333	6.87E-05	7.54E-04	3.14E-05
Dual Fuel Boiler 5-0347	3.24E-04	1.78E-03	7.41E-05

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Formaldehyde **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0348	3.24E-04	1.78E-03	7.41E-05
Dual Fuel Boiler 5-0349	3.24E-04	1.78E-03	7.41E-05
Dual Fuel Boiler 5-0350	3.24E-04	1.78E-03	7.41E-05
Dual Fuel Boiler 5-0351	3.24E-04	1.78E-03	7.41E-05
CHP Unit 5-0366	3.75E-01	3.17E+00	1.32E-01
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	2.28E-06	3.80E-04	9.12E-03
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	2.70E-05	4.49E-03	9.64E-03
Emergency Generator 9-0278	2.76E-05	4.61E-03	1.15E-02
Emergency Generator 9-0279	2.76E-05	4.60E-03	1.15E-02
Emergency Generator 9-0280	2.75E-05	4.59E-03	1.15E-02
Emergency Generator 9-0293	1.13E-05	1.89E-03	5.39E-03
Emergency Generator 9-0339	7.31E-05	1.22E-02	4.25E-03
Emergency Generator 9-0341	1.27E-04	2.11E-02	7.65E-03
Emergency Generator 9-0355	3.44E-04	5.73E-02	1.87E-02
Emergency Generator 9-0356	4.56E-05	7.59E-03	1.54E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	3.19E-04	5.31E-02	1.87E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Formaldehyde **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	4.02E-04	6.70E-02	1.87E-02
Emergency Generator 9-0380	6.09E-05	1.02E-02	1.87E-02
Emergency Generator 9-0402	2.35E-03	3.91E-01	9.36E-02
Emergency Generator 9-0442	4.22E-05	7.03E-03	1.14E-02
Emergency Generator 9-0448	2.03E-04	3.38E-02	1.60E-02
Emergency Generator 9-0453	1.19E-04	1.98E-02	7.99E-03
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	2.62E-04	4.37E-02	5.39E-03
Emergency Generator 9-0465	7.80E-06	1.30E-03	5.78E-03
Emergency Generator 9-0484	2.89E-05	4.81E-03	6.41E-03
Emergency Generator 9-0485	1.86E-05	3.10E-03	2.48E-02
Emergency Generator 9-0486	1.74E-05	2.90E-03	2.48E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	5.09E-05	8.48E-03	2.48E-02
Total	4.04E-01	4.11E+00	5.21E-01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Hexamethylene Diisocyanate **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0545	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0559	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0560	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0571	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0572	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0626	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0627	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0650	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0660	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0663	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0664	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Hexamethylene Diisocyanate **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0665	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0668	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0669	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0670	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0681	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0684	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0695	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0700	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0701	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0723	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0306	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0311	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0312	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0313	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0316	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0317	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0329	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0330	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0331	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0332	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0333	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Hexamethylene Diisocyanate **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0347	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0348	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0349	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0350	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0351	0.00E+00	0.00E+00	0.00E+00
CHP Unit 5-0366	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0497	1.81E-03	1.51E-07	9.03E-01
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0278	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0279	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0280	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0293	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0339	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0341	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0355	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0356	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0379	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0380	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0402	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0442	0.00E+00	0.00E+00	0.00E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Hexamethylene Diisocyanate **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0448	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0453	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0465	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0484	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0485	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0486	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	0.00E+00	0.00E+00	0.00E+00
Total	1.81E-03	1.51E-07	9.03E-01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Hydrochloric Acid **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	1.20E-02	1.32E-01	5.51E-03
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	6.77E-04	3.71E-03	1.55E-04
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	1.20E-02	6.59E-02	2.75E-03
Fuel Oil Boiler 4-0545	1.86E-04	2.05E-03	8.52E-05
Fuel Oil Boiler 4-0559	4.32E-03	4.75E-02	1.98E-03
Fuel Oil Boiler 4-0560	4.32E-03	4.75E-02	1.98E-03
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	1.30E-03	1.43E-02	5.97E-04
Fuel Oil Boiler 4-0571	1.30E-03	1.43E-02	5.97E-04
Fuel Oil Boiler 4-0572	1.30E-03	1.43E-02	5.97E-04
Fuel Oil Boiler 4-0626	1.33E-04	1.46E-03	6.10E-05
Fuel Oil Boiler 4-0627	8.64E-04	9.50E-03	3.96E-04
Fuel Oil Boiler 4-0650	1.84E-04	2.02E-03	8.43E-05
Fuel Oil Boiler 4-0660	7.15E-04	7.86E-03	3.28E-04
Fuel Oil Boiler 4-0663	1.12E-03	1.23E-02	5.12E-04
Fuel Oil Boiler 4-0664	1.12E-03	1.23E-02	5.12E-04

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Hydrochloric Acid **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0665	4.48E-04	4.92E-03	2.05E-04
Fuel Oil Boiler 4-0668	1.46E-03	1.60E-02	6.67E-04
Fuel Oil Boiler 4-0669	1.78E-03	1.95E-02	8.14E-04
Fuel Oil Boiler 4-0670	1.78E-03	1.95E-02	8.14E-04
Fuel Oil Boiler 4-0681	3.17E-04	3.48E-03	1.45E-04
Fuel Oil Boiler 4-0684	1.03E-03	1.14E-02	4.73E-04
Fuel Oil Boiler 4-0695	6.07E-04	6.67E-03	2.78E-04
Fuel Oil Boiler 4-0700	6.33E-04	6.95E-03	2.90E-04
Fuel Oil Boiler 4-0701	6.33E-04	6.95E-03	2.90E-04
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	1.58E-08	1.74E-07	7.25E-09
Fuel Oil Boiler 4-0723	6.77E-04	7.44E-03	3.10E-04
Dual Fuel Boiler 5-0306	3.11E-08	1.71E-07	7.11E-09
Dual Fuel Boiler 5-0311	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0312	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0313	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0316	7.34E-06	8.06E-05	3.36E-06
Dual Fuel Boiler 5-0317	7.34E-06	8.06E-05	3.36E-06
Dual Fuel Boiler 5-0329	7.34E-06	8.06E-05	3.36E-06
Dual Fuel Boiler 5-0330	7.34E-06	8.06E-05	3.36E-06
Dual Fuel Boiler 5-0331	7.34E-06	8.06E-05	3.36E-06
Dual Fuel Boiler 5-0332	7.34E-06	8.06E-05	3.36E-06
Dual Fuel Boiler 5-0333	7.34E-06	8.06E-05	3.36E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Hydrochloric Acid **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0347	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0348	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0349	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0350	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 5-0351	0.00E+00	0.00E+00	0.00E+00
CHP Unit 5-0366	1.93E-04	0.00E+00	9.63E-02
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	3.60E-04	6.00E-02	1.44E+00
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	4.26E-03	7.09E-01	1.52E+00
Emergency Generator 9-0278	4.36E-03	7.27E-01	1.81E+00
Emergency Generator 9-0279	4.36E-03	7.26E-01	1.81E+00
Emergency Generator 9-0280	4.35E-03	7.24E-01	1.81E+00
Emergency Generator 9-0293	1.79E-03	2.98E-01	8.52E-01
Emergency Generator 9-0339	1.15E-02	1.92E+00	6.71E-01
Emergency Generator 9-0341	2.00E-02	3.33E+00	1.21E+00
Emergency Generator 9-0355	5.43E-02	9.05E+00	2.95E+00
Emergency Generator 9-0356	7.19E-03	1.20E+00	2.44E+00
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	5.03E-02	8.38E+00	2.96E+00
Emergency Generator 9-0379	6.35E-02	1.06E+01	2.96E+00
Emergency Generator 9-0380	9.62E-03	1.60E+00	2.96E+00
Emergency Generator 9-0402	3.70E-01	6.17E+01	1.48E+01
Emergency Generator 9-0442	6.66E-03	1.11E+00	1.80E+00

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Hydrochloric Acid **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0448	3.20E-02	5.34E+00	2.52E+00
Emergency Generator 9-0453	1.87E-02	3.12E+00	1.26E+00
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	4.14E-02	6.91E+00	8.52E-01
Emergency Generator 9-0465	1.23E-03	2.05E-01	9.12E-01
Emergency Generator 9-0484	4.56E-03	7.60E-01	1.01E+00
Emergency Generator 9-0485	2.94E-03	4.90E-01	3.92E+00
Emergency Generator 9-0486	2.74E-03	4.57E-01	3.92E+00
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	8.04E-03	1.34E+00	3.92E+00
Total	7.76E-01	1.21E+02	6.04E+01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Lead **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	5.36E-04	5.89E-03	2.45E-04
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	3.02E-05	1.65E-04	6.89E-06
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	5.91E-04	3.24E-03	1.35E-04
Fuel Oil Boiler 4-0545	8.29E-06	9.11E-05	3.80E-06
Fuel Oil Boiler 4-0559	1.92E-04	2.12E-03	8.81E-05
Fuel Oil Boiler 4-0560	1.92E-04	2.12E-03	8.81E-05
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	5.81E-05	6.39E-04	2.66E-05
Fuel Oil Boiler 4-0571	5.81E-05	6.39E-04	2.66E-05
Fuel Oil Boiler 4-0572	5.81E-05	6.39E-04	2.66E-05
Fuel Oil Boiler 4-0626	5.93E-06	6.52E-05	2.72E-06
Fuel Oil Boiler 4-0627	3.85E-05	4.23E-04	1.76E-05
Fuel Oil Boiler 4-0650	8.20E-06	9.01E-05	3.75E-06
Fuel Oil Boiler 4-0660	3.19E-05	3.50E-04	1.46E-05
Fuel Oil Boiler 4-0663	4.98E-05	5.48E-04	2.28E-05
Fuel Oil Boiler 4-0664	4.98E-05	5.48E-04	2.28E-05
Fuel Oil Boiler 4-0665	1.99E-05	2.19E-04	9.13E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Lead **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	6.49E-05	7.13E-04	2.97E-05
Fuel Oil Boiler 4-0669	7.92E-05	8.71E-04	3.63E-05
Fuel Oil Boiler 4-0670	7.92E-05	8.71E-04	3.63E-05
Fuel Oil Boiler 4-0681	1.41E-05	1.55E-04	6.46E-06
Fuel Oil Boiler 4-0684	4.60E-05	5.06E-04	2.11E-05
Fuel Oil Boiler 4-0695	2.71E-05	2.97E-04	1.24E-05
Fuel Oil Boiler 4-0700	2.82E-05	3.10E-04	1.29E-05
Fuel Oil Boiler 4-0701	2.82E-05	3.10E-04	1.29E-05
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	6.14E-05	6.75E-04	2.81E-05
Fuel Oil Boiler 4-0723	3.02E-05	3.32E-04	1.38E-05
Dual Fuel Boiler 5-0306	3.01E-05	1.65E-04	6.88E-06
Dual Fuel Boiler 5-0311	6.77E-07	7.44E-06	3.10E-07
Dual Fuel Boiler 5-0312	6.77E-07	7.44E-06	3.10E-07
Dual Fuel Boiler 5-0313	6.77E-07	7.44E-06	3.10E-07
Dual Fuel Boiler 5-0316	7.76E-07	8.53E-06	3.55E-07
Dual Fuel Boiler 5-0317	7.76E-07	8.53E-06	3.55E-07
Dual Fuel Boiler 5-0329	7.76E-07	8.53E-06	3.55E-07
Dual Fuel Boiler 5-0330	7.76E-07	8.53E-06	3.55E-07
Dual Fuel Boiler 5-0331	7.76E-07	8.53E-06	3.55E-07
Dual Fuel Boiler 5-0332	7.76E-07	8.53E-06	3.55E-07
Dual Fuel Boiler 5-0333	7.76E-07	8.53E-06	3.55E-07

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Lead **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0347	2.16E-06	1.18E-05	4.94E-07
Dual Fuel Boiler 5-0348	2.16E-06	1.18E-05	4.94E-07
Dual Fuel Boiler 5-0349	2.16E-06	1.18E-05	4.94E-07
Dual Fuel Boiler 5-0350	2.16E-06	1.18E-05	4.94E-07
Dual Fuel Boiler 5-0351	2.16E-06	1.18E-05	4.94E-07
CHP Unit 5-0366	1.80E-03	3.67E-02	1.53E-03
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	1.60E-05	2.67E-03	6.41E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	1.90E-04	3.16E-02	6.78E-02
Emergency Generator 9-0278	1.94E-04	3.24E-02	8.07E-02
Emergency Generator 9-0279	1.94E-04	3.23E-02	8.07E-02
Emergency Generator 9-0280	1.94E-04	3.23E-02	8.07E-02
Emergency Generator 9-0293	7.97E-05	1.33E-02	3.79E-02
Emergency Generator 9-0339	5.14E-04	8.57E-02	2.99E-02
Emergency Generator 9-0341	8.91E-04	1.48E-01	5.38E-02
Emergency Generator 9-0355	2.42E-03	4.03E-01	1.31E-01
Emergency Generator 9-0356	3.20E-04	5.34E-02	1.09E-01
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	2.24E-03	3.74E-01	1.32E-01

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Lead **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	2.83E-03	4.71E-01	1.32E-01
Emergency Generator 9-0380	4.28E-04	7.14E-02	1.32E-01
Emergency Generator 9-0402	1.65E-02	2.75E+00	6.58E-01
Emergency Generator 9-0442	2.97E-04	4.94E-02	8.01E-02
Emergency Generator 9-0448	1.43E-03	2.38E-01	1.12E-01
Emergency Generator 9-0453	8.34E-04	1.39E-01	5.62E-02
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	1.85E-03	3.08E-01	3.79E-02
Emergency Generator 9-0465	5.49E-05	9.14E-03	4.06E-02
Emergency Generator 9-0484	2.03E-04	3.38E-02	4.51E-02
Emergency Generator 9-0485	1.31E-04	2.18E-02	1.75E-01
Emergency Generator 9-0486	1.22E-04	2.04E-02	1.75E-01
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	3.58E-04	5.97E-02	1.75E-01
Total	3.65E-02	5.44E+00	2.69E+00

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Manganese **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	2.00E-04	2.20E-03	9.16E-05
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	1.13E-05	6.18E-05	2.57E-06
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	2.42E-04	1.33E-03	5.53E-05
Fuel Oil Boiler 4-0545	3.10E-06	3.40E-05	1.42E-06
Fuel Oil Boiler 4-0559	7.19E-05	7.90E-04	3.29E-05
Fuel Oil Boiler 4-0560	7.19E-05	7.90E-04	3.29E-05
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	2.17E-05	2.39E-04	9.94E-06
Fuel Oil Boiler 4-0571	2.17E-05	2.39E-04	9.94E-06
Fuel Oil Boiler 4-0572	2.17E-05	2.39E-04	9.94E-06
Fuel Oil Boiler 4-0626	2.22E-06	2.44E-05	1.01E-06
Fuel Oil Boiler 4-0627	1.44E-05	1.58E-04	6.58E-06
Fuel Oil Boiler 4-0650	3.06E-06	3.36E-05	1.40E-06
Fuel Oil Boiler 4-0660	1.19E-05	1.31E-04	5.45E-06
Fuel Oil Boiler 4-0663	1.86E-05	2.04E-04	8.52E-06
Fuel Oil Boiler 4-0664	1.86E-05	2.04E-04	8.52E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Manganese **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0665	7.45E-06	8.19E-05	3.41E-06
Fuel Oil Boiler 4-0668	2.42E-05	2.66E-04	1.11E-05
Fuel Oil Boiler 4-0669	2.96E-05	3.25E-04	1.36E-05
Fuel Oil Boiler 4-0670	2.96E-05	3.25E-04	1.36E-05
Fuel Oil Boiler 4-0681	5.27E-06	5.79E-05	2.41E-06
Fuel Oil Boiler 4-0684	1.72E-05	1.89E-04	7.87E-06
Fuel Oil Boiler 4-0695	1.01E-05	1.11E-04	4.63E-06
Fuel Oil Boiler 4-0700	1.05E-05	1.16E-04	4.82E-06
Fuel Oil Boiler 4-0701	1.05E-05	1.16E-04	4.82E-06
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	2.29E-05	2.52E-04	1.05E-05
Fuel Oil Boiler 4-0723	1.13E-05	1.24E-04	5.16E-06
Dual Fuel Boiler 5-0306	2.29E-05	1.26E-04	5.23E-06
Dual Fuel Boiler 5-0311	5.14E-07	5.65E-06	2.35E-07
Dual Fuel Boiler 5-0312	5.14E-07	5.65E-06	2.35E-07
Dual Fuel Boiler 5-0313	5.14E-07	5.65E-06	2.35E-07
Dual Fuel Boiler 5-0316	4.63E-07	5.09E-06	2.12E-07
Dual Fuel Boiler 5-0317	4.63E-07	5.09E-06	2.12E-07
Dual Fuel Boiler 5-0329	4.63E-07	5.09E-06	2.12E-07
Dual Fuel Boiler 5-0330	4.63E-07	5.09E-06	2.12E-07
Dual Fuel Boiler 5-0331	4.63E-07	5.09E-06	2.12E-07
Dual Fuel Boiler 5-0332	4.63E-07	5.09E-06	2.12E-07
Dual Fuel Boiler 5-0333	4.63E-07	5.09E-06	2.12E-07

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Manganese **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0347	1.64E-06	9.01E-06	3.75E-07
Dual Fuel Boiler 5-0348	1.64E-06	9.01E-06	3.75E-07
Dual Fuel Boiler 5-0349	1.64E-06	9.01E-06	3.75E-07
Dual Fuel Boiler 5-0350	1.64E-06	9.01E-06	3.75E-07
Dual Fuel Boiler 5-0351	1.64E-06	9.01E-06	3.75E-07
CHP Unit 5-0366	1.12E-04	0.00E+00	5.61E-02
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	5.99E-06	9.98E-04	2.39E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	7.08E-05	1.18E-02	2.53E-02
Emergency Generator 9-0278	7.26E-05	1.21E-02	3.01E-02
Emergency Generator 9-0279	7.25E-05	1.21E-02	3.01E-02
Emergency Generator 9-0280	7.23E-05	1.21E-02	3.01E-02
Emergency Generator 9-0293	2.98E-05	4.96E-03	1.42E-02
Emergency Generator 9-0339	1.92E-04	3.20E-02	1.12E-02
Emergency Generator 9-0341	3.33E-04	5.54E-02	2.01E-02
Emergency Generator 9-0355	9.04E-04	1.51E-01	4.91E-02
Emergency Generator 9-0356	1.20E-04	2.00E-02	4.06E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	8.37E-04	1.40E-01	4.92E-02
Emergency Generator 9-0379	1.06E-03	1.76E-01	4.92E-02
Emergency Generator 9-0380	1.60E-04	2.67E-02	4.92E-02
Emergency Generator 9-0402	6.16E-03	1.03E+00	2.46E-01
Emergency Generator 9-0442	1.11E-04	1.85E-02	2.99E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Manganese **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0448	5.33E-04	8.89E-02	4.20E-02
Emergency Generator 9-0453	3.12E-04	5.19E-02	2.10E-02
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	6.90E-04	1.15E-01	1.42E-02
Emergency Generator 9-0465	2.05E-05	3.41E-03	1.52E-02
Emergency Generator 9-0484	7.58E-05	1.26E-02	1.69E-02
Emergency Generator 9-0485	4.89E-05	8.16E-03	6.52E-02
Emergency Generator 9-0486	4.57E-05	7.61E-03	6.52E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	1.34E-04	2.23E-02	6.52E-02
Total	1.31E-02	2.02E+00	1.06E+00

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Mercury **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	1.29E-04	1.42E-03	5.91E-05
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	7.27E-06	3.98E-05	1.66E-06
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	1.58E-04	8.65E-04	3.61E-05
Fuel Oil Boiler 4-0545	2.00E-06	2.20E-05	9.15E-07
Fuel Oil Boiler 4-0559	4.64E-05	5.10E-04	2.12E-05
Fuel Oil Boiler 4-0560	4.64E-05	5.10E-04	2.12E-05
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	1.40E-05	1.54E-04	6.41E-06
Fuel Oil Boiler 4-0571	1.40E-05	1.54E-04	6.41E-06
Fuel Oil Boiler 4-0572	1.40E-05	1.54E-04	6.41E-06
Fuel Oil Boiler 4-0626	1.43E-06	1.57E-05	6.55E-07
Fuel Oil Boiler 4-0627	9.28E-06	1.02E-04	4.25E-06
Fuel Oil Boiler 4-0650	1.98E-06	2.17E-05	9.05E-07
Fuel Oil Boiler 4-0660	7.68E-06	8.44E-05	3.52E-06
Fuel Oil Boiler 4-0663	1.20E-05	1.32E-04	5.50E-06
Fuel Oil Boiler 4-0664	1.20E-05	1.32E-04	5.50E-06
Fuel Oil Boiler 4-0665	4.81E-06	5.28E-05	2.20E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Mercury **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	1.56E-05	1.72E-04	7.16E-06
Fuel Oil Boiler 4-0669	1.91E-05	2.10E-04	8.74E-06
Fuel Oil Boiler 4-0670	1.91E-05	2.10E-04	8.74E-06
Fuel Oil Boiler 4-0681	3.40E-06	3.73E-05	1.56E-06
Fuel Oil Boiler 4-0684	1.11E-05	1.22E-04	5.08E-06
Fuel Oil Boiler 4-0695	6.52E-06	7.16E-05	2.98E-06
Fuel Oil Boiler 4-0700	6.79E-06	7.46E-05	3.11E-06
Fuel Oil Boiler 4-0701	6.79E-06	7.46E-05	3.11E-06
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	1.48E-05	1.63E-04	6.78E-06
Fuel Oil Boiler 4-0723	7.27E-06	7.99E-05	3.33E-06
Dual Fuel Boiler 5-0306	1.57E-05	8.59E-05	3.58E-06
Dual Fuel Boiler 5-0311	3.52E-07	3.87E-06	1.61E-07
Dual Fuel Boiler 5-0312	3.52E-07	3.87E-06	1.61E-07
Dual Fuel Boiler 5-0313	3.52E-07	3.87E-06	1.61E-07
Dual Fuel Boiler 5-0316	3.12E-07	3.43E-06	1.43E-07
Dual Fuel Boiler 5-0317	3.12E-07	3.43E-06	1.43E-07
Dual Fuel Boiler 5-0329	3.12E-07	3.43E-06	1.43E-07
Dual Fuel Boiler 5-0330	3.12E-07	3.43E-06	1.43E-07
Dual Fuel Boiler 5-0331	3.12E-07	3.43E-06	1.43E-07
Dual Fuel Boiler 5-0332	3.12E-07	3.43E-06	1.43E-07
Dual Fuel Boiler 5-0333	3.12E-07	3.43E-06	1.43E-07
Dual Fuel Boiler 5-0347	1.12E-06	6.16E-06	2.57E-07

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Mercury **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0348	1.12E-06	6.16E-06	2.57E-07
Dual Fuel Boiler 5-0349	1.12E-06	6.16E-06	2.57E-07
Dual Fuel Boiler 5-0350	1.12E-06	6.16E-06	2.57E-07
Dual Fuel Boiler 5-0351	1.12E-06	6.16E-06	2.57E-07
CHP Unit 5-0366	1.70E-07	0.00E+00	8.52E-05
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	3.86E-06	6.44E-04	1.55E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	4.57E-05	7.61E-03	1.63E-02
Emergency Generator 9-0278	4.69E-05	7.81E-03	1.94E-02
Emergency Generator 9-0279	4.68E-05	7.79E-03	1.94E-02
Emergency Generator 9-0280	4.67E-05	7.78E-03	1.94E-02
Emergency Generator 9-0293	1.92E-05	3.20E-03	9.14E-03
Emergency Generator 9-0339	1.24E-04	2.06E-02	7.20E-03
Emergency Generator 9-0341	2.15E-04	3.58E-02	1.30E-02
Emergency Generator 9-0355	5.83E-04	9.72E-02	3.17E-02
Emergency Generator 9-0356	7.72E-05	1.29E-02	2.62E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	5.40E-04	9.00E-02	3.18E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Mercury **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	6.81E-04	1.14E-01	3.18E-02
Emergency Generator 9-0380	1.03E-04	1.72E-02	3.18E-02
Emergency Generator 9-0402	3.97E-03	6.62E-01	1.59E-01
Emergency Generator 9-0442	7.14E-05	1.19E-02	1.93E-02
Emergency Generator 9-0448	3.44E-04	5.73E-02	2.71E-02
Emergency Generator 9-0453	2.01E-04	3.35E-02	1.35E-02
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	4.45E-04	7.42E-02	9.14E-03
Emergency Generator 9-0465	1.32E-05	2.20E-03	9.79E-03
Emergency Generator 9-0484	4.89E-05	8.15E-03	1.09E-02
Emergency Generator 9-0485	3.16E-05	5.26E-03	4.21E-02
Emergency Generator 9-0486	2.95E-05	4.91E-03	4.21E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	8.63E-05	1.44E-02	4.21E-02
Total	8.39E-03	1.30E+00	6.48E-01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Nickel **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	2.52E-04	2.77E-03	1.15E-04
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	1.42E-05	7.77E-05	3.24E-06
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	4.84E-04	2.65E-03	1.11E-04
Fuel Oil Boiler 4-0545	3.90E-06	4.28E-05	1.78E-06
Fuel Oil Boiler 4-0559	9.05E-05	9.94E-04	4.14E-05
Fuel Oil Boiler 4-0560	9.05E-05	9.94E-04	4.14E-05
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	2.73E-05	3.00E-04	1.25E-05
Fuel Oil Boiler 4-0571	2.73E-05	3.00E-04	1.25E-05
Fuel Oil Boiler 4-0572	2.73E-05	3.00E-04	1.25E-05
Fuel Oil Boiler 4-0626	2.79E-06	3.06E-05	1.28E-06
Fuel Oil Boiler 4-0627	1.81E-05	1.99E-04	8.28E-06
Fuel Oil Boiler 4-0650	3.85E-06	4.23E-05	1.76E-06
Fuel Oil Boiler 4-0660	1.50E-05	1.65E-04	6.86E-06
Fuel Oil Boiler 4-0663	2.34E-05	2.57E-04	1.07E-05
Fuel Oil Boiler 4-0664	2.34E-05	2.57E-04	1.07E-05
Fuel Oil Boiler 4-0665	9.37E-06	1.03E-04	4.29E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Nickel **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	3.05E-05	3.35E-04	1.40E-05
Fuel Oil Boiler 4-0669	3.72E-05	4.09E-04	1.70E-05
Fuel Oil Boiler 4-0670	3.72E-05	4.09E-04	1.70E-05
Fuel Oil Boiler 4-0681	6.63E-06	7.28E-05	3.03E-06
Fuel Oil Boiler 4-0684	2.16E-05	2.38E-04	9.90E-06
Fuel Oil Boiler 4-0695	1.27E-05	1.40E-04	5.82E-06
Fuel Oil Boiler 4-0700	1.32E-05	1.46E-04	6.06E-06
Fuel Oil Boiler 4-0701	1.32E-05	1.46E-04	6.06E-06
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	2.89E-05	3.17E-04	1.32E-05
Fuel Oil Boiler 4-0723	1.42E-05	1.56E-04	6.49E-06
Dual Fuel Boiler 5-0306	1.27E-04	6.94E-04	2.89E-05
Dual Fuel Boiler 5-0311	2.84E-06	3.12E-05	1.30E-06
Dual Fuel Boiler 5-0312	2.84E-06	3.12E-05	1.30E-06
Dual Fuel Boiler 5-0313	2.84E-06	3.12E-05	1.30E-06
Dual Fuel Boiler 5-0316	2.04E-06	2.24E-05	9.34E-07
Dual Fuel Boiler 5-0317	2.04E-06	2.24E-05	9.34E-07
Dual Fuel Boiler 5-0329	2.04E-06	2.24E-05	9.34E-07
Dual Fuel Boiler 5-0330	2.04E-06	2.24E-05	9.34E-07
Dual Fuel Boiler 5-0331	2.04E-06	2.24E-05	9.34E-07
Dual Fuel Boiler 5-0332	2.04E-06	2.24E-05	9.34E-07
Dual Fuel Boiler 5-0333	2.04E-06	2.24E-05	9.34E-07
Dual Fuel Boiler 5-0347	9.08E-06	4.98E-05	2.07E-06

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Nickel **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0348	9.08E-06	4.98E-05	2.07E-06
Dual Fuel Boiler 5-0349	9.08E-06	4.98E-05	2.07E-06
Dual Fuel Boiler 5-0350	9.08E-06	4.98E-05	2.07E-06
Dual Fuel Boiler 5-0351	9.08E-06	4.98E-05	2.07E-06
CHP Unit 5-0366	6.53E-07	0.00E+00	3.26E-04
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	7.53E-06	1.26E-03	3.01E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	8.91E-05	1.48E-02	3.19E-02
Emergency Generator 9-0278	9.14E-05	1.52E-02	3.79E-02
Emergency Generator 9-0279	9.12E-05	1.52E-02	3.79E-02
Emergency Generator 9-0280	9.10E-05	1.52E-02	3.79E-02
Emergency Generator 9-0293	3.74E-05	6.24E-03	1.78E-02
Emergency Generator 9-0339	2.41E-04	4.02E-02	1.40E-02
Emergency Generator 9-0341	4.19E-04	6.98E-02	2.53E-02
Emergency Generator 9-0355	1.14E-03	1.89E-01	6.18E-02
Emergency Generator 9-0356	1.51E-04	2.51E-02	5.10E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	1.05E-03	1.76E-01	6.19E-02

FORM 4

HAZARDOUS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082

Pollutant: Nickel **Calendar Year:** 2023

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0379	1.33E-03	2.21E-01	6.19E-02
Emergency Generator 9-0380	2.01E-04	3.36E-02	6.19E-02
Emergency Generator 9-0402	7.75E-03	1.29E+00	3.09E-01
Emergency Generator 9-0442	1.39E-04	2.32E-02	3.77E-02
Emergency Generator 9-0448	6.71E-04	1.12E-01	5.28E-02
Emergency Generator 9-0453	3.92E-04	6.53E-02	2.64E-02
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	8.68E-04	1.45E-01	1.78E-02
Emergency Generator 9-0465	2.58E-05	4.30E-03	1.91E-02
Emergency Generator 9-0484	9.54E-05	1.59E-02	2.12E-02
Emergency Generator 9-0485	6.16E-05	1.03E-02	8.21E-02
Emergency Generator 9-0486	5.75E-05	9.58E-03	8.21E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	1.68E-04	2.80E-02	8.21E-02
Total	1.67E-02	2.54E+00	1.26E+00

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 5

BILLABLE TOXIC AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 Calendar Year: 2023

Chemical Name	CAS Number		Actual Emissions Tons/yr	Actual Emissions lbs/dy	Actual Emissions lbs/dy		Estimation Method
Carbon Disulfide	75-15-0	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Carbonyl Sulfide	463-58-1	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Chlorine	7782-50-5	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Cyanide Compounds	57-12-5	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Hydrochloric Acid	7647-01-0	s	7.76E-01	1.21E+02	6.04E+01		C3
		f					
Hydrogen Fluoride	7664-39-3	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Methyl Chloroform	71-55-6	s	6.64E-05	6.41E-04	2.67E-05		C3
		f					
Methylene Chloride	74-87-3	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Perchloroethylene	127-18-4	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Phosphine	7803-51-2	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Titanium Tetrachloride	7550-45-0	s	0.00E+00	0.00E+00	0.00E+00		
		f					
Totals			0.78	121.24	60.41		

s - Stack Emissions f - Fugitive Emissions Daily emissions (lbs/day) are lbs/operating day of the source.

PLEASE NOTE: Be sure to attach all data and calculations necessary to support the emissions figures shown above.

See Attachment 1 for minimum reporting values

Emission Estimation Method

A1 - U.S. EPA Reference Method
A2 - Other Particulate Sampling Train
A3 - Liquid Absorption Technique
A4 - Solid Absorption Technique
A5 - Freezing-Out Technique
A9 - Other, Specify

C1 - User calculated based on source test or other measurement.
C2 - User calculated based on material balance using engineering knowledge of the process.
C3 - User calculated based on AP-42.
C4 - User calculated by best guess / engineering judgement.
C5 - User calculated based on a State or local agency factor.
C6 - New Construction, not operational.
C7 - Source closed, operation ceased.
C8 - Computer calculated based on standard.

This form to include only the eleven chemicals identified.

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** CO_2

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	1.44E+03	1.58E+04	6.59E+02
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	8.11E+01	4.44E+02	1.85E+01
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	1.50E+04	8.21E+04	3.42E+03
Fuel Oil Boiler 4-0545	2.23E+01	2.45E+02	1.02E+01
Fuel Oil Boiler 4-0559	5.17E+02	5.68E+03	2.37E+02
Fuel Oil Boiler 4-0560	5.17E+02	5.68E+03	2.37E+02
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	1.56E+02	1.72E+03	7.15E+01
Fuel Oil Boiler 4-0571	1.56E+02	1.72E+03	7.15E+01
Fuel Oil Boiler 4-0572	1.56E+02	1.72E+03	7.15E+01
Fuel Oil Boiler 4-0626	1.59E+01	1.75E+02	7.30E+00
Fuel Oil Boiler 4-0627	1.03E+02	1.14E+03	4.74E+01
Fuel Oil Boiler 4-0650	2.20E+01	2.42E+02	1.01E+01
Fuel Oil Boiler 4-0660	8.56E+01	9.41E+02	3.92E+01
Fuel Oil Boiler 4-0663	1.34E+02	1.47E+03	6.13E+01
Fuel Oil Boiler 4-0664	1.34E+02	1.47E+03	6.13E+01
Fuel Oil Boiler 4-0665	5.36E+01	5.89E+02	2.45E+01
Fuel Oil Boiler 4-0668	1.74E+02	1.92E+03	7.99E+01
Fuel Oil Boiler 4-0669	2.13E+02	2.34E+03	9.75E+01
Fuel Oil Boiler 4-0670	2.13E+02	2.34E+03	9.75E+01
Fuel Oil Boiler 4-0681	3.79E+01	4.16E+02	1.73E+01
Fuel Oil Boiler 4-0684	1.24E+02	1.36E+03	5.66E+01
Fuel Oil Boiler 4-0695	7.27E+01	7.99E+02	3.33E+01

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** CO_2

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0700	7.57E+01	8.32E+02	3.47E+01
Fuel Oil Boiler 4-0701	7.57E+01	8.32E+02	3.47E+01
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	1.65E+02	1.81E+03	7.56E+01
Fuel Oil Boiler 4-0723	8.11E+01	8.91E+02	3.71E+01
Dual Fuel Boiler 5-0306	2.12E+03	1.16E+04	4.83E+02
Dual Fuel Boiler 5-0311	1.66E+02	1.82E+03	7.59E+01
Dual Fuel Boiler 5-0312	1.66E+02	1.82E+03	7.59E+01
Dual Fuel Boiler 5-0313	1.66E+02	1.82E+03	7.59E+01
Dual Fuel Boiler 5-0316	1.11E+02	1.22E+03	5.07E+01
Dual Fuel Boiler 5-0317	1.11E+02	1.22E+03	5.07E+01
Dual Fuel Boiler 5-0329	1.11E+02	1.22E+03	5.07E+01
Dual Fuel Boiler 5-0330	1.11E+02	1.22E+03	5.07E+01
Dual Fuel Boiler 5-0331	1.11E+02	1.22E+03	5.07E+01
Dual Fuel Boiler 5-0332	1.11E+02	1.22E+03	5.07E+01
Dual Fuel Boiler 5-0333	1.11E+02	1.22E+03	5.07E+01
Dual Fuel Boiler 5-0347	5.29E+02	2.90E+03	1.21E+02
Dual Fuel Boiler 5-0348	5.29E+02	2.90E+03	1.21E+02
Dual Fuel Boiler 5-0349	5.29E+02	2.90E+03	1.21E+02
Dual Fuel Boiler 5-0350	5.29E+02	2.90E+03	1.21E+02
Dual Fuel Boiler 5-0351	5.29E+02	2.90E+03	1.21E+02
Dual Fuel Boiler 5-0389	8.78E+02	4.81E+03	2.01E+02
CHP Unit 5-0366	6.22E+03	1.92E+05	7.99E+03
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** CO_2

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	3.15E-01	5.25E+01	1.26E+03
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	3.72E+00	6.21E+02	1.33E+03
Emergency Generator 9-0278	3.82E+00	6.37E+02	1.58E+03
Emergency Generator 9-0279	3.81E+00	6.35E+02	1.58E+03
Emergency Generator 9-0280	3.80E+00	6.34E+02	1.58E+03
Emergency Generator 9-0293	1.57E+00	2.61E+02	7.45E+02
Emergency Generator 9-0339	1.01E+01	1.68E+03	5.87E+02
Emergency Generator 9-0341	1.75E+01	2.92E+03	1.06E+03
Emergency Generator 9-0355	4.75E+01	7.92E+03	2.58E+03
Emergency Generator 9-0356	6.30E+00	1.05E+03	2.13E+03
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	4.40E+01	7.34E+03	2.59E+03
Emergency Generator 9-0379	5.56E+01	9.26E+03	2.59E+03
Emergency Generator 9-0380	8.42E+00	1.40E+03	2.59E+03
Emergency Generator 9-0402	3.24E+02	5.40E+04	1.29E+04
Emergency Generator 9-0442	5.82E+00	9.71E+02	1.57E+03
Emergency Generator 9-0448	2.80E+01	4.67E+03	2.21E+03
Emergency Generator 9-0453	1.64E+01	2.73E+03	1.10E+03
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	3.63E+01	6.05E+03	7.45E+02
Emergency Generator 9-0465	1.08E+00	1.80E+02	7.98E+02
Emergency Generator 9-0484	3.99E+00	6.65E+02	8.86E+02
Emergency Generator 9-0485	2.57E+00	4.29E+02	3.43E+03
Emergency Generator 9-0486	2.40E+00	4.00E+02	3.43E+03

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** CO_2

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	7.03E+00	1.17E+03	3.43E+03
Total	3.36E+04	4.77E+05	6.82E+04

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** CH_4

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	1.39E-02	1.53E-01	6.39E-03
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	7.85E-04	4.30E-03	1.79E-04
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	2.74E-01	1.50E+00	6.24E-02
Fuel Oil Boiler 4-0545	2.16E-04	2.37E-03	9.88E-05
Fuel Oil Boiler 4-0559	5.01E-03	5.51E-02	2.29E-03
Fuel Oil Boiler 4-0560	5.01E-03	5.51E-02	2.29E-03
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	1.51E-03	1.66E-02	6.93E-04
Fuel Oil Boiler 4-0571	1.51E-03	1.66E-02	6.93E-04
Fuel Oil Boiler 4-0572	1.51E-03	1.66E-02	6.93E-04
Fuel Oil Boiler 4-0626	1.54E-04	1.70E-03	7.07E-05
Fuel Oil Boiler 4-0627	1.00E-03	1.10E-02	4.59E-04
Fuel Oil Boiler 4-0650	2.13E-04	2.34E-03	9.77E-05
Fuel Oil Boiler 4-0660	8.29E-04	9.11E-03	3.80E-04
Fuel Oil Boiler 4-0663	1.30E-03	1.42E-02	5.94E-04
Fuel Oil Boiler 4-0664	1.30E-03	1.42E-02	5.94E-04
Fuel Oil Boiler 4-0665	5.19E-04	5.70E-03	2.38E-04
Fuel Oil Boiler 4-0668	1.69E-03	1.86E-02	7.74E-04
Fuel Oil Boiler 4-0669	2.06E-03	2.27E-02	9.44E-04
Fuel Oil Boiler 4-0670	2.06E-03	2.27E-02	9.44E-04
Fuel Oil Boiler 4-0681	3.67E-04	4.03E-03	1.68E-04
Fuel Oil Boiler 4-0684	1.20E-03	1.32E-02	5.49E-04
Fuel Oil Boiler 4-0695	7.04E-04	7.74E-03	3.22E-04

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** CH_4

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0700	7.34E-04	8.06E-03	3.36E-04
Fuel Oil Boiler 4-0701	7.34E-04	8.06E-03	3.36E-04
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	1.60E-03	1.76E-02	7.32E-04
Fuel Oil Boiler 4-0723	7.85E-04	8.63E-03	3.60E-04
Dual Fuel Boiler 5-0306	4.06E-02	2.22E-01	9.27E-03
Dual Fuel Boiler 5-0311	3.18E-03	3.49E-02	1.45E-03
Dual Fuel Boiler 5-0312	3.18E-03	3.49E-02	1.45E-03
Dual Fuel Boiler 5-0313	3.18E-03	3.49E-02	1.45E-03
Dual Fuel Boiler 5-0316	2.12E-03	2.32E-02	9.69E-04
Dual Fuel Boiler 5-0317	2.12E-03	2.32E-02	9.69E-04
Dual Fuel Boiler 5-0329	2.12E-03	2.32E-02	9.69E-04
Dual Fuel Boiler 5-0330	2.12E-03	2.32E-02	9.69E-04
Dual Fuel Boiler 5-0331	2.12E-03	2.32E-02	9.69E-04
Dual Fuel Boiler 5-0332	2.12E-03	2.32E-02	9.69E-04
Dual Fuel Boiler 5-0333	2.12E-03	2.32E-02	9.69E-04
Dual Fuel Boiler 5-0347	1.01E-02	5.56E-02	2.32E-03
Dual Fuel Boiler 5-0348	1.01E-02	5.56E-02	2.32E-03
Dual Fuel Boiler 5-0349	1.01E-02	5.56E-02	2.32E-03
Dual Fuel Boiler 5-0350	1.01E-02	5.56E-02	2.32E-03
Dual Fuel Boiler 5-0351	1.01E-02	5.56E-02	2.32E-03
Dual Fuel Boiler 5-0389	1.68E-02	9.23E-02	3.84E-03
CHP Unit 5-0366	1.17E-01	3.61E+00	1.51E-01
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** CH_4

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	1.28E-05	2.13E-03	5.11E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	1.51E-04	2.52E-02	5.40E-02
Emergency Generator 9-0278	1.55E-04	2.58E-02	6.43E-02
Emergency Generator 9-0279	1.55E-04	2.58E-02	6.43E-02
Emergency Generator 9-0280	1.54E-04	2.57E-02	6.43E-02
Emergency Generator 9-0293	6.35E-05	1.06E-02	3.02E-02
Emergency Generator 9-0339	4.10E-04	6.83E-02	2.38E-02
Emergency Generator 9-0341	7.10E-04	1.18E-01	4.29E-02
Emergency Generator 9-0355	1.93E-03	3.21E-01	1.05E-01
Emergency Generator 9-0356	2.55E-04	4.26E-02	8.66E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	1.79E-03	2.98E-01	1.05E-01
Emergency Generator 9-0379	2.25E-03	3.76E-01	1.05E-01
Emergency Generator 9-0380	3.41E-04	5.69E-02	1.05E-01
Emergency Generator 9-0402	1.31E-02	2.19E+00	5.25E-01
Emergency Generator 9-0442	2.36E-04	3.94E-02	6.39E-02
Emergency Generator 9-0448	1.14E-03	1.90E-01	8.96E-02
Emergency Generator 9-0453	6.65E-04	1.11E-01	4.48E-02
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	1.47E-03	2.45E-01	3.02E-02
Emergency Generator 9-0465	4.37E-05	7.29E-03	3.24E-02
Emergency Generator 9-0484	1.62E-04	2.70E-02	3.60E-02
Emergency Generator 9-0485	1.04E-04	1.74E-02	1.39E-01
Emergency Generator 9-0486	9.74E-05	1.62E-02	1.39E-01

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** CH_4

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	2.85E-04	4.76E-02	1.39E-01
Total	5.96E-01	1.08E+01	2.41E+00

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

FORM 6

GREENHOUSE GAS AIR POLLUTANTS
EMISSIONS CERTIFICATION REPORT **Calendar Year:** 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** N_2O

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0392	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0432	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0460	1.68E-02	1.84E-01	7.69E-03
Fuel Oil Boiler 4-0506	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0523	9.45E-04	5.18E-03	2.16E-04
Dual Fuel Boiler 4-0543	0.00E+00	0.00E+00	0.00E+00
Dual Fuel Boiler 4-0544	2.65E-01	1.45E+00	6.05E-02
Fuel Oil Boiler 4-0545	2.60E-04	2.86E-03	1.19E-04
Fuel Oil Boiler 4-0559	6.03E-03	6.63E-02	2.76E-03
Fuel Oil Boiler 4-0560	6.03E-03	6.63E-02	2.76E-03
Fuel Oil Boiler 4-0568	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0570	1.82E-03	2.00E-02	8.34E-04
Fuel Oil Boiler 4-0571	1.82E-03	2.00E-02	8.34E-04
Fuel Oil Boiler 4-0572	1.82E-03	2.00E-02	8.34E-04
Fuel Oil Boiler 4-0626	1.86E-04	2.04E-03	8.51E-05
Fuel Oil Boiler 4-0627	1.21E-03	1.33E-02	5.52E-04
Fuel Oil Boiler 4-0650	2.57E-04	2.82E-03	1.18E-04
Fuel Oil Boiler 4-0660	9.98E-04	1.10E-02	4.57E-04
Fuel Oil Boiler 4-0663	1.56E-03	1.72E-02	7.15E-04
Fuel Oil Boiler 4-0664	1.56E-03	1.72E-02	7.15E-04
Fuel Oil Boiler 4-0665	6.25E-04	6.87E-03	2.86E-04

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** N_2O

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Fuel Oil Boiler 4-0668	2.03E-03	2.23E-02	9.31E-04
Fuel Oil Boiler 4-0669	2.48E-03	2.73E-02	1.14E-03
Fuel Oil Boiler 4-0670	2.48E-03	2.73E-02	1.14E-03
Fuel Oil Boiler 4-0681	4.42E-04	4.85E-03	2.02E-04
Fuel Oil Boiler 4-0684	1.44E-03	1.58E-02	6.60E-04
Fuel Oil Boiler 4-0695	8.47E-04	9.31E-03	3.88E-04
Fuel Oil Boiler 4-0700	8.83E-04	9.70E-03	4.04E-04
Fuel Oil Boiler 4-0701	8.83E-04	9.70E-03	4.04E-04
Fuel Oil Boiler 4-0702	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0703	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0704	0.00E+00	0.00E+00	0.00E+00
Fuel Oil Boiler 4-0716	1.92E-03	2.12E-02	8.81E-04
Fuel Oil Boiler 4-0723	9.45E-04	1.04E-02	4.33E-04
Dual Fuel Boiler 5-0306	3.88E-02	2.13E-01	8.86E-03
Dual Fuel Boiler 5-0311	3.04E-03	3.34E-02	1.39E-03
Dual Fuel Boiler 5-0312	3.04E-03	3.34E-02	1.39E-03
Dual Fuel Boiler 5-0313	3.04E-03	3.34E-02	1.39E-03
Dual Fuel Boiler 5-0316	2.03E-03	2.23E-02	9.27E-04
Dual Fuel Boiler 5-0317	2.03E-03	2.23E-02	9.27E-04
Dual Fuel Boiler 5-0329	2.03E-03	2.23E-02	9.27E-04
Dual Fuel Boiler 5-0330	2.03E-03	2.23E-02	9.27E-04
Dual Fuel Boiler 5-0331	2.03E-03	2.23E-02	9.27E-04
Dual Fuel Boiler 5-0332	2.03E-03	2.23E-02	9.27E-04
Dual Fuel Boiler 5-0333	2.03E-03	2.23E-02	9.27E-04
Dual Fuel Boiler 5-0347	9.71E-03	5.32E-02	2.22E-03

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** N_2O

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Dual Fuel Boiler 5-0348	9.71E-03	5.32E-02	2.22E-03
Dual Fuel Boiler 5-0349	9.71E-03	5.32E-02	2.22E-03
Dual Fuel Boiler 5-0350	9.71E-03	5.32E-02	2.22E-03
Dual Fuel Boiler 5-0351	9.71E-03	5.32E-02	2.22E-03
Dual Fuel Boiler 5-0389	1.61E-02	8.82E-02	3.68E-03
CHP Unit 5-0366	1.17E-02	3.61E-01	1.51E-02
Paint Spray Booth 6-0497	0.00E+00	0.00E+00	0.00E+00
Paint Spray Booth 6-0498	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0230	2.55E-06	4.26E-04	1.02E-02
Emergency Generator 9-0231	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0232	3.02E-05	5.04E-03	1.08E-02
Emergency Generator 9-0278	3.10E-05	5.16E-03	1.29E-02
Emergency Generator 9-0279	3.09E-05	5.15E-03	1.29E-02
Emergency Generator 9-0280	3.09E-05	5.14E-03	1.29E-02
Emergency Generator 9-0293	1.27E-05	2.12E-03	6.05E-03
Emergency Generator 9-0339	8.19E-05	1.37E-02	4.76E-03
Emergency Generator 9-0341	1.42E-04	2.37E-02	8.57E-03
Emergency Generator 9-0355	3.86E-04	6.43E-02	2.10E-02
Emergency Generator 9-0356	5.11E-05	8.51E-03	1.73E-02
Emergency Generator 9-0369	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0378	3.57E-04	5.95E-02	2.10E-02
Emergency Generator 9-0379	4.51E-04	7.51E-02	2.10E-02
Emergency Generator 9-0380	6.83E-05	1.14E-02	2.10E-02
Emergency Generator 9-0402	2.63E-03	4.38E-01	1.05E-01
Emergency Generator 9-0442	4.73E-05	7.88E-03	1.28E-02

FORM 6

GREENHOUSE GAS AIR POLLUTANTS EMISSIONS CERTIFICATION REPORT

Calendar Year: 2023

Facility Name: Aberdeen Proving Ground - Edgewood Area **Facility ID #:** 24-25-00082 **Pollutant:** N_2O

Equipment Description/ Registration No.	Actual Emissions		
	Tons/year	Lbs/day	Lbs/hr
Emergency Generator 9-0448	2.28E-04	3.79E-02	1.79E-02
Emergency Generator 9-0453	1.33E-04	2.22E-02	8.95E-03
Emergency Generator 9-0463	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0464	2.94E-04	4.90E-02	6.05E-03
Emergency Generator 9-0465	8.74E-06	1.46E-03	6.48E-03
Emergency Generator 9-0484	3.24E-05	5.39E-03	7.19E-03
Emergency Generator 9-0485	2.09E-05	3.48E-03	2.78E-02
Emergency Generator 9-0486	1.95E-05	3.25E-03	2.78E-02
Emergency Generator 5-0488	0.00E+00	0.00E+00	0.00E+00
Emergency Generator 9-0506	5.71E-05	9.51E-03	2.78E-02
Total	4.65E-01	4.11E+00	5.64E-01

Note: This data is presented by MDE registration number and not by emission unit number. Some MDE registration numbers correspond to more than one emission unit.

SUPPORTING CALCULATIONS

Annual Usage
Data Input
CY 2023

Report Year	2023	
Report type	Annual	
Total Natural Gas	4,285,631	therms
Total Fuel Oil	562,565	gals

Boilers

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
5-0329	E2100-A03	Natural Gas	18,320	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	79	gals
		Hours of Operation (Oil)		hrs
5-0330	E2100-A04	Natural Gas	18,320	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	79	gals
		Hours of Operation (Oil)		hrs
5-0331	E2100-A05	Natural Gas	18,320	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	79	gals
		Hours of Operation (Oil)		hrs
5-0332	E2100-A01	Natural Gas	18,320	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	79	gals
		Hours of Operation (Oil)		hrs
5-0333	E2100-A02	Natural Gas	18,320	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	79	gals
		Hours of Operation (Oil)		hrs
5-0316	E2100-A06	Natural Gas	18,320	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	79	gals
		Hours of Operation (Oil)		hrs
5-0317	E2100-A07	Natural Gas	18,320	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	79	gals
		Hours of Operation (Oil)		hrs
5-0311	E1574-A01	Natural Gas	27,610	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0312	E1574-A02	Natural Gas	27,610	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0313	E1574-A03	Natural Gas	27,610	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals

Annual Usage
Data Input
CY 2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
		Hours of Operation (Oil)		hrs
5-0389	E5126 - Temp	Natural Gas	146,397	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
4-0543	E5126-A01	Natural Gas	0	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
4-0544	E5126-A02	Natural Gas	2,257,083	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	129,137	gals
		Hours of Operation (Oil)		hrs
5-0306	E2901-A01	Natural Gas	307,486	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0306	E2901-A02	Natural Gas	307,486	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0306	E2901-A03	Natural Gas	307,486	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0306	E2901-A04	Natural Gas	307,486	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0347	E2851-A01	Natural Gas	88,228	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0348	E2851-A02	Natural Gas	88,228	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0349	E2851-A03	Natural Gas	88,228	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
5-0350	E2851-A04	Natural Gas	88,228	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals

Annual Usage
Data Input
CY 2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
		Hours of Operation (Oil)		hrs
5-0351	E2851-A05	Natural Gas	88,228	therms
		Hours of Operation (NG)		hrs
		No. 2 Oil	0	gals
		Hours of Operation (Oil)		hrs
4-0626	E1464-A01	No. 2 Oil	1,430	gal
		Hours of Operation (Oil)		hrs
4-0663 Removed	E1930-A01	No. 2 Oil	12,006	gal
		Hours of Operation (Oil)		hrs
4-0664	E1930-A02	No. 2 Oil	12,006	gal
		Hours of Operation (Oil)		hrs
4-0665	E1950-A01	No. 2 Oil	4,806	gal
		Hours of Operation (Oil)		hrs
4-0660	E1958-A01	No. 2 Oil	7,680	gal
		Hours of Operation (Oil)		hrs
4-0627	E2188-A01	No. 2 Oil	9,277	gal
		Hours of Operation (Oil)		hrs
4-0559	E4301-A02	No. 2 Oil	46,385	gal
		Hours of Operation (Oil)		hrs
4-0560	E4301-A03	No. 2 Oil	46,385	gal
		Hours of Operation (Oil)		hrs
4-0716 Replaced A03	E4516-A01	No. 2 Oil	7,403	gal
		Hours of Operation (Oil)		hrs
4-0716 Replaced A04	E4516-A02	No. 2 Oil	7,403	gal
		Hours of Operation (Oil)		hrs
4-0432	E4902-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0545	E5664-A01	No. 2 Oil	1,999	gal
		Hours of Operation (Oil)		hrs
4-0669	E5828-A01	No. 2 Oil	19,093	gal
		Hours of Operation (Oil)		hrs
4-0670	E5828-A02	No. 2 Oil	19,093	gal
		Hours of Operation (Oil)		hrs
4-0704 Removed	E4110-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0668	E5951-A01	No. 2 Oil	15,644	gal
		Hours of Operation (Oil)		hrs
4-0684	E3832-A02	No. 2 Oil	11,092	gal
		Hours of Operation (Oil)		hrs
4-0681	E4585-A02	No. 2 Oil	3,398	gal
		Hours of Operation (Oil)		hrs
4-0568 removed	E3302-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0570	E3312-A01	No. 2 Oil	14,007	gal
		Hours of Operation (Oil)		hrs
4-0571	E3312-A04	No. 2 Oil	14,007	gal
		Hours of Operation (Oil)		hrs

Annual Usage
Data Input
CY 2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
4-0572	E3312-A05	No. 2 Oil	14,007	gal
		Hours of Operation (Oil)		hrs
4-0700	E3844-A01	No. 2 Oil	6,793	gal
		Hours of Operation (Oil)		hrs
4-0701	E3844-A02	No. 2 Oil	6,793	gal
		Hours of Operation (Oil)		hrs
4-0695	E2194-A02	No. 2 Oil	6,519	gal
		Hours of Operation (Oil)		hrs
4-0392 Removed	E4160-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0506 Not Operating	E4160-A02	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0523	E4160-A03	No. 2 Oil	7,271	gal
		Hours of Operation (Oil)		hrs
4-0723	E4160-A04	No. 2 Oil	7,271	gal
		Hours of Operation (Oil)		hrs
4-0650	E5840-A01	No. 2 Oil	1,976	gal
		Hours of Operation (Oil)		hrs
4-0702 Exempt	E4305-A01	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0703 Exempt	E4305-A02	No. 2 Oil	0	gal
		Hours of Operation (Oil)		hrs
4-0460	E5126-A06	No. 2 Oil	129,137	gal
		Hours of Operation (Oil)		hrs

* - For the annual report, the hours of operation are based on fuel usage and boiler ratings

Operation Days: All NSPS boilers are assumed to be 365 days.
All space heating boilers are assumed to be 182 days.

Standby Generators

		Diesel		MMBtu
9-0448	09-E2800-A01	Hours of Operation	25.4	hrs
		Diesel		MMBtu
5-0488	26-E3156-A01	Hours of Operation	0.0	hrs
		Diesel		MMBtu
9-0378	E3510-A01	Hours of Operation	34.0	hrs
		Diesel		MMBtu
9-0232	E3549-A01	Hours of Operation	5.6	hrs
		Diesel		MMBtu
9-0341	E3835-A01	Hours of Operation	33.1	hrs
		Diesel		MMBtu
9-0278	E3150-A01	Hours of Operation	4.8	hrs

Annual Usage
Data Input
CY 2023

MDE Reg. No.	EU No.	Fuel Consumption/ Operational Hours		Units
		Diesel		MMBtu
9-0279	E3150-A02	Hours of Operation	4.8	hrs
		Diesel		MMBtu
9-0280	E3150-A03	Hours of Operation	4.8	hrs
		Diesel		MMBtu
9-0369	E3081-A02	Hours of Operation	0.0	hrs
		Diesel		MMBtu
9-0230	E3081-A03	Hours of Operation	0.5	hrs
		Diesel		MMBtu
9-0231	E3300-A01	Hours of Operation	0.0	hrs
		Diesel		MMBtu
9-0379	E5100-A01	Hours of Operation	42.9	hrs
		Diesel		MMBtu
9-0355	E1457-A01	Hours of Operation	36.8	hrs
		Diesel		MMBtu
9-0356	E3400-A01	Hours of Operation	5.9	hrs
		Diesel		MMBtu
9-0380	E3401-A01	Hours of Operation	6.5	hrs
		Diesel		MMBtu
9-0402	E2901-A01, A02, A03	Hours of Operation	50.1	hrs
		Diesel		MMBtu
9-0442	E3844-A03	Hours of Operation	7.4	hrs
		Diesel		MMBtu
9-0453	E2100	Hours of Operation	29.7	hrs
		Diesel		MMBtu
9-0465	E2390-A01	Hours of Operation	2.7	hrs
		Diesel		MMBtu
9-0463	E2400-A01	Hours of Operation	0.0	hrs
		Diesel		MMBtu
9-0339	E5146-A01	Hours of Operation	34.4	hrs
		Diesel		MMBtu
9-0293	E5126-A01	Hours of Operation	4.2	hrs
		Diesel		MMBtu
9-0464	E3566-A01	Hours of Operation	97.3	hrs
		Diesel		MMBtu
9-0485	E2851-A06	Hours of Operation	1.5	hrs
		Diesel		MMBtu
9-0486	E2851-A07	Hours of Operation	1.4	hrs
		Diesel		MMBtu
9-0506	E3857	Hours of Operation	4.1	hrs
		Diesel		MMBtu
9-0484	E4520 (old) E3462 (New)	Hours of Operation	9.0	hrs

Operation Days:

All emergency generators are assumed to be 12 days

ACTUAL EMISSION CALCULATIONS
CY 2023 BOILERS

Emission Factor Source: Criteria Pollutant Emission Factors from Table 1.3-1, 1.3-2, 1.3-3, and 1.3-7 of AP-42.
GHG factors derived from oil combustion factors, Tables 1.3-3, 1.3-8, and 1.3-12.

Pollutant	Fuel oil lb/10^3 gal
NOx	20
SOx*	7.2
CO	5
VOC	0.34

Pollutant	Fuel oil lb/10^3 gal
PM Filterable	2
PM-10 Filterable	1.08
PM-2.5 Filterable	0.83
PM Condensable	1.3

Pollutant	Fuel oil lb/10^3 gal
CO2	22,300
CH4	0.216
N2O	0.26

* Used 0.05% Sulfur (APG uses fuel oil with 500 ppm sulfur content)

Emission Factor Source: Criteria Pollutant Emission Factors from Table 1.4-1 and 1.4-2 of AP-42.
GHG factors derived from natural gas combustion factors, Table 1.4-2.

Pollutant	Natural Gas lb/10^6 cft	From MRICD Boiler Application (See Tab "MRICD Boiler EF") for E2901-A01 thru A04
NOx	100	36
SOx*	0.6	
CO	84	
VOC	5.5	

Pollutant	Natural Gas lb/10^6 cft	
PM Filterable	1.9	
PM-10 Filterable	1.9	**
PM-2.5 Filterable	1.9	**
PM Condensable	5.7	

Pollutant	Natural Gas lb/10^6 cft
CO2	120000
CH4	2.3
N2O	2.2

Pollutant	Natural Gas (low NOx burner) lb/10^6 cft	Natural Gas (fuel gas recirculation) lb/10^6 cft	Natural Gas for E2851-A01 thru A05 (PHCL)
NOx	50	32	36

*MMTCO2Eq = (million metric tons of a gas) * (GWP of the gas)

**All PM (total, condensable, and filterable) is assumed to be less than 1.0 micrometer in diameter. Therefore, the PM emission factors presented here may be used to estimate PM10, PM2.5 or PM1 emissions.

26-E5126-A01 and A02: These boilers have flue gas recirculation for NO_x control. The NO_x emission factor for boilers 0543 and 0544 should be 32 lb/million cubic feet of gas.	
32	Natural Gas lb/10^6 cft

Calculation Method
Annual Emission Rate (ton/yr)= (Emission Factor) X (Fuel Used) / 2000
Daily Emission Rate = Annual emission rate (tons/yr) X 2000 / Days per year

ACTUAL EMISSION CALCULATIONS
CY 2023 BOILERS

Emissions Unit Number	MDE Reg. Number	Type of Boiler	Oil Used (gal)	Gas Used (Therm)	NOx (tpy)	SOx (tpy)	CO (tpy)	VOC (tpy)	PM (tpy)	CO2 (tpy)	CH4 (tpy)	N2O (tpy)	PM Filterable	PM-10 Filterable	PM-2.5 Filterable	PM Condensable
E2100-A03	5-0329	Dual Fuel	78.76	18319.86	0.09	0.00	0.08	0.01	0.0018	110.80	0.00	0.00	0.0018	0.0018	0.0018	0.0053
E2100-A04	5-0330	Dual Fuel	78.76	18319.86	0.09	0.00	0.08	0.01	0.0018	110.80	0.00	0.00	0.0018	0.0018	0.0018	0.0053
E2100-A05	5-0331	Dual Fuel	78.76	18319.86	0.09	0.00	0.08	0.01	0.0018	110.80	0.00	0.00	0.0018	0.0018	0.0018	0.0053
E2100-A01	5-0332	Dual Fuel	78.76	18319.86	0.09	0.00	0.08	0.01	0.0018	110.80	0.00	0.00	0.0018	0.0018	0.0018	0.0053
E2100-A02	5-0333	Dual Fuel	78.76	18319.86	0.09	0.00	0.08	0.01	0.0018	110.80	0.00	0.00	0.0018	0.0018	0.0018	0.0053
E2100-A06	5-0316	Dual Fuel	78.76	18319.86	0.09	0.00	0.08	0.01	0.0018	110.80	0.00	0.00	0.0018	0.0018	0.0018	0.0053
E2100-A07	5-0317	Dual Fuel	78.76	18319.86	0.09	0.00	0.08	0.01	0.0018	110.80	0.00	0.00	0.0018	0.0018	0.0018	0.0053
E1574-A01	5-0311	Dual Fuel	0.00	27609.67	0.14	0.00	0.12	0.01	0.0026	165.66	0.00	0.00	0.0026	0.0026	0.0026	0.0079
E1574-A02	5-0312	Dual Fuel	0.00	27609.67	0.14	0.00	0.12	0.01	0.0026	165.66	0.00	0.00	0.0026	0.0026	0.0026	0.0079
E1574-A03	5-0313	Dual Fuel	0.00	27609.67	0.14	0.00	0.12	0.01	0.0026	165.66	0.00	0.00	0.0026	0.0026	0.0026	0.0079
E5126-A01	4-0543	Dual Fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000	0.0000	0.0000
E5126-A02	4-0544	Dual Fuel	129136.85	2257082.76	4.90	0.53	9.80	0.64	0.3436	14982.37	0.27	0.27	0.3436	0.2842	0.2680	0.7272
E2901-A01*	5-0306	Dual Fuel	0.00	307485.50	0.55	0.01	1.29	0.08	0.0292	1844.91	0.04	0.03	0.0292	0.0292	0.0292	0.0876
E2901-A02*	5-0306	Dual Fuel	0.00	307485.50	0.55	0.01	1.29	0.08	0.0292	1844.91	0.04	0.03	0.0292	0.0292	0.0292	0.0876
E2901-A03*	5-0306	Dual Fuel	0.00	307485.50	0.55	0.01	1.29	0.08	0.0292	1844.91	0.04	0.03	0.0292	0.0292	0.0292	0.0876
E2901-A04*	5-0306	Dual Fuel	0.00	307485.50	0.55	0.01	1.29	0.08	0.0292	1844.91	0.04	0.03	0.0292	0.0292	0.0292	0.0876
E2851-A01	5-0347	Dual Fuel	0.00	88228.20	0.16	0.00	0.37	0.02	0.0084	529.37	0.01	0.01	0.0084	0.0084	0.0084	0.0251
E2851-A02	5-0348	Dual Fuel	0.00	88228.20	0.16	0.00	0.37	0.02	0.0084	529.37	0.01	0.01	0.0084	0.0084	0.0084	0.0251
E2851-A03	5-0349	Dual Fuel	0.00	88228.20	0.16	0.00	0.37	0.02	0.0084	529.37	0.01	0.01	0.0084	0.0084	0.0084	0.0251
E2851-A04	5-0350	Dual Fuel	0.00	88228.20	0.16	0.00	0.37	0.02	0.0084	529.37	0.01	0.01	0.0084	0.0084	0.0084	0.0251
E2851-A05	5-0351	Dual Fuel	0.00	88228.20	0.16	0.00	0.37	0.02	0.0084	529.37	0.01	0.01	0.0084	0.0084	0.0084	0.0251
E5126 - Temp	5-0389	Dual Fuel	0.00	146397.28	0.26	0.00	0.61	0.04	0.0139	878.38	0.02	0.02	0.0139	0.0139	0.0139	0.0417
E1464-A01	4-0626	Fuel Oil	1430.00	0.00	0.01	0.01	0.00	0.00	0.0014	15.94	0.00	0.00	0.0014	0.0008	0.0006	0.0009
E1930-A01	4-0663	Fuel Oil	12006.00	0.00	0.12	0.04	0.03	0.00	0.0120	133.87	0.00	0.00	0.0120	0.0065	0.0050	0.0078
E1930-A02	4-0664	Fuel Oil	12006.00	0.00	0.12	0.04	0.03	0.00	0.0120	133.87	0.00	0.00	0.0120	0.0065	0.0050	0.0078
E1950-A01	4-0665	Fuel Oil	4805.50	0.00	0.05	0.02	0.01	0.00	0.0048	53.58	0.00	0.00	0.0048	0.0026	0.0020	0.0031
E1958-A01	4-0660	Fuel Oil	7679.60	0.00	0.08	0.03	0.02	0.00	0.0077	85.63	0.00	0.00	0.0077	0.0041	0.0032	0.0050
E2188-A01	4-0627	Fuel Oil	9277.00	0.00	0.09	0.03	0.02	0.00	0.0093	103.44	0.00	0.00	0.0093	0.0050	0.0038	0.0060
E4301-A02	4-0559	Fuel Oil	46385.00	0.00	0.46	0.17	0.12	0.01	0.0464	517.19	0.01	0.01	0.0464	0.0250	0.0192	0.0302
E4301-A03	4-0560	Fuel Oil	46385.00	0.00	0.46	0.17	0.12	0.01	0.0464	517.19	0.01	0.01	0.0464	0.0250	0.0192	0.0302
E4516-A01	4-0716	Fuel Oil	7403.00	0.00	0.07	0.03	0.02	0.00	0.0074	82.54	0.00	0.00	0.0074	0.0040	0.0031	0.0048
E4516-A02	4-0716	Fuel Oil	7403.00	0.00	0.07	0.03	0.02	0.00	0.0074	82.54	0.00	0.00	0.0074	0.0040	0.0031	0.0048
E4902-A01	4-0432	Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000	0.0000	0.0000
E5664-A01	4-0545	Fuel Oil	1998.60	0.00	0.02	0.01	0.00	0.00	0.0020	22.28	0.00	0.00	0.0020	0.0011	0.0008	0.0013
E5828-A01	4-0669	Fuel Oil	19092.50	0.00	0.19	0.07	0.05	0.00	0.0191	212.88	0.00	0.00	0.0191	0.0103	0.0079	0.0124
E5828-A02	4-0670	Fuel Oil	19092.50	0.00	0.19	0.07	0.05	0.00	0.0191	212.88	0.00	0.00	0.0191	0.0103	0.0079	0.0124
E4110-A01	4-0704	Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000	0.0000	0.0000
E5951-A01	4-0668	Fuel Oil	15644.00	0.00	0.16	0.06	0.04	0.00	0.0156	174.43	0.00	0.00	0.0156	0.0084	0.0065	0.0102
E3832-A02	4-0684	Fuel Oil	11092.00	0.00	0.11	0.04	0.03	0.00	0.0111	123.68	0.00	0.00	0.0111	0.0060	0.0046	0.0072
E4585-A02	4-0681	Fuel Oil	3398.10	0.00	0.03	0.01	0.01	0.00	0.0034	37.89	0.00	0.00	0.0034	0.0018	0.0014	0.0022
E3302-A01	4-0568	Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000	0.0000	0.0000
E3312-A01	4-0570	Fuel Oil	14007.00	0.00	0.14	0.05	0.04	0.00	0.0140	156.18	0.00	0.00	0.0140	0.0076	0.0058	0.0091
E3312-A04	4-0571	Fuel Oil	14007.00	0.00	0.14	0.05	0.04	0.00	0.0140	156.18	0.00	0.00	0.0140	0.0076	0.0058	0.0091
E3312-A05	4-0572	Fuel Oil	14007.00	0.00	0.14	0.05	0.04	0.00	0.0140	156.18	0.00	0.00	0.0140	0.0076	0.0058	0.0091
E3844-A01	4-0700	Fuel Oil	6792.50	0.00	0.07	0.02	0.02	0.00	0.0068	75.74	0.00	0.00	0.0068	0.0037	0.0028	0.0044
E3844-A02	4-0701	Fuel Oil	6792.50	0.00	0.07	0.02	0.02	0.00	0.0068	75.74	0.00	0.00	0.0068	0.0037	0.0028	0.0044
E2194-A02	4-0695	Fuel Oil	6518.90	0.00	0.07	0.02	0.02	0.00	0.0065	72.69	0.00	0.00	0.0065	0.0035	0.0027	0.0042
E4160-A01	4-0392	Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000	0.0000	0.0000
E4160-A02	4-0506	Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000	0.0000	0.0000
E4160-A03	4-0523	Fuel Oil	7271.00	0.00	0.07	0.03	0.02	0.00	0.0073	81.07	0.00	0.00	0.0073	0.0039	0.0030	0.0047
E4160-A04	4-0723	Fuel Oil	7271.00	0.00	0.07	0.03	0.02	0.00	0.0073	81.07	0.00	0.00	0.0073	0.0039	0.0030	0.0047
E5840-A01	4-0650	Fuel Oil	1975.50	0.00	0.02	0.01	0.00	0.00	0.0020	22.03	0.00	0.00	0.0020	0.0011	0.0008	0.0013
E4305-A01	4-0702	Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000	0.0000	0.0000
E4305-A02	4-0703	Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000	0.0000	0.0000
E5126-A06	4-0460	Fuel Oil	129136.85	0.00	1.29	0.46	0.32	0.02	0.1291	1439.88	0.01	0.02	0.1291	0.0697	0.0536	0.0839
				Total	**13.56**	**2.15**	**19.41**	**1.27**	**0.97**	**31986.39**	**0.55**	**0.54**	**0.97**	**0.71**	**0.64**	**1.59**

* NOx emissions controlled using low NOx burners. The low NOx burners reduce NOx emissions to 30 ppm (36 lb/MMScf) according to manufacturer specifications.

ACTUAL EMISSION CALCULATIONS
CY 2023 GENERATORS

Emission Factor Source: Criteria Pollutant Emission Factors from Table 3.4-1 and 3.4-2 of AP-42.
GHG factors derived from oil combustion factors, 40 CFR 98, Subpart C, Tables C-1 and C-2

Pollutant	Fuel Oil lb/MMBtu (2-02-004-01)
NOx	3.2
SOx	0.001515
CO	0.85
PM	0.1
VOC	0.0819

Pollutant	Fuel Oil lb/MMBtu (2-02-004-01)
PM (Filterable)	0.062
PM-10 (Filterable)	0.0496
PM-2.5 (Filterable)	0.0479
PM Condensable	0.0077

Pollutant		Fuel Oil lb/MMBtu (2-02-004-01)
CO2		163.05
CH4		0.00661386
N2O		0.001322772

Note: All generators at APG are fueled by ultra-low sulfur diesel.

Calculation Method
Annual Emission Rate = (Emission Factor) X (Horsepower of generator) X (7.2E-03 MMBtu/hr/hp) X (hours operated/yr) / 2000
Daily Emission Rate = Annual emission rate X 2000 / Days per year
Capacity Factor = Hours Operated/8760 X 100
MRICD Emission Factors from Caterpillar guarantes, see tab "MRICD Boiler and Em Gen EF"

ACTUAL EMISSION CALCULATIONS
CY 2023 GENERATORS

Emission Unit Number	MDE Reg. Number	HP	Capacity Factor	Hours/Yr	Emission Rates							
					NOx		SOx		CO		VOC	
					tpy	lb/day	tpy	lb/day	tpy	lb/day	tpy	lb/day
09-E2800-A01	9-0448	1881	0.29%	25.4	5.50E-01	9.17E+01	2.61E-04	4.34E-02	1.46E-01	2.44E+01	1.41E-02	2.35E+00
26-E3156-A01	5-0488	685	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3510-A01	9-0378	2206	0.39%	34.0	8.64E-01	1.44E+02	4.09E-04	6.82E-02	2.30E-01	3.83E+01	2.21E-02	3.69E+00
E3549-A01	9-0232	1135	0.06%	5.6	7.31E-02	1.22E+01	3.46E-05	5.77E-03	1.94E-02	3.24E+00	1.87E-03	3.12E-01
E3835-A01	9-0341	900	0.38%	33.1	3.43E-01	5.72E+01	1.63E-04	2.71E-02	9.12E-02	1.52E+01	8.79E-03	1.46E+00
E3150-A01	9-0278	1350	0.06%	4.8	7.50E-02	1.25E+01	3.55E-05	5.91E-03	1.99E-02	3.32E+00	1.92E-03	3.20E-01
E3150-A02	9-0279	1350	0.05%	4.8	7.48E-02	1.25E+01	3.54E-05	5.90E-03	1.99E-02	3.31E+00	1.91E-03	3.19E-01
E3150-A03	9-0280	1350	0.05%	4.8	7.46E-02	1.24E+01	3.53E-05	5.89E-03	1.98E-02	3.30E+00	1.91E-03	3.18E-01
E3081-A02	9-0369	1088	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3081-A03	9-0230	1073	0.01%	0.5	6.18E-03	1.03E+00	2.93E-06	4.88E-04	1.64E-03	2.74E-01	1.58E-04	2.64E-02
E3300-A01	9-0231	1490	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5100-A01	9-0379	2206	0.49%	42.9	1.09E+00	1.82E+02	5.16E-04	8.60E-02	2.90E-01	4.83E+01	2.79E-02	4.65E+00
E1457-A01	9-0355	2200	0.42%	36.8	9.33E-01	1.55E+02	4.42E-04	7.36E-02	2.48E-01	4.13E+01	2.39E-02	3.98E+00
E3400-A01	9-0356	1818	0.07%	5.9	1.24E-01	2.06E+01	5.85E-05	9.75E-03	3.28E-02	5.47E+00	3.16E-03	5.27E-01
E3401-A01	9-0380	2206	0.07%	6.5	1.65E-01	2.75E+01	7.82E-05	1.30E-02	4.39E-02	7.31E+00	4.23E-03	7.05E-01
E2901-A01, A02, A03	9-0402	3673	0.57%	50.1	1.18E+00	1.97E+02	1.00E-03	1.67E-01	1.66E-01	2.77E+01	2.28E-02	3.81E+00
E3844-A03	9-0442	1341	0.08%	7.4	1.14E-01	1.91E+01	5.41E-05	9.02E-03	3.04E-02	5.06E+00	2.93E-03	4.88E-01
E2100	9-0453	940	0.34%	29.7	3.22E-01	5.36E+01	1.52E-04	2.54E-02	8.54E-02	1.42E+01	8.23E-03	1.37E+00
E2390-A01	9-0465	680	0.03%	2.7	2.12E-02	3.53E+00	1.00E-05	1.67E-03	5.62E-03	9.36E-01	5.41E-04	9.02E-02
E2400-A01	9-0463	1207	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5146-A01	9-0339	500	0.39%	34.4	1.98E-01	3.30E+01	9.38E-05	1.56E-02	5.26E-02	8.77E+00	5.07E-03	8.45E-01
E5126-A01	9-0293	635	0.05%	4.2	3.07E-02	5.12E+00	1.45E-05	2.42E-03	8.16E-03	1.36E+00	7.86E-04	1.31E-01
E3566-A01	9-0464	635	1.11%	97.3	7.12E-01	1.19E+02	3.37E-04	5.62E-02	1.89E-01	3.15E+01	1.82E-02	3.04E+00
E2851-A06	9-0485	2923	0.02%	1.5	5.05E-02	8.42E+00	2.39E-05	3.99E-03	1.34E-02	2.24E+00	1.29E-03	2.15E-01
E2851-A07	9-0486	2923	0.02%	1.4	4.71E-02	7.86E+00	2.23E-05	3.72E-03	1.25E-02	2.09E+00	1.21E-03	2.01E-01
E3857	9-0506	2923	0.05%	4.1	1.38E-01	2.30E+01	6.54E-05	1.09E-02	3.67E-02	6.11E+00	3.53E-03	5.89E-01
E4520 (old) E3462 (New)	9-0484	755	0.10%	9.0	7.83E-02	1.30E+01	3.71E-05	6.18E-03	2.08E-02	3.47E+00	2.00E-03	3.34E-01
				Total	**7.26E+00**	**1.21E+03**	**3.88E-03**	**6.47E-01**	**1.78E+00**	**2.97E+02**	**1.79E-01**	**2.98E+01**

ACTUAL EMISSION CALCULATIONS
CY 2023 GENERATORS

Emission Unit Number	MDE Reg. Number	HP	Capacity Factor	Hours/Yr	Emission Rates							
					PM (filterable)		PM-10 (filterable)		PM-2.5 (filterable)		PM Condensable	
					tpy	lb/day	tpy	lb/day	tpy	lb/day	tpy	lb/day
09-E2800-A01	9-0448	1881	0.29%	25.4	1.07E-02	1.78E+00	8.53E-03	1.42E+00	8.24E-03	1.37E+00	1.32E-03	2.21E-01
26-E3156-A01	5-0488	685	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3510-A01	9-0378	2206	0.39%	34.0	1.67E-02	2.79E+00	1.34E-02	2.23E+00	1.29E-02	2.16E+00	2.08E-03	3.47E-01
E3549-A01	9-0232	1135	0.06%	5.6	1.42E-03	2.36E-01	1.13E-03	1.89E-01	1.09E-03	1.82E-01	1.76E-04	2.93E-02
E3835-A01	9-0341	900	0.38%	33.1	6.65E-03	1.11E+00	5.32E-03	8.87E-01	5.14E-03	8.57E-01	8.26E-04	1.38E-01
E3150-A01	9-0278	1350	0.06%	4.8	1.45E-03	2.42E-01	1.16E-03	1.94E-01	1.12E-03	1.87E-01	1.80E-04	3.01E-02
E3150-A02	9-0279	1350	0.05%	4.8	1.45E-03	2.42E-01	1.16E-03	1.93E-01	1.12E-03	1.87E-01	1.80E-04	3.00E-02
E3150-A03	9-0280	1350	0.05%	4.8	1.45E-03	2.41E-01	1.16E-03	1.93E-01	1.12E-03	1.86E-01	1.80E-04	2.99E-02
E3081-A02	9-0369	1088	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3300-A01	9-0231	1490	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3081-A03	9-0230	1073	0.01%	0.5	1.20E-04	2.00E-02	9.58E-05	1.60E-02	9.25E-05	1.54E-02	1.49E-05	2.48E-03
E5100-A01	9-0379	2206	0.49%	42.9	2.11E-02	3.52E+00	1.69E-02	2.82E+00	1.63E-02	2.72E+00	2.62E-03	4.37E-01
E1457-A01	9-0355	2200	0.42%	36.8	1.81E-02	3.01E+00	1.45E-02	2.41E+00	1.40E-02	2.33E+00	2.24E-03	3.74E-01
E3400-A01	9-0356	1818	0.07%	5.9	2.39E-03	3.99E-01	1.92E-03	3.19E-01	1.85E-03	3.08E-01	2.97E-04	4.96E-02
E3401-A01	9-0380	2206	0.07%	6.5	3.20E-03	5.33E-01	2.56E-03	4.27E-01	2.47E-03	4.12E-01	3.97E-04	6.62E-02
E2901-A01, A02, A03	9-0402	11019	0.57%	50.1	1.23E-01	2.05E+01	9.86E-02	1.64E+01	9.52E-02	1.59E+01	1.53E-02	2.55E+00
E3844-A03	9-0442	1341	0.08%	7.4	2.21E-03	3.69E-01	1.77E-03	2.95E-01	1.71E-03	2.85E-01	2.75E-04	4.58E-02
E2100	9-0453	940	0.34%	29.7	6.23E-03	1.04E+00	4.99E-03	8.31E-01	4.81E-03	8.02E-01	7.74E-04	1.29E-01
E2390-A01	9-0465	680	0.03%	2.7	4.10E-04	6.83E-02	3.28E-04	5.46E-02	3.17E-04	5.28E-02	5.09E-05	8.48E-03
E2400-A01	9-0463	1207	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5146-A01	9-0339	500	0.39%	34.4	3.84E-03	6.40E-01	3.07E-03	5.12E-01	2.97E-03	4.94E-01	4.77E-04	7.95E-02
E5126-A01	9-0293	635	0.05%	4.2	5.95E-04	9.92E-02	4.76E-04	7.94E-02	4.60E-04	7.66E-02	7.39E-05	1.23E-02
E3566-A01	9-0464	635	1.11%	97.3	1.38E-02	2.30E+00	1.10E-02	1.84E+00	1.07E-02	1.78E+00	1.71E-03	2.85E-01
E2851-A06	9-0485	2923	0.02%	1.5	9.79E-04	1.63E-01	7.83E-04	1.30E-01	7.56E-04	1.26E-01	1.22E-04	2.03E-02
E2851-A07	9-0486	2923	0.02%	1.4	9.13E-04	1.52E-01	7.31E-04	1.22E-01	7.06E-04	1.18E-01	1.13E-04	1.89E-02
E3857	9-0506	2923	0.05%	4.1	2.67E-03	4.46E-01	2.14E-03	3.57E-01	2.07E-03	3.44E-01	3.32E-04	5.54E-02
E4520 (old) E3462 (New)	9-0484	755	0.10%	9.0	1.52E-03	2.53E-01	1.21E-03	2.02E-01	1.17E-03	1.95E-01	1.88E-04	3.14E-02
				Total	**2.41E-01**	**4.02E+01**	**1.93E-01**	**3.21E+01**	**1.86E-01**	**3.10E+01**	**2.99E-02**	**4.99E+00**

ACTUAL EMISSION CALCULATIONS
CY 2023 GENERATORS

Emission Unit Number	MDE Reg. Number	HP	Capacity Factor	Hours/Yr	Emission Rates					
					CO2		CH4		N2O	
					tpy	lb/day	tpy	lb/day	tpy	lb/day
09-E2800-A01	9-0448	1881	0.29%	25.4	2.80E+01	4.67E+03	1.14E-03	1.90E-01	2.28E-04	3.79E-02
26-E3156-A01	5-0488	685	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3510-A01	9-0378	2206	0.39%	34.0	4.40E+01	7.34E+03	1.79E-03	2.98E-01	3.57E-04	5.95E-02
E3549-A01	9-0232	1135	0.06%	5.6	3.72E+00	6.21E+02	1.51E-04	2.52E-02	3.02E-05	5.04E-03
E3835-A01	9-0341	900	0.38%	33.1	1.75E+01	2.92E+03	7.10E-04	1.18E-01	1.42E-04	2.37E-02
E3150-A01	9-0278	1350	0.06%	4.8	3.82E+00	6.37E+02	1.55E-04	2.58E-02	3.10E-05	5.16E-03
E3150-A02	9-0279	1350	0.05%	4.8	3.81E+00	6.35E+02	1.55E-04	2.58E-02	3.09E-05	5.15E-03
E3150-A03	9-0280	1350	0.05%	4.8	3.80E+00	6.34E+02	1.54E-04	2.57E-02	3.09E-05	5.14E-03
E3081-A02	9-0369	1088	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3300-A01	9-0231	1490	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3081-A03	9-0230	1073	0.01%	0.5	3.15E-01	5.25E+01	1.28E-05	2.13E-03	2.55E-06	4.26E-04
E5100-A01	9-0379	2206	0.49%	42.9	5.56E+01	9.26E+03	2.25E-03	3.76E-01	4.51E-04	7.51E-02
E1457-A01	9-0355	2200	0.42%	36.8	4.75E+01	7.92E+03	1.93E-03	3.21E-01	3.86E-04	6.43E-02
E3400-A01	9-0356	1818	0.07%	5.9	6.30E+00	1.05E+03	2.55E-04	4.26E-02	5.11E-05	8.51E-03
E3401-A01	9-0380	2206	0.07%	6.5	8.42E+00	1.40E+03	3.41E-04	5.69E-02	6.83E-05	1.14E-02
E2901-A01, A02, A03	9-0402	11019	0.57%	50.1	3.24E+02	5.40E+04	1.31E-02	2.19E+00	2.63E-03	4.38E-01
E3844-A03	9-0442	1341	0.08%	7.4	5.82E+00	9.71E+02	2.36E-04	3.94E-02	4.73E-05	7.88E-03
E2100	9-0453	940	0.34%	29.7	1.64E+01	2.73E+03	6.65E-04	1.11E-01	1.33E-04	2.22E-02
E2390-A01	9-0465	680	0.03%	2.7	1.08E+00	1.80E+02	4.37E-05	7.29E-03	8.74E-06	1.46E-03
E2400-A01	9-0463	1207	0.00%	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5146-A01	9-0339	500	0.39%	34.4	1.01E+01	1.68E+03	4.10E-04	6.83E-02	8.19E-05	1.37E-02
E5126-A01	9-0293	635	0.05%	4.2	1.57E+00	2.61E+02	6.35E-05	1.06E-02	1.27E-05	2.12E-03
E3566-A01	9-0464	635	1.11%	97.3	3.63E+01	6.05E+03	1.47E-03	2.45E-01	2.94E-04	4.90E-02
E2851-A06	9-0485	2923	0.02%	1.5	2.57E+00	4.29E+02	1.04E-04	1.74E-02	2.09E-05	3.48E-03
E2851-A07	9-0486	2923	0.02%	1.4	2.40E+00	4.00E+02	9.74E-05	1.62E-02	1.95E-05	3.25E-03
E3857	9-0506	2923	0.05%	4.1	7.03E+00	1.17E+03	2.85E-04	4.76E-02	5.71E-05	9.51E-03
E4520 (old) E3462 (New)	9-0484	755	0.10%	9.0	3.99E+00	6.65E+02	1.62E-04	2.70E-02	3.24E-05	5.39E-03
				Total	**6.34E+02**	**1.06E+05**	**2.57E-02**	**4.29E+00**	**5.14E-03**	**8.57E-01**

NOTES:
Capacity Factor is calculated as defined in 40 CFR 72.2.
The generator hours shown on Forms 2 and 3 are based on the maintenance schedule, while the hours shown in the table above are the actual operating hours for maintenance and emergency use during the calendar year.

ACTUAL EMISSION CALCULATIONS CY2023
CHP Unit at E5126

CY2023 CHP Unit (E5126-A10 - MDE Regist. No. 5-0366) Criteria Pollutant Emissions

Emissions Point	Fuel	Annual Process Throughput		Annual Process duration		Criteria Pollutant	Emission Factors			Potential Emission Estimates	
		rate	unit	rate	unit		rate	unit	notes	lb/hr	ton/yr
Gas Turbine Emissions	Fuel Oil	284	MMBtu	4.0	hr	VOC	3.50E-02	lb/MMBtu	1	2.48490991	4.97E-03
		284	MMBtu	4.0	hr	NO_x	3.67E-02	lb/MMBtu	2	2.60E+00	5.21E-03
		284	MMBtu	4.0	hr	CO	6.13E-02	lb/MMBtu	1	4.35E+00	8.70E-03
		284	MMBtu	4.0	hr	PM10 (filterable)	6.00E-02	lb/MMBtu	1	4.26E+00	8.52E-03
		284	MMBtu	4.0	hr	PM2.5 (filterable)	6.00E-02	lb/MMBtu	1	4.26E+00	8.52E-03
		284	MMBtu	4.0	hr	PM (condensible)	7.20E-03	lb/MMBtu	3	5.11E-01	1.02E-03
		284	MMBtu	4.0	hr	SO_2	3.30E-02	lb/MMBtu	3	2.34E+00	4.68E-03
		284	MMBtu	4.0	hr	CO_2	73.96	kg/MMBtu	5	1.16E+04	2.31E+01
		284	MMBtu	4.0	hr	CH_4	3.00E-03	kg/MMBtu	5	4.69E-01	9.38E-04
		284	MMBtu	4.0	hr	N_2O	6.00E-04	kg/MMBtu	5	9.38E-02	1.88E-04
Gas Turbine Emissions	Natural Gas	598,727	MMBtu	6675	hr	VOC	6.91E-03	lb/MMBtu	1	6.19E-01	2.07E+00
		598,727	MMBtu	6675	hr	NOx	9.50E-03	lb/MMBtu	2	8.52E-01	2.84E+00
		598,727	MMBtu	6675	hr	CO	6.05E-02	lb/MMBtu	1	5.43E+00	1.81E+01
		598,727	MMBtu	6675	hr	PM10 (filterable)	1.50E-02	lb/MMBtu	1	1.35E+00	4.49E+00
		598,727	MMBtu	6675	hr	PM2.5 (filterable)	1.50E-02	lb/MMBtu	1	1.35E+00	4.49E+00
		598,727	MMBtu	6675	hr	PM (condensible)	4.70E-03	lb/MMBtu	3	4.22E-01	1.41E+00
		598,727	MMBtu	6675	hr	SO2	3.40E-03	lb/MMBtu	3	3.05E-01	1.02E+00
		598,727	MMBtu	6675	hr	CO_2	53.020	kg/MMBtu	5	1.05E+04	3.50E+04
		598,727	MMBtu	6675	hr	CH_4	1.00E-03	kg/MMBtu	5	1.98E-01	6.59E-01
		598,727	MMBtu	6675	hr	N_2O	1.00E-04	kg/MMBtu	5	1.98E-02	6.59E-02
Duct Burner Emissions	Natural Gas	106,460	MMBtu	1557	hr	VOC	2.00E-02	lb/MMBtu	4	1.37E+00	1.06E+00
		106,460	MMBtu	1557	hr	NO_x	9.50E-03	lb/MMBtu	2	6.50E-01	5.06E-01
		106,460	MMBtu	1557	hr	CO	8.00E-02	lb/MMBtu	4	5.47E+00	4.26E+00
		106,460	MMBtu	1557	hr	PM10 (filterable)	1.00E-02	lb/MMBtu	4	6.84E-01	5.32E-01
		106,460	MMBtu	1557	hr	PM2.5 (filterable)	1.00E-02	lb/MMBtu	4	6.84E-01	5.32E-01
		106,460	MMBtu	1557	hr	PM (condensible)	5.60E-03	lb/MMBtu	3	3.83E-01	2.98E-01
		106,460	MMBtu	1557	hr	SO_2	5.88E-04	lb/MMBtu	3	4.02E-02	3.13E-02
		106,460	MMBtu	1557	hr	CO_2	53.020	kg/MMBtu	5	7.99E+03	6.22E+03
		106,460	MMBtu	1557	hr	CH_4	1.00E-03	kg/MMBtu	5	1.51E-01	1.17E-01
		106,460	MMBtu	1557	hr	N_2O	1.00E-04	kg/MMBtu	5	1.51E-02	1.17E-02
Total Emissions						VOC	-	-	-	4.47E+00	3.14E+00
						NO_x	-	-	-	4.11E+00	3.35E+00
						CO	-	-	-	1.52E+01	2.24E+01
						PM10 (filterable)	-	-	-	6.29E+00	5.03E+00
						PM2.5 (filterable)	-	-	-	6.29E+00	5.03E+00
						PM (condensible)	-	-	-	1.32E+00	1.71E+00
						SO_2	-	-	-	2.69E+00	1.05E+00
						CO_2	-	-	-	3.00E+04	4.12E+04
						CH_4	-	-	-	8.17E-01	7.78E-01
						N_2O	-	-	-	1.29E-01	7.79E-02

Notes:
1. Solar Turbine, Technical Proposal submitted to Johnson Controls, Inc. on 11/25/2014 (page 81 to 85 of 131).
2. Per performance test conducted on November 2016 equipped with SCR operation
3. AP-42, Chapter 3.1, Table 3.1-2a for Gas Turbine and Chapter 1.4, Table 1.4-2 for Duct Burner
4. Rentech Proposal submitted to Johnson Controls, Inc. on 10/30/2014 (page 23 of 45).
5. 40 CFR 98, Subpart C, Table 1 and 2 for Natural Gas
6. Maximum hourly capacities for the gas turbine and the duct burner taken from PTC to calculate the annual process duration.
   89.7 MMBTU/hr for the gas turbine and 68.38 MMBTU/hr for the duct burner.

ACTUAL HAP EMISSION CALCULATIONS CY2023
CHP Unit at E5126

CY2023 CHP Unit (E5126-A10 - MDE Regist. No. 5-0366) HAP Emissions

Gas Turbine Heat Input (NG)	89.7	MMBtu/hr	6675 hr/yr	
Duct Burner Heat Input (NG)	68.4	MMBtu/hr	1557 hr/yr	
Total NG Heat Input	158.1	MMBtu/hr	6675 hr/yr	Duct burner hours included in turbine NG hours
Gas Turbine Heat Input (FO)	71.0	MMBtu/hr	4 hr/yr	

HAPS	Fuel Oil Emission Factor[1]	NG Emission Factor[2]	Fuel Oil HAP Emissions		Natural Gas HAP Emissions		Total Emissions	
	lb/MMBtu	lb/MMBtu	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
1,3-Butadiene	1.60E-05	4.30E-07	1.14E-03	2.27E-06	6.80E-05	2.27E-04	1.20E-03	2.29E-04
Acetaldehyde	2.55E-03	4.00E-05	1.81E-01	3.62E-04	6.32E-03	2.11E-02	1.87E-01	2.15E-02
Acrolein	2.55E-03	6.40E-06	1.81E-01	3.62E-04	1.01E-03	3.38E-03	1.82E-01	3.74E-03
Benzene	5.50E-05	1.20E-05	3.90E-03	7.81E-06	1.90E-03	6.33E-03	5.80E-03	6.34E-03
Chlorobenzene	1.46E-06		1.03E-04	2.07E-07			1.03E-04	2.07E-07
Ethylbenzene	1.46E-06	3.20E-05	1.03E-04	2.07E-07	5.06E-03	1.69E-02	5.16E-03	1.69E-02
Hexane	2.55E-05	1.27E-06	1.81E-03	3.62E-06	2.01E-04	6.72E-04	2.01E-03	6.76E-04
Hydrogen Chloride	1.36E-03		9.63E-02	1.93E-04			9.63E-02	1.93E-04
Formaldehyde	2.80E-04	7.10E-04	1.99E-02	3.97E-05	1.12E-01	3.75E-01	1.32E-01	3.75E-01
Naphthalene	3.50E-05	1.30E-06	2.48E-03	4.97E-06	2.06E-04	6.86E-04	2.69E-03	6.91E-04
PAH	4.00E-05	2.20E-06	2.84E-03	5.68E-06	3.48E-04	1.16E-03	3.19E-03	1.17E-03
Arsenic	1.10E-05		7.81E-04	1.56E-06			7.81E-04	1.56E-06
Beryllium	3.10E-07		2.20E-05	4.40E-08			2.20E-05	4.40E-08
Cadmium	4.80E-06		3.41E-04	6.81E-07			3.41E-04	6.81E-07
Chromium	1.10E-05		7.81E-04	1.56E-06			7.81E-04	1.56E-06
Copper	2.98E-05		2.12E-03	4.24E-06			2.12E-03	4.24E-06
Lead	1.40E-05	3.40E-06	9.94E-04	1.99E-06	5.37E-04	1.79E-03	1.53E-03	1.80E-03
Manganese	7.90E-04		5.61E-02	1.12E-04			5.61E-02	1.12E-04
Mercury	1.20E-06		8.52E-05	1.70E-07			8.52E-05	1.70E-07
Nickel	4.60E-06		3.26E-04	6.53E-07			3.26E-04	6.53E-07
Propylene Oxide		2.90E-05			4.58E-03	1.53E-02	4.58E-03	1.53E-02
Selenium	2.50E-05		1.77E-03	3.55E-06			1.77E-03	3.55E-06
Toluene	3.20E-05	1.30E-04	2.27E-03	4.55E-06	2.06E-02	6.86E-02	2.28E-02	6.86E-02
Xylene	1.16E-05	6.40E-05	8.27E-04	1.65E-06	1.01E-02	3.38E-02	1.09E-02	3.38E-02
Zinc	1.63E-04		1.16E-02	2.31E-05			1.16E-02	2.31E-05
Total			**0.57**	**0.00**	**0.16**	**0.54**	**0.73**	**0.55**

[1] AP-42 Chapter 3.1 Gas Turbines (Tables 3.1-4 and 3.1-5) & Ventura County Air Pollution Control District AB2588 Combustion Emission Factors

[2] AP-42 Chapter 3.1 Gas Turbines (Table 3.1-3) & Ventura County Air Pollution Control District AB2588 Combustion Emission Factors

Large Paint Spray Booth
Log CY2023

Paint Spray Booth (Large PSB: Bldg E4301, E4301-A01 MDE Registration # 12-6-0497)

HAP/TAP Emissions				Tons/year		lbs/hr					
Material	**Constituent**	**Constituent % by weight (expressed as a decimal)**	**Density (lb/gal)**	**Volatile Constituent Emissions (tpy)**	**Particulate Constituent Emissions (tpy)***	**Volatile Constituent Emissions (lb/hr)**	**Particulate Constituent Emissions (lb/hr)**	**Reporting Threshold (lb/hr)**	**Reporting Threshold (tpy)**	**Report on Form 4 (tpy)**	**Report on Form 4 (lb/hr)**
ESU470	Epoxy Resin	0.135	12.52	2.23E-04		2.23E-01					
	Titanium Dioxide	0.15	12.52		8.68E-06		4.34E-03				
	bis-[4-(2,3-epoxipropoxi)phenyl]propane	0.15	12.52	2.48E-04		2.48E-01					
	4-chloro-α,α,α-trifluorotoluene	0.115	12.52	1.90E-04		1.90E-01					
	Talc, not containing asbestiform fibres	0.15	12.52		8.68E-06		4.34E-03				
	Acetone	0.075	12.52	1.24E-04		1.24E-01					
	Kaolin	0.075	12.52		4.34E-06		2.17E-03				
	Butanone	0.03	12.52	4.96E-05		4.96E-02		1.00E+01	1.00E+01	No	No
	Xylene	0.0145	12.52	2.40E-05		2.40E-02		1.00E+00	1.00E+01	No	No
	Isopropyl alcohol	0.025	12.52	4.13E-05		4.13E-02					
	Ethyl Benzene	0.01	12.52	1.65E-05		1.65E-02		1.00E+00	1.00E+01	No	No
	Fatty acids, C18-unsatd., dimers, reaction products with N,N-dimethyl1,3-propanediamine and 1,3-propanediamine	0.01	12.52		5.79E-07		2.89E-04				
	Crystalline Silica, respirable powder (<10 microns)	0.01	12.52		5.79E-07		2.89E-04				
	Carbon Black, respirable powder	0.01	12.52		5.79E-07		2.89E-04				
ESS (HS Polyurethane Single Stage)	Acetone	0.5	8.76	1.74E-03		1.74E+00					
	n-butyl acetate	0.5	8.76	1.74E-03		1.74E+00					
	4-chloro-α,α,α-trifluorotoluene	0.5	8.76	1.74E-03		1.74E+00					
	Heptanone	0.5	8.76	1.74E-03		1.74E+00					
	Diiron trioxide	0.2	8.76		2.43E-05		1.22E-02				
	2-methoxy-1-methylethyl acetate	0.2	8.76	6.94E-04		6.94E-01		1.00E+00	1.00E+00	No	No
	Barium sulfate	0.05	8.76		6.08E-06		3.04E-03				
	Solvent naphtha, light aromatic	0.05	8.76	1.74E-04		1.74E-01					
	Solvent naphtha, light aliph.	0.05	8.76	1.74E-04		1.74E-01					
	Naphtha, hydrotreated heavy	0.05	8.76	1.74E-04		1.74E-01					
	2-hydroxyethyl ethers (cashew nutshell)	0.05	8.76	1.74E-04		1.74E-01					
	ethyl-3-ethoxypropionate	0.05	8.76	1.74E-04		1.74E-01					
	Isopropyl alcohol	0.05	8.76	1.74E-04		1.74E-01					
	Aluminum hyroxide	0.05	8.76		6.08E-06		3.04E-03				
	Acidic polyester	0.05	8.76		6.08E-06		3.04E-03				
	Stoddard solvent	0.05	8.76	1.74E-04		1.74E-01					
	1,2,4-Trimethylbenzene	0.05	8.76	1.74E-04		1.74E-01					
	Zinc Sulphide	0.05	8.76		6.08E-06		3.04E-03	1.00E-02	1.00E-01	No	No
	Carbon Black, respirable powder	0.05	8.76		6.08E-06		3.04E-03				
	2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol	0.05	8.76	1.74E-04		1.74E-01					
	Heptane	0.05	8.76	1.74E-04		1.74E-01					
	Naphtha, heavy alkylate	0.05	8.76	1.74E-04		1.74E-01					
	Dibutyltin di(acetate)	0.01	8.76	3.47E-05		3.47E-02					
	Fatty acides, C18-unsatd., dimers, reaction products with N,N-dimethyl-1, 3-propanediamine, and 1,3-propanediamine	0.01	8.76		1.22E-06		6.08E-04				
	Ethyl Benzene	0.01	8.76	3.47E-05		3.47E-02		1.00E+00	1.00E+01	No	No
	Titanium Dioxide	0.75	8.76		9.11E-05		4.56E-02				
Nanoclear	t-Butyl Acetate	0.6250	8.26	9.03E-03		4.52E+00					
	Acrylic Polyol	0.3750	8.26		1.90E-04		9.48E-02				
	Light, Aromatic Naphtha	0.1250	8.26	1.81E-03		9.03E-01					
	1,6-hexamethylene diisocyanate Homopolymer	0.1250	8.26	1.81E-03		9.03E-01		1.00E-04	1.00E-03	No	Yes
			Totals	**2.32E-02**	**3.60E-04**						

* Conservative assumption that there is 35% overspray and the filter capture efficiency is 90%, so 10% of the overspray escapes the filters.

Small Paint Spray Booth
Log CY2023

Paint Spray Booth (Small PSB: Bldg E4301, E4301-A02 MDE Registration # 12-6-0498)

HAP/TAP Emissions				Tons/year		lbs/hr					
Material	**Constituent**	**Constituent % by weight (expressed as a decimal)**	**Density (lb/gal)**	**Volatile Constituent Emissions (tpy)**	**Particulate Constituent Emissions (tpy)***	**Volatile Constituent Emissions (lb/hr)**	**Particulate Constituent Emissions (lb/hr)**	**Reporting Threshold (lb/hr)**	**Reporting Threshold (tpy)**	**Report on Form 4 (tpy)**	**Report on Form 4 (lb/hr)**
ESS (HS Polyurethane Single Stage)	Acetone	0.5	8.76	1.16E-03		7.71E-01					
	n-butyl acetate	0.5	8.76	1.16E-03		7.71E-01					
	4-chloro-α,α,α-trifluorotoluene	0.5	8.76	1.16E-03		7.71E-01					
	Heptanone	0.5	8.76	1.16E-03		7.71E-01					
	Diiron trioxide	0.2	8.76		1.62E-05		1.08E-02				
	2-methoxy-1-methylethyl acetate	0.2	8.76	4.63E-04		3.09E-01		1.00E+00	1.00E+00	No	No
	Barium sulfate	0.05	8.76		4.05E-06		2.70E-03				
	Solvent naphtha, light aromatic	0.05	8.76	1.16E-04		7.71E-02					
	Solvent naphtha, light aliph.	0.05	8.76	1.16E-04		7.71E-02					
	Naphtha, hydrotreated heavy	0.05	8.76	1.16E-04		7.71E-02					
	2-hydroxyethyl ethers (cashew nutshell)	0.05	8.76	1.16E-04		7.71E-02					
	ethyl-3-ethoxypropionate	0.05	8.76	1.16E-04		7.71E-02					
	Isopropyl alcohol	0.05	8.76	1.16E-04		7.71E-02					
	Aluminum hyroxide	0.05	8.76		4.05E-06		2.70E-03				
	Acidic polyester	0.05	8.76		4.05E-06		2.70E-03				
	Stoddard solvent	0.05	8.76	1.16E-04		7.71E-02					
	1,2,4-Trimethylbenzene	0.05	8.76	1.16E-04		7.71E-02					
	Zinc Sulphide	0.05	8.76		4.05E-06		2.70E-03	1.00E-02	1.00E-01	No	No
	Carbon Black, respirable powder	0.05	8.76		4.05E-06		2.70E-03				
	2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol	0.05	8.76	1.16E-04		7.71E-02					
	Heptane	0.05	8.76	1.16E-04		7.71E-02					
	Naphtha, heavy alkylate	0.05	8.76	1.16E-04		7.71E-02					
	Dibutyltin di(acetate)	0.01	8.76	2.31E-05		1.54E-02					
	Fatty acids, C18-unsatd., dimers, reaction products with N,N-dimethyl-1, 3-propanediamine, and 1,3-propanediamine	0.01	8.76		8.10E-07		5.40E-04				
	Ethyl Benzene	0.01	8.76	2.31E-05		1.54E-02		1.00E+00	1.00E+01	No	No
	Titanium Dioxide	0.75	8.76		6.08E-05		4.05E-02				
Nanoclear	t-Butyl Acetate	0.6250	8.26	3.41E-04		1.70E-01					
	Acrylic Polyol	0.3750	8.26		7.16E-06		3.58E-03				
	Light, Aromatic Naphtha	0.1250	8.26	6.82E-05		3.41E-02					
	1,6-hexamethylene diisocyanate Homopolymer	0.1250	8.26	6.82E-05		3.41E-02		1.00E-04	1.00E-03	No	Yes
			Totals	**6.89E-03**	**1.05E-04**						

* Conservative assumption that there is 35% overspray and the filter capture efficiency is 90%, so 10% of the overspray escapes the filters.

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Boilers

HAP	NG EF lb/MMscf	Oil EF lb/1000 gal
Acetaldehyde	4.30E-03	3.51E-01
Acenaphthene	1.80E-06	2.11E-05
Acenaphthylene	1.80E-06	2.53E-07
Acrolein	2.70E-03	3.51E-01
Anthracene	2.40E-06	1.22E-06
Arsenic	2.00E-04	1.60E-03
Benz(a)anthracene	1.80E-06	4.01E-06
Benzene	2.10E-03	2.14E-04
Benzo(a)pyrene	1.20E-06	
Benzo(b)fluoranthene	1.80E-06	1.48E-06
Benzo(ghi)perylene	1.20E-06	2.26E-06
Benzo(k)fluoranthene	1.80E-06	1.48E-06
Beryllium	1.20E-05	
1,3-Butadiene		1.48E-02
Cadmium	1.10E-03	1.50E-03
Chlorobenzene		2.00E-04
Chromium	1.40E-03	6.00E-04
Chrysene	1.80E-06	2.38E-06
Cobalt	8.40E-05	
Copper		4.10E-03
Dibenzo(a,h)anthracene	1.20E-06	1.67E-06
Dichlorobenzene	1.20E-03	
Ethyl Benzene	9.50E-03	6.36E-05
Fluoranthene	3.00E-06	4.84E-06
Fluorene	2.80E-06	4.47E-06
Formaldehyde	7.50E-02	3.30E-02
Hydrochloric Acid		1.86E-01
Indeno(1,2,3-cd)pyrene	1.80E-06	2.14E-06
Lead	5.00E-04	8.30E-03
Manganese	3.80E-04	3.10E-03
Mercury	2.60E-04	2.00E-03
Methyl Chloroform		2.36E-04
Naphthalene	6.10E-04	1.13E-03
Nickel	2.10E-03	3.90E-03
Phenanthrene	1.70E-05	1.05E-05
Pyrene	5.00E-06	4.25E-06
Selenium	2.40E-05	2.20E-03
Toluene	3.40E-03	6.20E-03
Xylene	2.72E-02	1.09E-04
Zinc		2.24E-02
Hexane	1.80E+00	3.50E-03

Emergency Generators Oil EF

HAP	≤600 HP lb/MMBtu	>600 HP lb/MMBtu
Acetaldehyde	7.67E-04	2.52E-05
Acenaphthene	1.42E-06	4.68E-06
Acenaphthylene	5.06E-06	9.23E-06
Acrolein	9.25E-05	7.88E-06
Anthracene	1.87E-06	1.23E-06
Arsenic	1.60E-03	1.60E-03
Benz(a)anthracene	1.68E-06	6.22E-07
Benzene	9.33E-04	7.76E-04
Benzo(a)pyrene	1.88E-07	2.57E-07
Benzo(b)fluoranthene	9.91E-08	1.11E-06
Benzo(ghi)perylene	4.89E-07	5.56E-07
Benzo(k)fluoranthene	1.55E-07	2.18E-07
Beryllium		
1,3-Butadiene	3.91E-05	2.17E-01
Cadmium	1.50E-03	1.50E-03
Chlorobenzene	2.00E-04	2.00E-04
Chromium	6.00E-04	6.00E-04
Chrysene	3.53E-07	1.53E-06
Cobalt		
Copper	4.10E-03	4.10E-03
Dibenzo(a,h)anthracene	5.83E-07	3.46E-07
Dichlorobenzene		
Ethyl Benzene	1.09E-02	1.09E-02
Fluoranthene	7.61E-06	4.03E-06
Fluorene	2.92E-05	1.28E-05
Formaldehyde	1.18E-03	7.89E-05
Hydrochloric Acid	1.86E-01	1.86E-01
Indeno(1,2,3-cd)pyrene	3.75E-07	4.14E-07
Lead	8.30E-03	8.30E-03
Manganese	3.10E-03	3.10E-03
Mercury	2.00E-03	2.00E-03
Methyl Chloroform		
Naphthalene	8.48E-05	1.30E-04
Nickel	3.90E-03	3.90E-03
Phenanthrene	2.94E-05	4.08E-05
Pyrene	4.78E-06	3.71E-06
Selenium	2.20E-03	2.20E-03
Toluene	4.09E-04	2.81E-04
Xylene	2.85E-04	1.93E-04
Zinc	2.24E-02	2.24E-02
Hexane	2.69E-02	2.69E-02

Notes: 1. Boiler NG EFs from AP-42 Vol. I:1.4: Natural Gas Combustion, Table 1.4-3.
2. Boiler Oil EFs from AP-42 Vol. I:1.3: Fuel Oil Combustion, Table 1.3-9.
3. Emergency Generator EFs from AP-42 Vol. I:3.3: Gasoline and Diesel Industrial Engines, Table 3.3-2. & AP-42 Vol. I3.4: Large Stationary Diesel and All Stationary Duel-fuel Engines, Tables 3.4-3 and 3.4-4
4. HAPs EF not available from AP-42 were replaced with factors from "*Ventura County Air Pollution Control District - AB 2588 Combustion Emission Factors, May 17, 2001*"

From MDE's Air Quality Compliance Program webpage: Beginning with the 2010 emissions year, ARA is requiring that all Title V facilities report emissions of HAPs from all registered equipment including fuel burning sources.

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Boilers Emissions (tpy)

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Acetaldehyde	Acenaphthene	Acenaphthylene	Acrolein	Anthracene	Arsenic	Benz(a)anthracene	Benzene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Beryllium	1,3-Butadiene	Cadmium	Chlorobenzene	Chromium	Chrysene	Cobalt	Copper
E2100-A03	5-0329	0.08	1.80	1.77E-05	2.45E-09	1.63E-09	1.62E-05	2.20E-09	2.43E-07	1.77E-09	1.89E-06	1.08E-09	1.67E-09	1.17E-09	1.67E-09	1.08E-08	5.83E-07	1.05E-06	7.88E-09	1.28E-06	1.71E-09	7.54E-08	1.61E-07
E2100-A04	5-0330	0.08	1.80	1.77E-05	2.45E-09	1.63E-09	1.62E-05	2.20E-09	2.43E-07	1.77E-09	1.89E-06	1.08E-09	1.67E-09	1.17E-09	1.67E-09	1.08E-08	5.83E-07	1.05E-06	7.88E-09	1.28E-06	1.71E-09	7.54E-08	1.61E-07
E2100-A05	5-0331	0.08	1.80	1.77E-05	2.45E-09	1.63E-09	1.62E-05	2.20E-09	2.43E-07	1.77E-09	1.89E-06	1.08E-09	1.67E-09	1.17E-09	1.67E-09	1.08E-08	5.83E-07	1.05E-06	7.88E-09	1.28E-06	1.71E-09	7.54E-08	1.61E-07
E2100-A01	5-0332	0.08	1.80	1.77E-05	2.45E-09	1.63E-09	1.62E-05	2.20E-09	2.43E-07	1.77E-09	1.89E-06	1.08E-09	1.67E-09	1.17E-09	1.67E-09	1.08E-08	5.83E-07	1.05E-06	7.88E-09	1.28E-06	1.71E-09	7.54E-08	1.61E-07
E2100-A02	5-0333	0.08	1.80	1.77E-05	2.45E-09	1.63E-09	1.62E-05	2.20E-09	2.43E-07	1.77E-09	1.89E-06	1.08E-09	1.67E-09	1.17E-09	1.67E-09	1.08E-08	5.83E-07	1.05E-06	7.88E-09	1.28E-06	1.71E-09	7.54E-08	1.61E-07
E2100-A06	5-0316	0.08	1.80	1.77E-05	2.45E-09	1.63E-09	1.62E-05	2.20E-09	2.43E-07	1.77E-09	1.89E-06	1.08E-09	1.67E-09	1.17E-09	1.67E-09	1.08E-08	5.83E-07	1.05E-06	7.88E-09	1.28E-06	1.71E-09	7.54E-08	1.61E-07
E2100-A07	5-0317	0.08	1.80	1.77E-05	2.45E-09	1.63E-09	1.62E-05	2.20E-09	2.43E-07	1.77E-09	1.89E-06	1.08E-09	1.67E-09	1.17E-09	1.67E-09	1.08E-08	5.83E-07	1.05E-06	7.88E-09	1.28E-06	1.71E-09	7.54E-08	1.61E-07
E1574-A01	5-0311	0.00	2.71	5.82E-06	2.44E-09	2.44E-09	3.65E-06	3.25E-09	2.71E-07	2.44E-09	2.84E-06	1.62E-09	2.44E-09	1.62E-09	2.44E-09	1.62E-08	0.00E+00	1.49E-06	0.00E+00	1.89E-06	2.44E-09	1.14E-07	0.00E+00
E1574-A02	5-0312	0.00	2.71	5.82E-06	2.44E-09	2.44E-09	3.65E-06	3.25E-09	2.71E-07	2.44E-09	2.84E-06	1.62E-09	2.44E-09	1.62E-09	2.44E-09	1.62E-08	0.00E+00	1.49E-06	0.00E+00	1.89E-06	2.44E-09	1.14E-07	0.00E+00
E1574-A03	5-0313	0.00	2.71	5.82E-06	2.44E-09	2.44E-09	3.65E-06	3.25E-09	2.71E-07	2.44E-09	2.84E-06	1.62E-09	2.44E-09	1.62E-09	2.44E-09	1.62E-08	0.00E+00	1.49E-06	0.00E+00	1.89E-06	2.44E-09	1.14E-07	0.00E+00
E5126-A01	4-0543	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5126-A02	4-0544	129.14	221.28	2.31E-02	1.56E-06	2.15E-07	2.29E-02	3.44E-07	1.25E-04	4.58E-07	2.46E-04	1.33E-07	2.95E-07	2.79E-07	2.95E-07	1.33E-06	9.56E-04	2.19E-04	1.29E-05	1.94E-04	3.53E-07	9.29E-06	2.65E-04
E2901-A01*	5-0306	0.00	30.15	6.48E-05	2.71E-08	2.71E-08	4.07E-05	3.62E-08	3.01E-06	2.71E-08	3.17E-05	1.81E-08	2.71E-08	1.81E-08	2.71E-08	1.81E-07	0.00E+00	1.66E-05	0.00E+00	2.11E-05	2.71E-08	1.27E-06	0.00E+00
E2901-A02*	5-0306	0.00	30.15	6.48E-05	2.71E-08	2.71E-08	4.07E-05	3.62E-08	3.01E-06	2.71E-08	3.17E-05	1.81E-08	2.71E-08	1.81E-08	2.71E-08	1.81E-07	0.00E+00	1.66E-05	0.00E+00	2.11E-05	2.71E-08	1.27E-06	0.00E+00
E2901-A03*	5-0306	0.00	30.15	6.48E-05	2.71E-08	2.71E-08	4.07E-05	3.62E-08	3.01E-06	2.71E-08	3.17E-05	1.81E-08	2.71E-08	1.81E-08	2.71E-08	1.81E-07	0.00E+00	1.66E-05	0.00E+00	2.11E-05	2.71E-08	1.27E-06	0.00E+00
E2901-A04*	5-0306	0.00	30.15	6.48E-05	2.71E-08	2.71E-08	4.07E-05	3.62E-08	3.01E-06	2.71E-08	3.17E-05	1.81E-08	2.71E-08	1.81E-08	2.71E-08	1.81E-07	0.00E+00	1.66E-05	0.00E+00	2.11E-05	2.71E-08	1.27E-06	0.00E+00
E2851-A01	5-0347	0.00	8.65	1.86E-05	7.78E-09	7.78E-09	1.17E-05	1.04E-08	8.65E-07	7.78E-09	9.08E-06	5.19E-09	7.78E-09	5.19E-09	7.78E-09	5.19E-08	0.00E+00	4.76E-06	0.00E+00	6.05E-06	7.78E-09	3.63E-07	0.00E+00
E2851-A02	5-0348	0.00	8.65	1.86E-05	7.78E-09	7.78E-09	1.17E-05	1.04E-08	8.65E-07	7.78E-09	9.08E-06	5.19E-09	7.78E-09	5.19E-09	7.78E-09	5.19E-08	0.00E+00	4.76E-06	0.00E+00	6.05E-06	7.78E-09	3.63E-07	0.00E+00
E2851-A03	5-0349	0.00	8.65	1.86E-05	7.78E-09	7.78E-09	1.17E-05	1.04E-08	8.65E-07	7.78E-09	9.08E-06	5.19E-09	7.78E-09	5.19E-09	7.78E-09	5.19E-08	0.00E+00	4.76E-06	0.00E+00	6.05E-06	7.78E-09	3.63E-07	0.00E+00
E2851-A04	5-0350	0.00	8.65	1.86E-05	7.78E-09	7.78E-09	1.17E-05	1.04E-08	8.65E-07	7.78E-09	9.08E-06	5.19E-09	7.78E-09	5.19E-09	7.78E-09	5.19E-08	0.00E+00	4.76E-06	0.00E+00	6.05E-06	7.78E-09	3.63E-07	0.00E+00
E2851-A05	5-0351	0.00	8.65	1.86E-05	7.78E-09	7.78E-09	1.17E-05	1.04E-08	8.65E-07	7.78E-09	9.08E-06	5.19E-09	7.78E-09	5.19E-09	7.78E-09	5.19E-08	0.00E+00	4.76E-06	0.00E+00	6.05E-06	7.78E-09	3.63E-07	0.00E+00
E1464-A01	4-0626	1.43	0.00	2.51E-04	1.51E-08	1.81E-10	2.51E-04	8.72E-10	1.14E-06	2.87E-09	1.53E-07	0.00E+00	1.06E-09	1.62E-09	1.06E-09	0.00E+00	1.06E-05	1.07E-06	1.43E-07	4.29E-07	1.70E-09	0.00E+00	2.93E-06
E1930-A01	4-0663	12.01	0.00	2.10E-03	1.27E-07	1.52E-09	2.10E-03	7.32E-09	9.60E-06	2.41E-08	1.28E-06	0.00E+00	8.88E-09	1.36E-08	8.88E-09	0.00E+00	8.88E-05	9.00E-06	1.20E-06	3.60E-06	1.43E-08	0.00E+00	2.46E-05
E1930-A02	4-0664	12.01	0.00	2.10E-03	1.27E-07	1.52E-09	2.10E-03	7.32E-09	9.60E-06	2.41E-08	1.28E-06	0.00E+00	8.88E-09	1.36E-08	8.88E-09	0.00E+00	8.88E-05	9.00E-06	1.20E-06	3.60E-06	1.43E-08	0.00E+00	2.46E-05
E1950-A01	4-0665	4.81	0.00	8.42E-04	5.07E-08	6.08E-10	8.42E-04	2.93E-09	3.84E-06	9.64E-09	5.14E-07	0.00E+00	3.56E-09	5.43E-09	3.56E-09	0.00E+00	3.56E-05	3.60E-06	4.81E-07	1.44E-06	5.72E-09	0.00E+00	9.85E-06
E1958-A01	4-0660	7.68	0.00	1.35E-03	8.10E-08	9.71E-10	1.35E-03	4.68E-09	6.14E-06	1.54E-08	8.22E-07	0.00E+00	5.68E-09	8.68E-09	5.68E-09	0.00E+00	5.68E-05	5.76E-06	7.68E-07	2.30E-06	9.14E-09	0.00E+00	1.57E-05
E2188-A01	4-0627	9.28	0.00	1.63E-03	9.79E-08	1.17E-09	1.63E-03	5.66E-09	7.42E-06	1.86E-08	9.93E-07	0.00E+00	6.86E-09	1.05E-08	6.86E-09	0.00E+00	6.86E-05	6.96E-06	9.28E-07	2.78E-06	1.10E-08	0.00E+00	1.90E-05
E4301-A02	4-0559	46.39	0.00	8.13E-03	4.89E-07	5.87E-09	8.13E-03	2.83E-08	3.71E-05	9.30E-08	4.96E-06	0.00E+00	3.43E-08	5.24E-08	3.43E-08	0.00E+00	3.43E-04	3.48E-05	4.64E-06	1.39E-05	5.52E-08	0.00E+00	9.51E-05
E4301-A03	4-0560	46.39	0.00	8.13E-03	4.89E-07	5.87E-09	8.13E-03	2.83E-08	3.71E-05	9.30E-08	4.96E-06	0.00E+00	3.43E-08	5.24E-08	3.43E-08	0.00E+00	3.43E-04	3.48E-05	4.64E-06	1.39E-05	5.52E-08	0.00E+00	9.51E-05
E4516-A01	4-0716	7.40	0.00	1.30E-03	7.81E-08	9.36E-10	1.30E-03	4.52E-09	5.92E-06	1.48E-08	7.92E-07	0.00E+00	5.48E-09	8.37E-09	5.48E-09	0.00E+00	5.48E-05	5.55E-06	7.40E-07	2.22E-06	8.81E-09	0.00E+00	1.52E-05
E4516-A02	4-0716	7.40	0.00	1.30E-03	7.81E-08	9.36E-10	1.30E-03	4.52E-09	5.92E-06	1.48E-08	7.92E-07	0.00E+00	5.48E-09	8.37E-09	5.48E-09	0.00E+00	5.48E-05	5.55E-06	7.40E-07	2.22E-06	8.81E-09	0.00E+00	1.52E-05
E4902-A01	4-0432	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5664-A01	4-0545	2.00	0.00	3.50E-04	2.11E-08	2.53E-10	3.50E-04	1.22E-09	1.60E-06	4.01E-09	2.14E-07	0.00E+00	1.48E-09	2.26E-09	1.48E-09	0.00E+00	1.48E-05	1.50E-06	2.00E-07	6.00E-07	2.38E-09	0.00E+00	4.10E-06
E5828-A01	4-0669	19.09	0.00	3.35E-03	2.01E-07	2.42E-09	3.35E-03	1.16E-08	1.53E-05	3.83E-08	2.04E-06	0.00E+00	1.41E-08	2.16E-08	1.41E-08	0.00E+00	1.41E-04	1.43E-05	1.91E-06	5.73E-06	2.27E-08	0.00E+00	3.91E-05
E5828-A02	4-0670	19.09	0.00	3.35E-03	2.01E-07	2.42E-09	3.35E-03	1.16E-08	1.53E-05	3.83E-08	2.04E-06	0.00E+00	1.41E-08	2.16E-08	1.41E-08	0.00E+00	1.41E-04	1.43E-05	1.91E-06	5.73E-06	2.27E-08	0.00E+00	3.91E-05
E4110-A01	4-0704	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5951-A01	4-0668	15.64	0.00	2.74E-03	1.65E-07	1.98E-09	2.74E-03	9.54E-09	1.25E-05	3.14E-08	1.67E-06	0.00E+00	1.16E-08	1.77E-08	1.16E-08	0.00E+00	1.16E-04	1.17E-05	1.56E-06	4.69E-06	1.86E-08	0.00E+00	3.21E-05
E3832-A02	4-0684	11.09	0.00	1.94E-03	1.17E-07	1.40E-09	1.94E-03	6.77E-09	8.87E-06	2.22E-08	1.19E-06	0.00E+00	8.21E-09	1.25E-08	8.21E-09	0.00E+00	8.21E-05	8.32E-06	1.11E-06	3.33E-06	1.32E-08	0.00E+00	2.27E-05
E4585-A02	4-0681	3.40	0.00	5.96E-04	3.58E-08	4.30E-10	5.96E-04	2.07E-09	2.72E-06	6.81E-09	3.64E-07	0.00E+00	2.51E-09	3.84E-09	2.51E-09	0.00E+00	2.51E-05	2.55E-06	3.40E-07	1.02E-06	4.04E-09	0.00E+00	6.97E-06
E3302-A01	4-0568	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3312-A01	4-0570	14.01	0.00	2.46E-03	1.48E-07	1.77E-09	2.46E-03	8.54E-09	1.12E-05	2.81E-08	1.50E-06	0.00E+00	1.04E-08	1.58E-08	1.04E-08	0.00E+00	1.04E-04	1.05E-05	1.40E-06	4.20E-06	1.67E-08	0.00E+00	2.87E-05
E3312-A04	4-0571	14.01	0.00	2.46E-03	1.48E-07	1.77E-09	2.46E-03	8.54E-09	1.12E-05	2.81E-08	1.50E-06	0.00E+00	1.04E-08	1.58E-08	1.04E-08	0.00E+00	1.04E-04	1.05E-05	1.40E-06	4.20E-06	1.67E-08	0.00E+00	2.87E-05
E3312-A05	4-0572	14.01	0.00	2.46E-03	1.48E-07	1.77E-09	2.46E-03	8.54E-09	1.12E-05	2.81E-08	1.50E-06	0.00E+00	1.04E-08	1.58E-08	1.04E-08	0.00E+00	1.04E-04	1.05E-05	1.40E-06	4.20E-06	1.67E-08	0.00E+00	2.87E-05
E3844-A01	4-0700	6.79	0.00	1.19E-03	7.17E-08	8.59E-10	1.19E-03	4.14E-09	5.43E-06	1.36E-08	7.27E-07	0.00E+00	5.03E-09	7.68E-09	5.03E-09	0.00E+00	5.03E-05	5.09E-06	6.79E-07	2.04E-06	8.08E-09	0.00E+00	1.39E-05
E3844-A02	4-0701	6.79	0.00	1.19E-03	7.17E-08	8.59E-10	1.19E-03	4.14E-09	5.43E-06	1.36E-08	7.27E-07	0.00E+00	5.03E-09	7.68E-09	5.03E-09	0.00E+00	5.03E-05	5.09E-06	6.79E-07	2.04E-06	8.08E-09	0.00E+00	1.39E-05
E2194-A02	4-0695	6.52	0.00	1.14E-03	6.88E-08	8.25E-10	1.14E-03	3.98E-09	5.22E-06	1.31E-08	6.98E-07	0.00E+00	4.82E-09	7.37E-09	4.82E-09	0.00E+00	4.82E-05	4.89E-06	6.52E-07	1.96E-06	7.76E-09	0.00E+00	1.34E-05
E4160-A01	4-0392	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4160-A02	4-0506	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4160-A03	4-0523	7.27	0.00	1.27E-03	7.67E-08	9.20E-10	1.27E-03	4.44E-09	5.82E-06	1.46E-08	7.78E-07	0.00E+00	5.38E-09	8.22E-09	5.38E-09	0.00E+00	5.38E-05	5.45E-06	7.27E-07	2.18E-06	8.65E-09	0.00E+00	1.49E-05
E4160-A04	4-0723	7.27	0.00	1.27E-03	7.67E-08	9.20E-10	1.27E-03	4.44E-09	5.82E-06	1.46E-08	7.78E-07	0.00E+00	5.38E-09	8.22E-09	5.38E-09	0.00E+00	5.38E-05	5.45E-06	7.27E-07	2.18E-06	8.65E-09	0.00E+00	1.49E-05
E5840-A01	4-0650	1.98	0.00	3.46E-04	2.08E-08	2.50E-10	3.46E-04	1.21E-09	1.58E-06	3.96E-09	2.11E-07	0.00E+00	1.46E-09	2.23E-09	1.46E-09	0.00E+00	1.46E-05	1.48E-06	1.98E-07	5.93E-07	2.35E-09	0.00E+00	4.05E-06
E4305-A01	4-0702	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4305-A02	4-0703	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5126-A06	4-0460	129.14	0.00	2.26E-02	1.36E-06	1.63E-08	2.26E-02	7.88E-08	1.03E-04	2.59E-07	1.38E-05	0.00E+00	9.56E-08	1.46E-07	9.56E-08	0.00E+00	9.56E-04	9.69E-05	1.29E-05	3.87E-05	1.54E-07	0.00E+00	2.65E-04
			Totals	**9.95E-02**	**6.30E-06**	**4.36E-07**	**9.92E-02**	**8.30E-07**	**4.91E-04**	**1.49E-06**	**4.86E-04**	**2.43E-07**	**7.82E-07**	**8.79E-07**	**7.82E-07**	**2.43E-06**	**4.16E-03**	**6.45E-04**	**5.63E-05**	**4.53E-04**	**1.03E-06**	**1.70E-05**	**1.15E-03**

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emergency Generators Emissions (tpy)

Emissions Unit	Registration Number	HP	Hours	Acetaldehyde	Acenaphthene	Acenaphthylene	Acrolein	Anthracene	Arsenic	Benz(a)anthracene	Benzene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Beryllium	1,3-Butadiene	Cadmium	Chlorobenzene	Chromium	Chrysene	Cobalt	Copper
09-E2800-A01	9-0448	1881	25.4	1.32E-04	2.44E-07	8.70E-07	1.59E-05	3.22E-07	2.75E-04	2.89E-07	1.60E-04	3.23E-08	1.70E-08	8.41E-08	2.67E-08	0.00E+00	6.73E-06	2.58E-04	3.44E-05	1.03E-04	6.07E-08	0.00E+00	7.05E-04
26-E3156-A01	5-0488	685	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3510-A01	9-0378	2206	34.0	2.07E-04	3.83E-07	1.37E-06	2.50E-05	5.05E-07	4.32E-04	4.54E-07	2.52E-04	5.08E-08	2.68E-08	1.32E-07	4.19E-08	0.00E+00	1.06E-05	4.05E-04	5.40E-05	1.62E-04	9.53E-08	0.00E+00	1.11E-03
E3549-A01	9-0232	1135	5.6	1.75E-05	3.24E-08	1.16E-07	2.11E-06	4.27E-08	3.65E-05	3.84E-08	2.13E-05	4.29E-09	2.26E-09	1.12E-08	3.54E-09	0.00E+00	8.93E-07	3.43E-05	4.57E-06	1.37E-05	8.06E-09	0.00E+00	9.36E-05
E3835-A01	9-0341	900	33.1	8.23E-05	1.52E-07	5.43E-07	9.93E-06	2.01E-07	1.72E-04	1.80E-07	1.00E-04	2.02E-08	1.06E-08	5.25E-08	1.66E-08	0.00E+00	4.20E-06	1.61E-04	2.15E-05	6.44E-05	3.79E-08	0.00E+00	4.40E-04
E3150-A01	9-0278	1350	4.8	1.80E-05	3.33E-08	1.19E-07	2.17E-06	4.38E-08	3.75E-05	3.94E-08	2.19E-05	4.40E-09	2.32E-09	1.15E-08	3.63E-09	0.00E+00	9.16E-07	3.51E-05	4.69E-06	1.41E-05	8.27E-09	0.00E+00	9.60E-05
E3150-A02	9-0279	1350	4.8	1.79E-05	3.32E-08	1.18E-07	2.16E-06	4.37E-08	3.74E-05	3.93E-08	2.18E-05	4.39E-09	2.32E-09	1.14E-08	3.62E-09	0.00E+00	9.14E-07	3.51E-05	4.68E-06	1.40E-05	8.25E-09	0.00E+00	9.58E-05
E3150-A03	9-0280	1350	4.8	1.79E-05	3.31E-08	1.18E-07	2.16E-06	4.36E-08	3.73E-05	3.92E-08	2.18E-05	4.39E-09	2.31E-09	1.14E-08	3.62E-09	0.00E+00	9.12E-07	3.50E-05	4.67E-06	1.40E-05	8.23E-09	0.00E+00	9.56E-05
E3081-A02	9-0369	1088	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3081-A03	9-0230	1073	0.5	1.48E-06	2.74E-09	9.77E-09	1.79E-07	3.61E-09	3.09E-06	3.24E-09	1.80E-06	3.63E-10	1.91E-10	9.44E-10	2.99E-10	0.00E+00	7.55E-08	2.90E-06	3.86E-07	1.16E-06	6.82E-10	0.00E+00	7.92E-06
E3300-A01	9-0231	1490	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5100-A01	9-0379	2206	42.9	2.61E-04	4.84E-07	1.72E-06	3.15E-05	6.37E-07	5.45E-04	5.72E-07	3.18E-04	6.41E-08	3.38E-08	1.67E-07	5.28E-08	0.00E+00	1.33E-05	5.11E-04	6.81E-05	2.04E-04	1.20E-07	0.00E+00	1.40E-03
E1457-A01	9-0355	2200	36.8	2.24E-04	4.14E-07	1.47E-06	2.70E-05	5.45E-07	4.66E-04	4.90E-07	2.72E-04	5.48E-08	2.89E-08	1.43E-07	4.52E-08	0.00E+00	1.14E-05	4.37E-04	5.83E-05	1.75E-04	1.03E-07	0.00E+00	1.19E-03
E3400-A01	9-0356	1818	5.9	2.96E-05	5.48E-08	1.95E-07	3.57E-06	7.22E-08	6.18E-05	6.49E-08	3.60E-05	7.26E-09	3.83E-09	1.89E-08	5.99E-09	0.00E+00	1.51E-06	5.79E-05	7.72E-06	2.32E-05	1.36E-08	0.00E+00	1.58E-04
E3401-A01	9-0380	2206	6.5	3.96E-05	7.33E-08	2.61E-07	4.77E-06	9.65E-08	8.26E-05	8.67E-08	4.82E-05	9.70E-09	5.12E-09	2.52E-08	8.00E-09	0.00E+00	2.02E-06	7.74E-05	1.03E-05	3.10E-05	1.82E-08	0.00E+00	2.12E-04
E2901-A01, A02, A03	9-0402	11019	50.1	1.52E-03	2.82E-06	1.01E-05	1.84E-04	3.72E-06	3.18E-03	3.34E-06	1.85E-03	3.74E-07	1.97E-07	9.72E-07	3.08E-07	0.00E+00	7.77E-05	2.98E-03	3.97E-04	1.19E-03	7.02E-07	0.00E+00	8.15E-03
E3844-A03	9-0442	1341	7.4	2.74E-05	5.07E-08	1.81E-07	3.30E-06	6.68E-08	5.72E-05	6.00E-08	3.33E-05	6.72E-09	3.54E-09	1.75E-08	5.54E-09	0.00E+00	1.40E-06	5.36E-05	7.14E-06	2.14E-05	1.26E-08	0.00E+00	1.46E-04
E2100	9-0453	940	29.7	7.71E-05	1.43E-07	5.09E-07	9.30E-06	1.88E-07	1.61E-04	1.69E-07	9.38E-05	1.89E-08	9.96E-09	4.91E-08	1.56E-08	0.00E+00	3.93E-06	1.51E-04	2.01E-05	6.03E-05	3.55E-08	0.00E+00	4.12E-04
E2390-A01	9-0465	680	2.7	5.07E-06	9.39E-09	3.34E-08	6.11E-07	1.24E-08	1.06E-05	1.11E-08	6.17E-06	1.24E-09	6.55E-10	3.23E-09	1.02E-09	0.00E+00	2.58E-07	9.91E-06	1.32E-06	3.97E-06	2.33E-09	0.00E+00	2.71E-05
E2400-A01	9-0463	1207	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5146-A01	9-0339	500	34.4	4.75E-05	8.79E-08	3.13E-07	5.73E-06	1.16E-07	9.91E-05	1.04E-07	5.78E-05	1.16E-08	6.14E-09	3.03E-08	9.60E-09	0.00E+00	2.42E-06	9.29E-05	1.24E-05	3.72E-05	2.19E-08	0.00E+00	2.54E-04
E5126-A01	9-0293	635	4.2	7.36E-06	1.36E-08	4.86E-08	8.88E-07	1.80E-08	1.54E-05	1.61E-08	8.96E-06	1.81E-09	9.51E-10	4.69E-09	1.49E-09	0.00E+00	3.75E-07	1.44E-05	1.92E-06	5.76E-06	3.39E-09	0.00E+00	3.94E-05
E3566-A01	9-0464	635	97.3	1.71E-04	3.16E-07	1.13E-06	2.06E-05	4.16E-07	3.56E-04	3.74E-07	2.08E-04	4.18E-08	2.20E-08	1.09E-07	3.45E-08	0.00E+00	8.70E-06	3.34E-04	4.45E-05	1.33E-04	7.85E-08	0.00E+00	9.12E-04
E2851-A06	9-0485	2923	1.5	1.21E-05	2.24E-08	7.99E-08	1.46E-06	2.95E-08	2.53E-05	2.65E-08	1.47E-05	2.97E-09	1.56E-09	7.72E-09	2.45E-09	0.00E+00	6.17E-07	2.37E-05	3.16E-06	9.47E-06	5.57E-09	0.00E+00	6.47E-05
E2851-A07	9-0486	2923	1.4	1.13E-05	2.09E-08	7.45E-08	1.36E-06	2.75E-08	2.36E-05	2.47E-08	1.37E-05	2.77E-09	1.46E-09	7.20E-09	2.28E-09	0.00E+00	5.76E-07	2.21E-05	2.95E-06	8.84E-06	5.20E-09	0.00E+00	6.04E-05
E3857	9-0506	2923	4.1	3.31E-05	6.13E-08	2.18E-07	3.99E-06	8.07E-08	6.90E-05	7.25E-08	4.03E-05	8.11E-09	4.28E-09	2.11E-08	6.69E-09	0.00E+00	1.69E-06	6.47E-05	8.63E-06	2.59E-05	1.52E-08	0.00E+00	1.77E-04
E4520 (old) E3462 (New)	9-0484	755	9.0	1.88E-05	3.47E-08	1.24E-07	2.26E-06	4.57E-08	3.91E-05	4.11E-08	2.28E-05	4.60E-09	2.42E-09	1.20E-08	3.79E-09	0.00E+00	9.56E-07	3.67E-05	4.89E-06	1.47E-05	8.64E-09	0.00E+00	1.00E-04
			Totals	**2.98E-03**	**5.52E-06**	**1.97E-05**	**3.60E-04**	**7.27E-06**	**6.22E-03**	**6.53E-06**	**3.63E-03**	**7.31E-07**	**3.85E-07**	**1.90E-06**	**6.03E-07**	**0.00E+00**	**1.52E-04**	**5.83E-03**	**7.78E-04**	**2.33E-03**	**1.37E-06**	**0.00E+00**	**1.59E-02**

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Boilers Emissions (tpy)

Emissions Unit	Registration Number	Oil Used (1000 gal)	Gas Used (MMscf)	Dibenzo(a,h) anthracene	Dichlorobenz ene	Ethyl Benzene	Fluoranthen e	Fluorene	Formaldehyde	Hydrochloric Acid	Indeno(1,2,3-cd)pyrene	Lead	Manganese	Mercury	Methyl Chloroform	Naphthalene	Nickel	Phenanthre ne	Pyrene	Selenium	Toluene	Xylene	Zinc	Hexane
E2100-A03	5-0329	0.08	1.80	1.14E-09	1.08E-06	8.53E-06	2.88E-09	2.69E-09	6.87E-05	7.34E-06	1.70E-09	7.76E-07	4.63E-07	3.12E-07	9.29E-09	5.92E-07	2.04E-06	1.57E-08	4.66E-09	1.08E-07	3.30E-06	2.44E-05	8.82E-07	1.62E-03
E2100-A04	5-0330	0.08	1.80	1.14E-09	1.08E-06	8.53E-06	2.88E-09	2.69E-09	6.87E-05	7.34E-06	1.70E-09	7.76E-07	4.63E-07	3.12E-07	9.29E-09	5.92E-07	2.04E-06	1.57E-08	4.66E-09	1.08E-07	3.30E-06	2.44E-05	8.82E-07	1.62E-03
E2100-A05	5-0331	0.08	1.80	1.14E-09	1.08E-06	8.53E-06	2.88E-09	2.69E-09	6.87E-05	7.34E-06	1.70E-09	7.76E-07	4.63E-07	3.12E-07	9.29E-09	5.92E-07	2.04E-06	1.57E-08	4.66E-09	1.08E-07	3.30E-06	2.44E-05	8.82E-07	1.62E-03
E2100-A01	5-0332	0.08	1.80	1.14E-09	1.08E-06	8.53E-06	2.88E-09	2.69E-09	6.87E-05	7.34E-06	1.70E-09	7.76E-07	4.63E-07	3.12E-07	9.29E-09	5.92E-07	2.04E-06	1.57E-08	4.66E-09	1.08E-07	3.30E-06	2.44E-05	8.82E-07	1.62E-03
E2100-A02	5-0333	0.08	1.80	1.14E-09	1.08E-06	8.53E-06	2.88E-09	2.69E-09	6.87E-05	7.34E-06	1.70E-09	7.76E-07	4.63E-07	3.12E-07	9.29E-09	5.92E-07	2.04E-06	1.57E-08	4.66E-09	1.08E-07	3.30E-06	2.44E-05	8.82E-07	1.62E-03
E2100-A06	5-0316	0.08	1.80	1.14E-09	1.08E-06	8.53E-06	2.88E-09	2.69E-09	6.87E-05	7.34E-06	1.70E-09	7.76E-07	4.63E-07	3.12E-07	9.29E-09	5.92E-07	2.04E-06	1.57E-08	4.66E-09	1.08E-07	3.30E-06	2.44E-05	8.82E-07	1.62E-03
E2100-A07	5-0317	0.08	1.80	1.14E-09	1.08E-06	8.53E-06	2.88E-09	2.69E-09	6.87E-05	7.34E-06	1.70E-09	7.76E-07	4.63E-07	3.12E-07	9.29E-09	5.92E-07	2.04E-06	1.57E-08	4.66E-09	1.08E-07	3.30E-06	2.44E-05	8.82E-07	1.62E-03
E1574-A01	5-0311	0.00	2.71	1.62E-09	1.62E-06	1.29E-05	4.06E-09	3.79E-09	1.02E-04	0.00E+00	2.44E-09	6.77E-07	5.14E-07	3.52E-07	0.00E+00	8.26E-07	2.84E-06	2.30E-08	6.77E-09	3.25E-08	4.60E-06	3.68E-05	0.00E+00	2.44E-03
E1574-A02	5-0312	0.00	2.71	1.62E-09	1.62E-06	1.29E-05	4.06E-09	3.79E-09	1.02E-04	0.00E+00	2.44E-09	6.77E-07	5.14E-07	3.52E-07	0.00E+00	8.26E-07	2.84E-06	2.30E-08	6.77E-09	3.25E-08	4.60E-06	3.68E-05	0.00E+00	2.44E-03
E1574-A03	5-0313	0.00	2.71	1.62E-09	1.62E-06	1.29E-05	4.06E-09	3.79E-09	1.02E-04	0.00E+00	2.44E-09	6.77E-07	5.14E-07	3.52E-07	0.00E+00	8.26E-07	2.84E-06	2.30E-08	6.77E-09	3.25E-08	4.60E-06	3.68E-05	0.00E+00	2.44E-03
E5126-A01	4-0543	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5126-A02	4-0544	129.14	221.28	2.41E-07	1.33E-04	1.06E-03	6.44E-07	5.98E-07	1.04E-02	1.20E-02	3.37E-07	5.91E-04	2.42E-04	1.58E-04	1.52E-05	1.40E-04	4.84E-04	2.56E-06	8.28E-07	1.45E-04	7.77E-04	3.02E-03	1.45E-03	1.99E-01
E2901-A01*	5-0306	0.00	30.15	1.81E-08	1.81E-05	1.43E-04	4.52E-08	4.22E-08	1.13E-03	0.00E+00	2.71E-08	7.54E-06	5.73E-06	3.92E-06	0.00E+00	9.19E-06	3.17E-05	2.56E-07	7.54E-08	3.62E-07	5.12E-05	4.10E-04	0.00E+00	2.71E-02
E2901-A02*	5-0306	0.00	30.15	1.81E-08	1.81E-05	1.43E-04	4.52E-08	4.22E-08	1.13E-03	0.00E+00	2.71E-08	7.54E-06	5.73E-06	3.92E-06	0.00E+00	9.19E-06	3.17E-05	2.56E-07	7.54E-08	3.62E-07	5.12E-05	4.10E-04	0.00E+00	2.71E-02
E2901-A03*	5-0306	0.00	30.15	1.81E-08	1.81E-05	1.43E-04	4.52E-08	4.22E-08	1.13E-03	0.00E+00	2.71E-08	7.54E-06	5.73E-06	3.92E-06	0.00E+00	9.19E-06	3.17E-05	2.56E-07	7.54E-08	3.62E-07	5.12E-05	4.10E-04	0.00E+00	2.71E-02
E2901-A04*	5-0306	0.00	30.15	1.81E-08	1.81E-05	1.43E-04	4.52E-08	4.22E-08	1.13E-03	0.00E+00	2.71E-08	7.54E-06	5.73E-06	3.92E-06	0.00E+00	9.19E-06	3.17E-05	2.56E-07	7.54E-08	3.62E-07	5.12E-05	4.10E-04	0.00E+00	2.71E-02
E2851-A01	5-0347	0.00	8.65	5.19E-09	5.19E-06	4.11E-05	1.30E-08	1.21E-08	3.24E-04	0.00E+00	7.78E-09	2.16E-06	1.64E-06	1.12E-06	0.00E+00	2.64E-06	9.08E-06	7.35E-08	2.16E-08	1.04E-07	1.47E-05	1.18E-04	0.00E+00	7.78E-03
E2851-A02	5-0348	0.00	8.65	5.19E-09	5.19E-06	4.11E-05	1.30E-08	1.21E-08	3.24E-04	0.00E+00	7.78E-09	2.16E-06	1.64E-06	1.12E-06	0.00E+00	2.64E-06	9.08E-06	7.35E-08	2.16E-08	1.04E-07	1.47E-05	1.18E-04	0.00E+00	7.78E-03
E2851-A03	5-0349	0.00	8.65	5.19E-09	5.19E-06	4.11E-05	1.30E-08	1.21E-08	3.24E-04	0.00E+00	7.78E-09	2.16E-06	1.64E-06	1.12E-06	0.00E+00	2.64E-06	9.08E-06	7.35E-08	2.16E-08	1.04E-07	1.47E-05	1.18E-04	0.00E+00	7.78E-03
E2851-A04	5-0350	0.00	8.65	5.19E-09	5.19E-06	4.11E-05	1.30E-08	1.21E-08	3.24E-04	0.00E+00	7.78E-09	2.16E-06	1.64E-06	1.12E-06	0.00E+00	2.64E-06	9.08E-06	7.35E-08	2.16E-08	1.04E-07	1.47E-05	1.18E-04	0.00E+00	7.78E-03
E2851-A05	5-0351	0.00	8.65	5.19E-09	5.19E-06	4.11E-05	1.30E-08	1.21E-08	3.24E-04	0.00E+00	7.78E-09	2.16E-06	1.64E-06	1.12E-06	0.00E+00	2.64E-06	9.08E-06	7.35E-08	2.16E-08	1.04E-07	1.47E-05	1.18E-04	0.00E+00	7.78E-03
E1464-A01	4-0626	1.43	0.00	1.19E-09	0.00E+00	4.55E-08	3.46E-09	3.20E-09	2.36E-05	1.33E-04	1.53E-09	5.93E-06	2.22E-06	1.43E-06	1.69E-07	8.08E-07	2.79E-06	7.51E-09	3.04E-09	1.57E-06	4.43E-06	7.79E-08	1.60E-05	2.50E-06
E1930-A01	4-0663	12.01	0.00	1.00E-08	0.00E+00	3.82E-07	2.91E-08	2.68E-08	1.98E-04	1.12E-03	1.28E-08	4.98E-05	1.86E-05	1.20E-05	1.42E-06	6.78E-06	2.34E-05	6.30E-08	2.55E-08	1.32E-05	3.72E-05	6.54E-07	1.34E-04	2.10E-05
E1930-A02	4-0664	12.01	0.00	1.00E-08	0.00E+00	3.82E-07	2.91E-08	2.68E-08	1.98E-04	1.12E-03	1.28E-08	4.98E-05	1.86E-05	1.20E-05	1.42E-06	6.78E-06	2.34E-05	6.30E-08	2.55E-08	1.32E-05	3.72E-05	6.54E-07	1.34E-04	2.10E-05
E1950-A01	4-0665	4.81	0.00	4.01E-09	0.00E+00	1.53E-07	1.16E-08	1.07E-08	7.93E-05	4.48E-04	5.14E-09	1.99E-05	7.45E-06	4.81E-06	5.67E-07	2.72E-06	9.37E-06	2.52E-08	1.02E-08	5.29E-06	1.49E-05	2.62E-07	5.38E-05	8.41E-06
E1958-A01	4-0660	7.68	0.00	6.41E-09	0.00E+00	2.44E-07	1.86E-08	1.72E-08	1.27E-04	7.15E-04	8.22E-09	3.19E-05	1.19E-05	7.68E-06	9.06E-07	4.34E-06	1.50E-05	4.03E-08	1.63E-08	8.45E-06	2.38E-05	4.19E-07	8.60E-05	1.34E-05
E2188-A01	4-0627	9.28	0.00	7.75E-09	0.00E+00	2.95E-07	2.25E-08	2.07E-08	1.53E-04	8.64E-04	9.93E-09	3.85E-05	1.44E-05	9.28E-06	1.09E-06	5.24E-06	1.81E-05	4.87E-08	1.97E-08	1.02E-05	2.88E-05	5.06E-07	1.04E-04	1.62E-05
E4301-A02	4-0559	46.39	0.00	3.87E-08	0.00E+00	1.48E-06	1.12E-07	1.04E-07	7.65E-04	4.32E-03	4.96E-08	1.92E-04	7.19E-05	4.64E-05	5.47E-06	2.62E-05	9.05E-05	2.44E-07	9.86E-08	5.10E-05	1.44E-04	2.53E-06	5.20E-04	8.12E-05
E4301-A03	4-0560	46.39	0.00	3.87E-08	0.00E+00	1.48E-06	1.12E-07	1.04E-07	7.65E-04	4.32E-03	4.96E-08	1.92E-04	7.19E-05	4.64E-05	5.47E-06	2.62E-05	9.05E-05	2.44E-07	9.86E-08	5.10E-05	1.44E-04	2.53E-06	5.20E-04	8.12E-05
E4516-A01	4-0716	7.40	0.00	6.18E-09	0.00E+00	2.35E-07	1.79E-08	1.65E-08	1.22E-04	6.90E-04	7.92E-09	3.07E-05	1.15E-05	7.40E-06	8.74E-07	4.18E-06	1.44E-05	3.89E-08	1.57E-08	8.14E-06	2.29E-05	4.03E-07	8.29E-05	1.30E-05
E4516-A02	4-0716	7.40	0.00	6.18E-09	0.00E+00	2.35E-07	1.79E-08	1.65E-08	1.22E-04	6.90E-04	7.92E-09	3.07E-05	1.15E-05	7.40E-06	8.74E-07	4.18E-06	1.44E-05	3.89E-08	1.57E-08	8.14E-06	2.29E-05	4.03E-07	8.29E-05	1.30E-05
E4902-A01	4-0432	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5664-A01	4-0545	2.00	0.00	1.67E-09	0.00E+00	6.36E-08	4.84E-09	4.47E-09	3.30E-05	1.86E-04	2.14E-09	8.29E-06	3.10E-06	2.00E-06	2.36E-07	1.13E-06	3.90E-06	1.05E-08	4.25E-09	2.20E-06	6.20E-06	1.09E-07	2.24E-05	3.50E-06
E5828-A01	4-0669	19.09	0.00	1.59E-08	0.00E+00	6.07E-07	4.62E-08	4.27E-08	3.15E-04	1.78E-03	2.04E-08	7.92E-05	2.96E-05	1.91E-05	2.25E-06	1.08E-05	3.72E-05	1.00E-07	4.06E-08	2.10E-05	5.92E-05	1.04E-06	2.14E-04	3.34E-05
E5828-A02	4-0670	19.09	0.00	1.59E-08	0.00E+00	6.07E-07	4.62E-08	4.27E-08	3.15E-04	1.78E-03	2.04E-08	7.92E-05	2.96E-05	1.91E-05	2.25E-06	1.08E-05	3.72E-05	1.00E-07	4.06E-08	2.10E-05	5.92E-05	1.04E-06	2.14E-04	3.34E-05
E4110-A01	4-0704	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5951-A01	4-0668	15.64	0.00	1.31E-08	0.00E+00	4.97E-07	3.79E-08	3.50E-08	2.58E-04	1.46E-03	1.67E-08	6.49E-05	2.42E-05	1.56E-05	1.85E-06	8.84E-06	3.05E-05	8.21E-08	3.32E-08	1.72E-05	4.85E-05	8.53E-07	1.75E-04	2.74E-05
E3832-A02	4-0684	11.09	0.00	9.26E-09	0.00E+00	3.53E-07	2.68E-08	2.48E-08	1.83E-04	1.03E-03	1.19E-08	4.60E-05	1.72E-05	1.11E-05	1.31E-06	6.27E-06	2.16E-05	5.82E-08	2.36E-08	1.22E-05	3.44E-05	6.05E-07	1.24E-04	1.94E-05
E4585-A02	4-0681	3.40	0.00	2.84E-09	0.00E+00	1.08E-07	8.22E-09	7.59E-09	5.61E-05	3.17E-04	3.64E-09	1.41E-05	5.27E-06	3.40E-06	4.01E-07	1.92E-06	6.63E-06	1.78E-08	7.22E-09	3.74E-06	1.05E-05	1.85E-07	3.81E-05	5.95E-06
E3302-A01	4-0568	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3312-A01	4-0570	14.01	0.00	1.17E-08	0.00E+00	4.45E-07	3.39E-08	3.13E-08	2.31E-04	1.30E-03	1.50E-08	5.81E-05	2.17E-05	1.40E-05	1.65E-06	7.91E-06	2.73E-05	7.35E-08	2.98E-08	1.54E-05	4.34E-05	7.63E-07	1.57E-04	2.45E-05
E3312-A04	4-0571	14.01	0.00	1.17E-08	0.00E+00	4.45E-07	3.39E-08	3.13E-08	2.31E-04	1.30E-03	1.50E-08	5.81E-05	2.17E-05	1.40E-05	1.65E-06	7.91E-06	2.73E-05	7.35E-08	2.98E-08	1.54E-05	4.34E-05	7.63E-07	1.57E-04	2.45E-05
E3312-A05	4-0572	14.01	0.00	1.17E-08	0.00E+00	4.45E-07	3.39E-08	3.13E-08	2.31E-04	1.30E-03	1.50E-08	5.81E-05	2.17E-05	1.40E-05	1.65E-06	7.91E-06	2.73E-05	7.35E-08	2.98E-08	1.54E-05	4.34E-05	7.63E-07	1.57E-04	2.45E-05
E3844-A01	4-0700	6.79	0.00	5.67E-09	0.00E+00	2.16E-07	1.64E-08	1.52E-08	1.12E-04	6.33E-04	7.27E-09	2.82E-05	1.05E-05	6.79E-06	8.02E-07	3.84E-06	1.32E-05	3.57E-08	1.44E-08	7.47E-06	2.11E-05	3.70E-07	7.61E-05	1.19E-05
E3844-A02	4-0701	6.79	0.00	5.67E-09	0.00E+00	2.16E-07	1.64E-08	1.52E-08	1.12E-04	6.33E-04	7.27E-09	2.82E-05	1.05E-05	6.79E-06	8.02E-07	3.84E-06	1.32E-05	3.57E-08	1.44E-08	7.47E-06	2.11E-05	3.70E-07	7.61E-05	1.19E-05
E2194-A02	4-0695	6.52	0.00	5.44E-09	0.00E+00	2.07E-07	1.58E-08	1.46E-08	1.08E-04	6.07E-04	6.98E-09	2.71E-05	1.01E-05	6.52E-06	7.69E-07	3.68E-06	1.27E-05	3.42E-08	1.39E-08	7.17E-06	2.02E-05	3.55E-07	7.30E-05	1.14E-05
E4160-A01	4-0392	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4160-A02	4-0506	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4160-A03	4-0523	7.27	0.00	6.07E-09	0.00E+00	2.31E-07	1.76E-08	1.63E-08	1.20E-04	6.77E-04	7.78E-09	3.02E-05	1.13E-05	7.27E-06	8.58E-07	4.11E-06	1.42E-05	3.82E-08	1.55E-08	8.00E-06	2.25E-05	3.96E-07	8.14E-05	1.27E-05
E4160-A04	4-0723	7.27	0.00	6.07E-09	0.00E+00	2.31E-07	1.76E-08	1.63E-08	1.20E-04	6.77E-04	7.78E-09	3.02E-05	1.13E-05	7.27E-06	8.58E-07	4.11E-06	1.42E-05	3.82E-08	1.55E-08	8.00E-06	2.25E-05	3.96E-07	8.14E-05	1.27E-05
E5840-A01	4-0650	1.98	0.00	1.65E-09	0.00E+00	6.28E-08	4.78E-09	4.42E-09	3.26E-05	1.84E-04	2.11E-09	8.20E-06	3.06E-06	1.98E-06	2.33E-07	1.12E-06	3.85E-06	1.04E-08	4.20E-09	2.17E-06	6.12E-06	1.08E-07	2.21E-05	3.46E-06
E4305-A01	4-0702	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4305-A02	4-0703	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5126-A06	4-0460	129.14	0.00	1.08E-07	0.00E+00	4.11E-06	3.13E-07	2.89E-07	2.13E-03	1.20E-02	1.38E-07	5.36E-04	2.00E-04	1.29E-04	1.52E-05	7.30E-05	2.52E-04	6.78E-07	2.74E-07	1.42E-04	4.00E-04	7.04E-06	1.45E-03	2.26E-04
			Totals	**7.13E-07**	**2.43E-04**	**1.95E-03**	**1.97E-06**	**1.83E-06**	**2.45E-02**	**5.24E-02**	**9.67E-07**	**2.44E-03**	**9.49E-04**	**6.15E-04**	**6.64E-05**	**4.42E-04**	**1.52E-03**	**6.40E-06**	**2.21E-06**	**6.24E-04**	**2.43E-03**	**5.55E-03**	**6.30E-03**	**3.66E-01**

ACTUAL HAP EMISSION CALCULATIONS CY 2023
BOILERS AND GENERATORS

Emergency Generators Emissions (tpy)

Emissions Unit	Registration Number	HP	Hours	Dibenzo(a,h) anthracene	Dichlorobenzene	Ethyl Benzene	Fluoranthene	Fluorene	Formaldehyde	Hydrochloric Acid	Indeno(1,2,3-cd)pyrene	Lead	Manganese	Mercury	Methyl Chloroform	Naphthalene	Nickel	Phenanthrene	Pyrene	Selenium	Toluene	Xylene	Zinc	Hexane
09-E2800-A01	9-0448	1881	25.4	1.00E-07	0.00E+00	1.87E-03	1.31E-06	5.02E-06	2.03E-04	3.20E-02	6.45E-08	1.43E-03	5.33E-04	3.44E-04	0.00E+00	1.46E-05	6.71E-04	5.06E-06	8.22E-07	3.78E-04	7.03E-05	4.90E-05	3.85E-03	4.63E-03
26-E3156-A01	5-0488	685	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3510-A01	9-0378	2206	34.0	1.57E-07	0.00E+00	2.94E-03	2.05E-06	7.88E-06	3.19E-04	5.03E-02	1.01E-07	2.24E-03	8.37E-04	5.40E-04	0.00E+00	2.29E-05	1.05E-03	7.94E-06	1.29E-06	5.94E-04	1.10E-04	7.70E-05	6.05E-03	7.26E-03
E3549-A01	9-0232	1135	5.6	1.33E-08	0.00E+00	2.49E-04	1.74E-07	6.67E-07	2.70E-05	4.26E-03	8.57E-09	1.90E-04	7.08E-05	4.57E-05	0.00E+00	1.94E-06	8.91E-05	6.72E-07	1.09E-07	5.02E-05	9.34E-06	6.51E-06	5.12E-04	6.14E-04
E3835-A01	9-0341	900	33.1	6.26E-08	0.00E+00	1.17E-03	8.17E-07	3.13E-06	1.27E-04	2.00E-02	4.02E-08	8.91E-04	3.33E-04	2.15E-04	0.00E+00	9.10E-06	4.19E-04	3.15E-06	5.13E-07	2.36E-04	4.39E-05	3.06E-05	2.40E-03	2.89E-03
E3150-A01	9-0278	1350	4.8	1.37E-08	0.00E+00	2.55E-04	1.78E-07	6.84E-07	2.76E-05	4.36E-03	8.78E-09	1.94E-04	7.26E-05	4.69E-05	0.00E+00	1.99E-06	9.14E-05	6.89E-07	1.12E-07	5.15E-05	9.58E-06	6.68E-06	5.25E-04	6.30E-04
E3150-A02	9-0279	1350	4.8	1.36E-08	0.00E+00	2.55E-04	1.78E-07	6.83E-07	2.76E-05	4.36E-03	8.77E-09	1.94E-04	7.25E-05	4.68E-05	0.00E+00	1.98E-06	9.12E-05	6.87E-07	1.12E-07	5.14E-05	9.56E-06	6.66E-06	5.24E-04	6.29E-04
E3150-A03	9-0280	1350	4.8	1.36E-08	0.00E+00	2.54E-04	1.78E-07	6.81E-07	2.75E-05	4.35E-03	8.75E-09	1.94E-04	7.23E-05	4.67E-05	0.00E+00	1.98E-06	9.10E-05	6.86E-07	1.12E-07	5.13E-05	9.54E-06	6.65E-06	5.23E-04	6.28E-04
E3081-A02	9-0369	1088	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3081-A03	9-0230	1073	0.5	1.13E-09	0.00E+00	2.11E-05	1.47E-08	5.64E-08	2.28E-06	3.60E-04	7.24E-10	1.60E-05	5.99E-06	3.86E-06	0.00E+00	1.64E-07	7.53E-06	5.68E-08	9.23E-09	4.25E-06	7.90E-07	5.50E-07	4.33E-05	5.20E-05
E3300-A01	9-0231	1490	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5100-A01	9-0379	2206	42.9	1.99E-07	0.00E+00	3.71E-03	2.59E-06	9.95E-06	4.02E-04	6.35E-02	1.28E-07	2.83E-03	1.06E-03	6.81E-04	0.00E+00	2.89E-05	1.33E-03	1.00E-05	1.63E-06	7.50E-04	1.39E-04	9.71E-05	7.63E-03	9.16E-03
E1457-A01	9-0355	2200	36.8	1.70E-07	0.00E+00	3.18E-03	2.22E-06	8.51E-06	3.44E-04	5.43E-02	1.09E-07	2.42E-03	9.04E-04	5.83E-04	0.00E+00	2.47E-05	1.14E-03	8.57E-06	1.39E-06	6.41E-04	1.19E-04	8.31E-05	6.53E-03	7.84E-03
E3400-A01	9-0356	1818	5.9	2.25E-08	0.00E+00	4.21E-04	2.94E-07	1.13E-06	4.56E-05	7.19E-03	1.45E-08	3.20E-04	1.20E-04	7.72E-05	0.00E+00	3.27E-06	1.51E-04	1.14E-06	1.85E-07	8.50E-05	1.58E-05	1.10E-05	8.65E-04	1.04E-03
E3401-A01	9-0380	2206	6.5	3.01E-08	0.00E+00	5.63E-04	3.93E-07	1.51E-06	6.09E-05	9.62E-03	1.94E-08	4.28E-04	1.60E-04	1.03E-04	0.00E+00	4.38E-06	2.01E-04	1.52E-06	2.47E-07	1.14E-04	2.11E-05	1.47E-05	1.16E-03	1.39E-03
E2901-A01, A02, A03	9-0402	11019	50.1	1.16E-06	0.00E+00	2.17E-02	1.51E-05	5.80E-05	2.35E-03	3.70E-01	7.45E-07	1.65E-02	6.16E-03	3.97E-03	0.00E+00	1.69E-04	7.75E-03	5.84E-05	9.50E-06	4.37E-03	8.13E-04	5.66E-04	4.45E-02	5.35E-02
E3844-A03	9-0442	1341	7.4	2.08E-08	0.00E+00	3.89E-04	2.72E-07	1.04E-06	4.22E-05	6.66E-03	1.34E-08	2.97E-04	1.11E-04	7.14E-05	0.00E+00	3.03E-06	1.39E-04	1.05E-06	1.71E-07	7.86E-05	1.46E-05	1.02E-05	8.00E-04	9.61E-04
E2100	9-0453	940	29.7	5.86E-08	0.00E+00	1.10E-03	7.65E-07	2.93E-06	1.19E-04	1.87E-02	3.77E-08	8.34E-04	3.12E-04	2.01E-04	0.00E+00	8.52E-06	3.92E-04	2.95E-06	4.80E-07	2.21E-04	4.11E-05	2.86E-05	2.25E-03	2.70E-03
E2390-A01	9-0465	680	2.7	3.85E-09	0.00E+00	7.20E-05	5.03E-08	1.93E-07	7.80E-06	1.23E-03	2.48E-09	5.49E-05	2.05E-05	1.32E-05	0.00E+00	5.60E-07	2.58E-05	1.94E-07	3.16E-08	1.45E-05	2.70E-06	1.88E-06	1.48E-04	1.78E-04
E2400-A01	9-0463	1207	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5146-A01	9-0339	500	34.4	3.61E-08	0.00E+00	6.75E-04	4.71E-07	1.81E-06	7.31E-05	1.15E-02	2.32E-08	5.14E-04	1.92E-04	1.24E-04	0.00E+00	5.25E-06	2.41E-04	1.82E-06	2.96E-07	1.36E-04	2.53E-05	1.76E-05	1.39E-03	1.67E-03
E5126-A01	9-0293	635	4.2	5.60E-09	0.00E+00	1.05E-04	7.31E-08	2.80E-07	1.13E-05	1.79E-03	3.60E-09	7.97E-05	2.98E-05	1.92E-05	0.00E+00	8.14E-07	3.74E-05	2.82E-07	4.59E-08	2.11E-05	3.93E-06	2.74E-06	2.15E-04	2.58E-04
E3566-A01	9-0464	635	97.3	1.30E-07	0.00E+00	2.42E-03	1.69E-06	6.50E-06	2.62E-04	4.14E-02	8.34E-08	1.85E-03	6.90E-04	4.45E-04	0.00E+00	1.89E-05	8.68E-04	6.54E-06	1.06E-06	4.89E-04	9.10E-05	6.34E-05	4.98E-03	5.98E-03
E2851-A06	9-0485	2923	1.5	9.20E-09	0.00E+00	1.72E-04	1.20E-07	4.61E-07	1.86E-05	2.94E-03	5.92E-09	1.31E-04	4.89E-05	3.16E-05	0.00E+00	1.34E-06	6.16E-05	4.64E-07	7.54E-08	3.47E-05	6.46E-06	4.50E-06	3.54E-04	4.25E-04
E2851-A07	9-0486	2923	1.4	8.59E-09	0.00E+00	1.61E-04	1.12E-07	4.30E-07	1.74E-05	2.74E-03	5.52E-09	1.22E-04	4.57E-05	2.95E-05	0.00E+00	1.25E-06	5.75E-05	4.33E-07	7.04E-08	3.24E-05	6.03E-06	4.20E-06	3.30E-04	3.96E-04
E3857	9-0506	2923	4.1	2.52E-08	0.00E+00	4.70E-04	3.28E-07	1.26E-06	5.09E-05	8.04E-03	1.62E-08	3.58E-04	1.34E-04	8.63E-05	0.00E+00	3.66E-06	1.68E-04	1.27E-06	2.06E-07	9.49E-05	1.76E-05	1.23E-05	9.66E-04	1.16E-03
E4520 (old) E3462 (New)	9-0484	755	9.0	1.43E-08	0.00E+00	2.67E-04	1.86E-07	7.14E-07	2.89E-05	4.56E-03	9.17E-09	2.03E-04	7.58E-05	4.89E-05	0.00E+00	2.07E-06	9.54E-05	7.19E-07	1.17E-07	5.38E-05	1.00E-05	6.97E-06	5.48E-04	6.58E-04
		Totals		**2.27E-06**	**0.00E+00**	**4.24E-02**	**2.96E-05**	**1.14E-04**	**4.59E-03**	**7.25E-01**	**1.46E-06**	**3.23E-02**	**1.21E-02**	**7.78E-03**	**0.00E+00**	**3.30E-04**	**1.52E-02**	**1.14E-04**	**1.86E-05**	**8.56E-03**	**1.59E-03**	**1.11E-03**	**8.71E-02**	**1.05E-01**

CY2023 Summary of Criteria Pollutants, tons/yr

	Boilers	Generators	CHP Unit	PSB	Total
VOC	1.27E+00	1.79E-01	3.14E+00	3.01E-02	4.62E+00
NO_x	1.36E+01	7.26E+00	3.35E+00		2.42E+01
CO	1.94E+01	1.78E+00	2.24E+01		4.36E+01
PM Filterable	9.70E-01	2.41E-01	5.03E+00		6.24E+00
PM-10 Filterable	7.11E-01	1.93E-01	5.03E+00		5.94E+00
PM-2.5 Filterable	6.41E-01	1.86E-01	5.03E+00		5.86E+00
PM Condensable	1.59E+00	2.99E-02	1.71E+00		3.32E+00
PM				4.65E-04	4.65E-04
SO_2	2.15E+00	3.88E-03	1.05E+00		3.21E+00
TOTAL	4.03E+01	9.88E+00	4.67E+01	3.05E-02	9.69E+01

CY2023 Summary of Hazardous Air Pollutants (HAPs) and Toxic Air Pollutants (TAPs), tons

	Boilers	Generators	CHP	PSB	Total
Acetaldehyde	9.95E-02	2.98E-03	2.15E-02		1.24E-01
Acenaphthene	6.30E-06	5.52E-06			1.18E-05
Acenaphthylene	4.36E-07	1.97E-05			2.01E-05
Acrolein	9.92E-02	3.60E-04	3.74E-03		1.03E-01
Anthracene	8.30E-07	7.27E-06			8.10E-06
Arsenic	4.91E-04	6.22E-03	1.56E-06		6.71E-03
Benz(a)anthracene	1.49E-06	6.53E-06			8.03E-06
Benzene	4.86E-04	3.63E-03	6.34E-03		1.05E-02
Benzo(a)pyrene	2.43E-07	7.31E-07			9.75E-07
Benzo(b)fluoranthene	7.82E-07	3.85E-07			1.17E-06
Benzo(ghi)perylene	8.79E-07	1.90E-06			2.78E-06
Benzo(k)fluoranthene	7.82E-07	6.03E-07			1.38E-06
Beryllium	2.43E-06	0.00E+00	4.40E-08		2.48E-06
1,3-Butadiene	4.16E-03	1.52E-04	2.29E-04		4.54E-03
Butanone				4.96E-05	4.96E-05
Cadmium	6.45E-04	5.83E-03	6.81E-07		6.48E-03
Chlorobenzene	5.63E-05	7.78E-04	2.07E-07		8.34E-04
Chromium	4.53E-04	2.33E-03	1.56E-06		2.79E-03
Chrysene	1.03E-06	1.37E-06			2.41E-06
Cobalt	1.70E-05	0.00E+00			1.70E-05
Copper	1.15E-03	1.59E-02	4.24E-06		1.71E-02
Dibenzo(a,h)anthracene	7.13E-07	2.27E-06			2.98E-06
Dichlorobenzene	2.43E-04	0.00E+00			2.43E-04
Ethyl Benzene	1.95E-03	4.24E-02	1.69E-02	7.44E-05	6.13E-02
Fluoranthene	1.97E-06	2.96E-05			3.16E-05
Fluorene	1.83E-06	1.14E-04			1.15E-04
Formaldehyde	2.45E-02	4.59E-03	3.75E-01		4.04E-01
Glycol Ethers				1.16E-03	1.16E-03
Hexamethyl diisocyanate				1.87E-03	1.87E-03
Hydrochloric Acid	5.24E-02	7.25E-01	1.93E-04		7.77E-01
Indeno(1,2,3-cd)pyrene	9.67E-07	1.46E-06			2.43E-06
Lead	2.44E-03	3.23E-02	1.80E-03		3.65E-02
Manganese	9.49E-04	1.21E-02	1.12E-04		1.31E-02
Mercury	6.15E-04	7.78E-03	1.70E-07		8.39E-03
Methyl Chloroform	6.64E-05	0.00E+00			6.64E-05
Naphthalene	4.42E-04	3.30E-04	6.91E-04		1.46E-03
Nickel	1.52E-03	1.52E-02	6.53E-07		1.67E-02
PAH			1.17E-03		1.17E-03
Phenanthrene	6.40E-06	1.14E-04			1.21E-04
Propylene Oxide			1.53E-02		1.53E-02
Pyrene	2.21E-06	1.86E-05			2.08E-05
Selenium	6.24E-04	8.56E-03	3.55E-06		9.18E-03
Toluene	2.43E-03	1.59E-03	6.86E-02		7.26E-02
Xylene	5.55E-03	1.11E-03	3.38E-02	2.40E-05	4.04E-02
Zinc	6.30E-03	8.71E-02	2.31E-05	1.01E-05	9.34E-02
Hexane	3.66E-01	1.05E-01	6.76E-04		4.71E-01
TOTAL HAPs	6.72E-01	1.08E+00	5.46E-01	3.19E-03	2.30E+00

CY2023 Summary of Greenhouse Gases (GHGs), short tons/yr CO_2 Eq.

Intergovernmental Panel on Climate Change GHGs	Direct Emissions				Total	
	Combustion Sources			Fugitive Sources	short tons/yr CO_2 eq.*	metric tons/yr CO_2 eq.
	Boilers	Generators	CHP	PSB		
CO_2	3.2E+04	6.3E+02	4.1E+04	0.00	7.4E+04	6.7E+04
N_2O	5.4E-01	5.1E-03	7.8E-02	0.00	6.3E-01	5.7E-01
CH_4	5.5E-01	2.6E-02	7.8E-01	0.00	1.4E+00	1.2E+00
					7.4E+04	6.7E+04

*Based on GWP values from the IPCC Fifth Assessment Report - CH_4 =28; N_20 = 265

Emission Comparison (TPY)										
Pollutant	**2023**	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**
NOx	24.18	25.91	31.85	34.87	39.58	48.96	39.08	61.85	84.56	22.72
SOx	3.21	3.50	3.46	3.64	3.00	3.36	3.73	4.36	9.90	8.47
VOC	4.62	5.08	4.97	4.66	6.10	8.62	8.74	3.92	2.70	1.03
CO	43.58	47.03	47.17	45.38	53.98	88.65	80.42	46.70	32.39	14.58
PM Filterable	6.24	7.18	6.70	1.71						
PM-10 Filterable	5.94	6.85	6.33	5.56						
PM-2.5 Filterable	5.86	6.77	6.24	1.17						
PM Condensable	3.32	3.59	3.51	1.91						
PM					7.94	8.93	9.83	3.80	1.95	1.11
CO_2e	74,025.23	80,615.60	77,963.51	74,045.90	85,865.51	136,893.91	127,590.75	72,470.59	25,509.45	23,208.07
Total HAPs	2.30	1.43	1.47	1.24	1.56	2.34	2.31	1.59	0.25	0.25

Aberdeen Proving Grounds - Edgewood
USAMRICD
Boilers

NOx. All other EF from AP-42

Assumed Heat Content for Natural Gas =	1,020	Btu/cf
Assumed Heat Content for No. 2 Fuel Oil =	140,000	Btu/gal
Natural Gas NOx ppm:	30	ppm
Natural Gas NOx Emission Factor:	36	lb/MMcf

Dual-Fired Heating Units - Natural Gas[1]	Maximum Heat Input (each) (Btu/hr)	Natural Gas Firing Rate (cf/hr)	Total Natural Gas Consumption Limit (cf/yr)	NO_x Emission Factor ($lb/10^6$ cf)	NO_x Emissions (tpy)	CO Emission Factor ($lb/10^6$ cf)	CO Emissions (tpy)	VOC Emission Factor ($lb/10^6$ cf)	VOC Emissions (tpy)	PM Emission Factor ($lb/10^6$ cf)	PM Emissions (tpy)	SO_2 Emission Factor ($lb/10^6$ cf)	SO_2 Emissions (tpy)
USAMRICD Boilers 1 - 4	33,500,000	32,843	330,000,000	36	5.94	84	13.86	5.5	0.91	7.6	1.25	0.6	0.099
TOTAL	-	-	330,000,000	-	5.94	-	13.86	-	0.91	-	1.25	-	0.099

Dual-Fired Heating Units - No. 2 Fuel Oil[2]	Maximum Heat Input (each) (Btu/hr)	Fuel Oil Firing Rate (gal/hr)	Total No. 2 Fuel Oil Consumption Limit (gal/yr)	NO_x Emission Factor ($lb/10^3$ gal)	NO_x Emissions (tpy)	CO Emission Factor ($lb/10^3$ gal)	CO Emissions (tpy)	VOC Emission Factor ($lb/10^3$ gal)	VOC Emissions (tpy)	PM Emission Factor ($lb/10^3$ gal)	PM Emissions (tpy)	SO_2 Emission Factor ($lb/10^3$ gal)	SO_2 Emissions (tpy)
USAMRICD Boilers 1 - 4	33,500,000	239.3	800,000	20	8.00	5	2.00	0.34	1.36E-01	3.3	1.32	43.2	17.28
TOTAL	-	-	800,000	-	8.00	-	2.00	-	0.14	-	1.32	-	17.28

1. Natural gas emission factors for all pollutants except NO_x were obtained from U.S. EPA's AP-42, Section 1.4. The low NO_x burners reduce NO_x emissions to 30 ppm according to manufacturer specifications. Using a standard conversion: lb/MMBtu = ppm / 850, the NOx emission factor appropriate for burning natural gas in the proposed burners is 0.035 lb/MMBtu or 36 lb/MMcf. (This conversion assumes that the NOx concentration reflects 3% oxygen.) Conservatively assume that PM_{10} = PM.

2. No. 2 fuel oil emission factors for all pollutants were obtained from U.S. EPA's AP-42, Section 1.3. Conservatively assume that PM_{10} = PM. The SO_2 emission factor uses a sulfur content of 0.3 wt%.

CO: 3.5 gm/Kw-hr
PM: 0.2 gm/Kw-hr

Aberdeen Proving Grounds - Edgewood
USAMRICD
Emergency Generators

Hours of Operation Limit for Each Emergency Generator per Year	150

Emergency Generators[1,2]	NO_x Emissions (tpy)	CO Emissions (tpy)	VOC Emissions (tpy)	PM Emissions (tpy)	SO_x Emission Factor (lb/hp-hr)	SO_x Emissions (tpy)
USAMRICD Generator 1, 2,500 kW	3.61	0.44	0.080	0.030	4.05E-04	0.11
USAMRICD Generator 2, 2,500 kW	3.61	0.44	0.080	0.030	4.05E-04	0.11
USAMRICD Generator 3, 2,500 kW	3.61	0.44	0.080	0.030	4.05E-04	0.11
TOTAL	10.82	1.32	0.24	0.090	-	0.33

SOx Pro-rate 0.0015 / 0.05 = 0.03 lb/HP-hr

Not-to-Exceed Emissions Data for Caterpillar 2,500 kW Tier II Certified Emergency Generators

Percent Load (%)	Engine Horse Power	Total NOx (lb/hr)	Total CO (lb/hr)	Total VOC (lb/hr)	PM (lb/hr)
100	3,604	48.11	5.86	1.07	0.40
75	2,738	29.62	2.78	1.06	0.26
50	1,880	14.84	2.35	1.17	0.28
25	1,029	7.65	3.25	0.89	0.31
10	496	6.64	4.50	0.94	0.30

PM: 0.4016 lb/hr × 453.6 gm/lb / 2500 Kw = 0.0726 gm/Kw-hr

1. All engines will be Tier II certified; not-to-exceed manufacturer's data (Caterpillar) were used for the NO_x emission factor, CO emission factor, VOC emission factor, and PM emission factor included in these calculations. Emissions data were not provided for PM_{10}, so it was assumed that PM_{10} = PM. The emission factor for SO_x was obtained from U.S. EPA's AP-42, Section 3.3. The SO_x emission factor uses "S", a sulfur content of 0.05 wt%.
2. Emissions data at 100% load were used to quantify emissions.

SOx SHOULD NOW BE 15 PPM 0.0015 %

CO: 5.86 × 453.6 / 2500 = 1.063 gm/Kw-hr (Kw = generator KW)

NOx 48.11 × 453.6 / 2500 = 8.729 gm/Kw-hr

	HP	lb/hr	lb/hp-hr	AP-42 (lb/hp-hr)	Ratio	
Nox	3604	48.11	1.33E-02	2.40E-02	0.56	
SO2			3.00E-02	4.05E-02	0.74	0.30
CO	3604	5.86	1.63E-03	5.50E-03	0.30	
PM	3604	0.40	1.11E-04	7.00E-04	0.16	
VOC	3604	1.07	2.97E-04	7.05E-04	0.42	

Pollutant	PLANT LEVEL Round to Nearest:	
	Lbs / hour	Tons/year
Acetaldehyde	1.00E-01	1.00E-01
Acetamide	1.00E-01	1.00E+00
Acetonirile	1.00E+00	1.00E+00
Acetophenone	1.00E-01	1.00E+00
2-Acetylaminofluorene	1.00E-02	1.00E-02
Acrolein	1.00E-03	1.00E-02
Acrylamide	1.00E-04	1.00E-04
Acrylic Acid	1.00E-01	1.00E-01
Acrylonitrile	1.00E-02	1.00E-02
Allyl chloride	1.00E-02	1.00E-01
4-Aminobiphenyl	1.00E-02	1.00E-01
Ammonia	1.00E-01	1.00E+00
Aniline	1.00E-01	1.00E-01
o-Anisidine	1.00E-03	1.00E-02
Antimony & compounds	1.00E-03	1.00E-02
Arsenic & compounds	1.00E-04	1.00E-04
Benzene	1.00E-02	1.00E-01
Benzidene	1.00E-02	1.00E-05
Benzotrichloride	1.00E-02	1.00E-04
Benzyl chloride	1.00E-02	1.00E-01
Beryllium & compounds	1.00E-05	1.00E-04
Biphenyl	1.00E-02	1.00E-01
Bis (2-ethylhexyl) phthalate	1.00E-02	1.00E-01
Bis (chloromethyl) ether	1.00E-05	1.00E-05
Bromoform	1.00E-02	1.00E-01
1,3-Butadiene	1.00E-02	1.00E-03
Cadmium & compounds	1.00E-04	1.00E-04
Calcium cyanamide	1.00E-03	1.00E-02
Captan	1.00E-02	1.00E-01
Carbaryl	1.00E-02	1.00E-01
Carbon disulfide	1.00E-01	1.00E+00
Carbon tetrachloride	1.00E-01	1.00E-02
Carbonyl sulfide	1.00E-01	1.00E+00
Catechol	1.00E-01	1.00E+00
Chloramben	1.00E-01	1.00E+00
Chlordane	1.00E-03	1.00E-02
Chlorine	1.00E-02	1.00E-01
Chlorine dioxide	1.00E-03	1.00E-02
Chloroacetic acid	1.00E-02	1.00E-01
2-Chloroacetophenone	1.00E-03	1.00E-02

Pollutant	PLANT LEVEL Round to Nearest: Lbs / hour	 Tons/year
Chlorobenzene	1.00E-01	1.00E+00
Chlorobenzilate	1.00E-02	1.00E-01
Chloroform	1.00E-01	1.00E-02
Chloromethyl methyl ether	1.00E-02	1.00E-01
Chloroprene	1.00E-01	1.00E+00
Chromium (Elemental) Compounds	1.00E-03	1.00E-02
Chromium III Compounds	1.00E-03	1.00E-02
Chromium VI Compounds	1.00E-03	1.00E-05
Cobalt & compounds	1.00E-04	1.00E-03
Coke oven emissions	1.00E-03	1.00E-03
Copper	1.00E-03	1.00E-02
Cresol/Cresylic acid	1.00E-01	1.00E+00
0-Cresol	1.00E-01	1.00E+00
m-Cresol	1.00E-01	1.00E+00
p-Cresol	1.00E-01	1.00E+00
Cumene	1.00E+00	1.00E+01
Cyanide Compounds	1.00E-02	1.00E-01
2,4-D (including salts and esters)	1.00E-01	1.00E-01
DDE	1.00E-02	1.00E-01
Diazomethane	1.00E-03	1.00E-02
Dibenzofuran	1.00E-01	1.00E+00
1,2-Dibromo-3-chloropropane	1.00E-02	1.00E+00
Dibutyl phthalate	1.00E-02	1.00E-01
1,4-Dichlorobenzene(P)	1.00E+00	1.00E-01
3,3’-Dichlorobenzidine	1.00E-03	1.00E-03
Dichloroethyl ether	1.00E-01	1.00E+00
1,2-Dichloropropane	1.00E+00	1.00E+01
1,3-Dichloropropene	1.00E-02	1.00E-02
Dichlorvos	1.00E-02	1.00E-02
Dieldrin	1.00E-03	1.00E-02
Diethanolamine	1.00E-02	1.00E-01
Diethyl sulfate	1.00E-02	1.00E-01
3,3’-Dimethoxybenzidine	1.00E-01	1.00E-01

Pollutant	PLANT LEVEL Round to Nearest:	
	Lbs / hour	Tons/year
4-Dimethylaminoazobenzene	1.00E-02	1.00E-02
N,N-Dimethylaniline	1.00E-01	1.00E+00
3,3’-Dimethylbenzidine	1.00E-01	1.00E-01
Dimethylcarbamoyl chloride	1.00E-02	1.00E-01
N,N-Dimethylformamide	1.00E-01	1.00E+00
1,1-Dimethylhydrazine	1.00E-04	1.00E-04
Dimethyl phthalate	1.00E-02	1.00E-01
Dimethyl sulfate	1.00E-03	1.00E-02
4,6-Dinitro-o-cresol (including salts)	1.00E-03	1.00E-02
2,4-Dinitrophenol	1.00E-03	1.00E-03
2,4-Dinitrotoluene	1.00E-02	1.00E-01
1,4-dioxane	1.00E+00	1.00E-01
1,2-Diphenylhydrazine	1.00E-02	1.00E-03
Epichlorohydrin	1.00E-02	1.00E-01
1,2-Epoxybutane	1.00E-02	1.00E-02
Ethyl arcylate	1.00E-01	1.00E-02
Ethyl benezene	1.00E+00	1.00E+01
Ethyl carbamate	1.00E-02	1.00E-01
Ethyl chloride	1.00E-03	1.00E-02
Ethylene dibromide	1.00E+00	1.00E-03
Ethylene dichloride	1.00E-01	1.00E-02
Ethylene glycol	1.00E+00	1.00E+00
Ethyleneimine	1.00E-02	1.00E-02
Ethylene oxide	1.00E-02	1.00E-03
Ethylene thiourea	1.00E-01	1.00E-02
Ethylidene dichloride	1.00E+00	1.00E+01
Formaldehyde	1.00E-03	1.00E-02
Glycol ethers	1.00E-01	1.00E+00
Heptachlor	1.00E-04	1.00E-03
Hexachlorobenzene	1.00E-05	1.00E-03
Hexachlorobutadiene	1.00E-03	1.00E-02
1,2,3,4,5,6-Hexachlorocyclyhexane (including all stereo isomers)	1.00E-03	1.00E-02
Hexachlorocyclopentadiene	1.00E-03	1.00E-03

Pollutant	PLANT LEVEL	
	Round to Nearest:	
	Lbs / hour	Tons/year
Hexachloroethane	1.00E-01	1.00E-01
Hexamethylene diisocyanate	1.00E-04	1.00E-03
Hexamethylphosphoramide	1.00E-01	1.00E-01
n-Hexane	1.00E+00	1.00E+01
Hydrazine	1.00E-03	1.00E-03
Hydrochloric acid	1.00E-01	1.00E-01
Hydrogen fluoride	1.00E-02	1.00E-01
Hydroquinone	1.00E-02	1.00E-01
Isophorone	1.00E-01	1.00E+00
Lead & compounds	1.00E-04	1.00E-03
Maleic anhydride	1.00E-02	1.00E-02
Manganese & compounds	1.00E-03	1.00E-02
Mercury & compounds	1.00E-04	1.00E-03
Methanol	1.00E+00	1.00E+01
Methoxychlor	1.00E-01	1.00E-01
Methyl bromide	1.00E-02	1.00E-02
Methyl chloride	1.00E-01	1.00E-01
Methyl chloroform	1.00E+01	1.00E+01
Methyl ethyl ketone (MEK)	1.00E+01	1.00E+01
Methyl hydrazine	1.00E-04	1.00E-03
Methyl iodide	1.00E-01	1.00E-01
Methyl isobutyl ketone (MIBK)	1.00E+00	1.00E+01
Methyl isocyanate	1.00E-04	1.00E-03
Methyl methacrylate	1.00E+00	1.00E+01
Methyl tert-butyl ether (MTBE)	1.00E+00	1.00E+01
4,4’-Methylenebis(2-chloroaniline)	1.00E-03	1.00E-02
Methylene chloride	1.00E+00	1.00E+00
4,4’-Methylenediphenyl diisocyanate (MDI)	1.00E-04	1.00E-03
4,4’-Methylenedianiline	1.00E-02	1.00E-02
Naphthalene	1.00E-01	1.00E+00
Nickel & compounds	1.00E-03	1.00E-03
Nitrobenzene	1.00E-02	1.00E-01
4-Nitrobiphenyl	1.00E-01	1.00E-01

Pollutant	PLANT LEVEL Round to Nearest:	
	Lbs / hour	Tons/year
4-Nitrophenol	1.00E-02	1.00E-02
2-Nitropropane	1.00E-01	1.00E-04
N-Nitroso-N-methylurea	1.00E-03	1.00E-02
N-Nitrosodimethylamine	1.00E-03	1.00E-05
N-Nitrosomorpholine	1.00E-02	1.00E-02
Parathion	1.00E-03	1.00E-03
Pentachloronitrobenzene	1.00E-03	1.00E-02
Pentachlorophenol	1.00E-03	1.00E-02
Phenol	1.00E-01	1.00E+00
p-Phenylenediamine	1.00E-03	1.00E-03
Phosgene	1.00E-03	1.00E-02
Phosphine	1.00E-03	1.00E-02
Phosphorus	1.00E-03	1.00E-03
Phthalic anhydride	1.00E-01	1.00E-01
PCB	1.00E-02	1.00E-03
POM (PAHs)[a]	**As Individual Pollutant (See Below)**	
1,3-Propane sultone	1.00E+01	1.00E+01
Beta-Propiolactone	1.00E-02	1.00E-01
Propionaldehyde	1.00E-01	1.00E-01
Propoxur	1.00E-03	1.00E-02
Propylene oxide	1.00E-01	1.00E-01
1,2-Propylenimine	1.00E-02	1.00E-01
Quinoline	1.00E-02	1.00E-01
Quinone	1.00E-03	1.00E-02
Selenium & Compounds	1.00E-03	1.00E-02
Styrene	1.00E+00	1.00E+00
Stryene oxide	1.00E-01	1.00E-01
2,3,7,8,-TCDF/2,3,7,8-TCDD[b]	1.00E-07	1.00E-08
1,1,2,2-Tetrachloroethane	1.00E-01	1.00E-01
Tetrachloroethylene	1.00E+00	1.00E+01
Titanium Tetrachloride	1.00E-02	1.00E-01
Toluene	1.00E+00	1.00E+01
Toluene-2,4-damine	1.00E-04	1.00E-04
2,4-Toluene Diisocyanate	1.00E-04	1.00E-02

Pollutant	PLANT LEVEL Round to Nearest: Lbs / hour	 Tons/year
o-Toluidine	1.00E-01	1.00E-02
Toxaphene	1.00E-03	1.00E-03
1,2,4-Trichlorobenzene	1.00E-01	1.00E+00
1,1,2-Trichloroethane	1.00E-01	1.00E+00
Trichloroethylene	1.00E+00	1.00E+01
2,4,5-Trichlorophenol	1.00E-02	1.00E-01
2,4,6-Trichlorophenol	1.00E-02	1.00E-01
Triethylamine	1.00E-02	1.00E-01
Trifluranlin	1.00E-01	1.00E-01
2,2,4-Trimethylpentane	1.00E-01	1.00E+00
Vinyl acetate	1.00E-01	1.00E+00
Vinyl bromide	1.00E-01	1.00E+00
Vinyl chloride	1.00E-01	1.00E-02
Vinylidenen chloride	1.00E-01	1.00E+00
Xylenes	1.00E+00	1.00E+01
o-Xylene	1.00E+00	1.00E+01
m-Xylene	1.00E+00	1.00E+01
p-Xylene	1.00E+00	1.00E+01
Zinc compounds	1.00E-02	1.00E-01
[a]**POM includes:**		
Acenaphthene	1.00E-03	1.00E-02
Acenaphthylene	1.00E-02	1.00E-01
Anthracene	1.00E-03	1.00E-02
Benz(a)anthracene	1.00E-03	1.00E-03
Benzo(a)pyrene	1.00E-03	1.00E-04
Benzo(b)fluoranthene	1.00E-01	1.00E-03
Benzo(ghi)perylene	1.00E-03	1.00E-02
Benzo(k)fluoranthene	1.00E-02	1.00E-02
Chrysene	1.00E-03	1.00E-02
Dibenzo(a,h)anthracene	1.00E-04	1.00E-04
Fluoranthene	1.00E-01	1.00E-01
Fluorene	1.00E-03	1.00E-02
Indeno(1,2,3-cd)pyrene	1.00E-03	1.00E-03
Naphthalene	1.00E-01	1.00E+00
Phenanthrene	1.00E-02	1.00E-02
Pyrene	1.00E-03	1.00E-02
[b]2,3,7,8-Tetrachlorodibenzofuran/		

Pollutant	PLANT LEVEL	
	Round to Nearest:	
	Lbs / hour	Tons/year
2,3,7,8-Tetrachlorodibenzo-p-dioxin.		
Inventory these HAPS as toxic equivalents		
(TEQs)		

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APPENDIX C

EMISSIONS ESTIMATES

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Weide Data (APG, 2014)

Aircraft Type	Engine Model	LTOs	T&P
CH-47D	CH-46, T-58-GE-8F, (T55-GA-714A not available)	430	2
OH-58A/C	T63-A-720	190	2
UH-60A	T760-GE-700	730	2
	Total operations in 2014	**1350**	**6**

Key Assumptions for Weide Army Heliport Data from 2014 Report:

1. If an aircraft enters APG airspace, it counts as one LTO.
2. One LTO cycle consists of 2 aircraft operations: one landing operation and one takeoff operation.
3. Each military aircraft conducts two Trim & Power check (T&P) operations during the calendar year.

Phillips Data (APG, 2014)

		Normal Flights			Training Flights	
Aircraft Type	**Engine Model**	**LTOs**	**T&G**	**LAs**	**LTOs**	**LAs**
A-10 (Fairchild)	TF34-GE-100/-100A	84	24	12	30	4
A-109 (Augusta)	250B17B	387		43		
AS-350	Augusta A109 250B17B (Turbomeca 319 not available)*	301	86	43		
B-12	F101-GE-102	301	86	43		
B-190	F101-GE-102	301	86	43		
B-206	bell 250B17B	387		43		
B-407	bell 250B17B*	387		43		
BE-20	PT6A-28	301	86	43		
BE-23	PT6A-28	301	86	43		
C-130	T-56-A-15	301	86	43		
C-172	IO-360-B	301	86	43		
CASA-212	TPE331-10	301	86	43		
GLF	Tay Mark 611-8	301	86	43		
H-60	T700-GE-700	387		43	30	4
PA-28	IO-320-D1AD	301	86	43		
S-61	T58-GE-8F	387		43		
S-65C	T58-GE-8F	387		43		
S-76	T700-GE-700	387		43		
UH-1N	T-400-CP-400	387		43	30	4
U-2	F-118-GE-100	301	86	43		
B-707	JT3D-7	361				
B-757	PW2037	361				
BE-33G	Raytheon Beech TIO-54-J2B2*	361				
DC-9	JT8D-11	361				
DC-10	CF6-6K	361				
EC-120	Augusta A109 250B17B (Turbomeca 319 not available)*	361				
PA-35	IO-320-D1AD	361				

1. APG only records military and general aviation aircraft entering APG airspace and does not track operations by type of aircraft. Therefore, the aircraft activity associated with each type of military aircraft is estimated by dividing the total military aircraft activity by the number of typical military aircraft handled at APG. Similarly, the aircraft activity associated with each type of general aviation aircraft is estimated by dividing the total general aviation aircraft activity by the number of typical general aviation aircraft handled
2. Of all military aircraft entering APG airspace, Touch & Go operations (T&G) account for 20% (for which any T&G operations are grouped with the LTO numbers, since the EDMS 5.1 model does not allow input of T&G numbers for helicopters), and Low Approaches (LA) for 10%. Landing & Takeoff Operations (LTOs) account for the remainder.
3. General aviation aircraft conduct only LTOs at Aberdeen Proving Ground, i.e., no LAs, T&G or T&P operations.
4. The aircraft activity numbers above include those associated with training activities. 10% of the total LTOs and LAs are associated with training exercises conducted by three aircraft types used in training (A-10, AH-60 and UH-1N). These three aircraft types are the same as those reported in the section on training in the 2002 inventory.

Aircraft Activity in 2023 - Philips Airfield

Totals	**435**

Aircraft Activity in 2023 - Weide Heliport

Note: Data for CY 2023 taken from CY 2017.

From 4/20/21 phone conversation with the Weide Airfield Manager: Total hours flown (3 aircraft) = 3529 hrs., 60% local traffic, 10 minutes per rotation at heliport.
LTOs = ((total hours * 60%)/ 10 minutes)* (60 minutes/1 hour) =((3529 * .6)/ 10) * 60 = 12704

Emissions Calculations

Philips Airfield	**LTOs**	**T&Gs**	**LA**	**Total**
Total operations in 2014	9018	970	829	10817
Total operations in 2023	304.5	87	43.5	435
Ratio of 2023 to 2014	0.033766	0.089691	0.052473	0.040214

See notes for Philips Data (APG, 2014): LA = 10% military, T&G = 20% military, and LTO = 70% military + 100% general avn

Weide Heliport	**LTOs**	**T&P**
Total operations in 2014	1350	6
Total operations in 2023	12704.4	0
Ratio of 2020 to 2014 (LTOs and T&P)	9.369027	0

Pollutant	**CO2**	**CO**	**NOX**	**PM10**	**PM2.5**	**SOX**	**VOC**
Data from 2012 Report to MDE (APG 2014 report on Insignificant Emissions) - Phillips Airfield	22,420	165.24	55.41	0.62	0.6	9.2	44.85
Data from 2012 Report to MDE (APG 2014 report on Insignificant Emissions) - Weide Heliport	767	8.99	1.3	0	0	0.31	7.29
Totals	**23,187**	**174.23**	**56.71**	**0.62**	**0.6**	**9.51**	**52.14**

Criteria Emissions from Aircrafts and GSE, 2011

Pollutant	**CO2 (tpy)**	**CO (tpy)**	**NOX (tpy)**	**PM10 (tpy)**	**PM2.5 (tpy)**	**SOX (tpy)**	**VOC (tpy)**
Philips Airfield Aircraft Emissions	9.02E+02	6.65E+00	2.23E+00	2.49E-02	2.41E-02	3.70E-01	1.80E+00
Weide Heliport Aircraft Emissions	7.19E+03	8.42E+01	1.22E+01	0.00E+00	0.00E+00	2.90E+00	6.83E+01
Total Aircraft Operations Emissions	**8.09E+03**	**9.09E+01**	**1.44E+01**	**2.49E-02**	**2.41E-02**	**3.27E+00**	**7.01E+01**

2023 Emissions = (Ratio of 2023/2014 number of operations)*(2014 emissions)

Residential Emissions

Residential VOC Emissions for Solvent-Based Coatings = Population * Usage Factor * VOC Emission Factor
Residential VOC Emissions for Water-Based Coatings = Population * Usage Factor * VOC Emission Factor

Census Data

Census Data Used	2010 (Solvent-based)	2010 (Water-based)
US Population	308,745,539.0	308,745,539.0
Architectural Coatings Total Usage (gal)	93,571,000.0	515,679,000.0
Per Capita Usage	0.30	1.67

VOC Emission Factors and Usage Factors

	VOC Emission Factor (lb/gal)	Per Capita Usage (gal/person)
Solvent-Based Coatings	3.87	0.30
Water-Based Coatings	0.74	1.67

Emissions Calculations

	2023 AA Residental Population	AA VOC Emissions (lbs/yr)	AA VOC Emissions (tpy)	2023 EA Residental Population	EA VOC Emissions (lbs/yr)	EA VOC Emissions (tpy)	Total VOC Emissions (lbs/yr)	Total VOC Emissions (tpy)
Residential Emissions for Solvent-Based Coatings	925	1.08E+03	5.42E-01	356	4.18E+02	2.09E-01	1.50E+03	7.51E-01
Residential Emissions for Water-Based Coatings	925	1.14E+03	5.72E-01	356	4.40E+02	2.20E-01	1.58E+03	7.92E-01
Totals		**2.23E+03**	**1.11E+00**		**8.58E+02**	**4.29E-01**	**3.09E+03**	**1.54E+00**

Commercial Emissions

Commercial VOC Emissions = VOC Emission Factor * Conversion Factor * Area Painted

COMAR 26.11.33.05 says 250 g/L (max) * 1 lb/453.6 grams * 1 L/0.264 gal
VOC Emission Factor 1.39 lb / gal

For APG a conversion factor was determined to convert square foot of exterior building to gallons of coating used based on historical use data at APG
Conversion Factor 0.001726824 gal / s.f.

From the APG website there are more than 17 million square feet of building space.
Assume 10% is painted each year (i.e. building space is repainted every ten years)
Area Painted 1700000 s.f. / yr

Emissions Calculations

	VOC (lb/yr)	VOC (tpy)
Commercial emissions (lb/yr)	**4.08E+03**	**2.04E+00**

Asphalt Striping Emissions

Project Title	AEI Project Type	AEI Est. Data Quantity	AEI Data Type
MD Aberdeen Intersection	Asphalt Paving	35000	Asphalt Paving Amount (linear feet)
Phillips Runway	Asphalt Paving	150000	Asphalt Paint Amount (square feet)
Perryman 3-mile straightway	Asphalt Paving	21000	Asphalt Paving Amount (linear feet)

Determine CY 2023 Area of Painting from Volume of Paving

Project Title	AEI Data Type	CY 2023 Square Feet of Striping
MD Aberdeen Intersection	Asphalt Paint Amount (ft^2)	11666.7
Phillips Runwway	Asphalt Paint Amount (ft^2)	150000
Perryman 3-mile straightway	Asphalt Paint Amount (ft^2)	7000
Total		**168666.7**

Determine Linear Feet of Asphalt Striping

Assumptions: each linear foot of striping is 4 inches wide

Emissions Calculations

Volume of paint required (gal/yr)	2108
Waterborne paint VOC content (lb/gal)	0.83
Asphalt striping VOC emissions (lb/yr)	1759.58
Asphalt striping VOC emissions (tpy)	0.880

Volume of paint required taken from the paint calculator at https://www.asphaltkingdom.com/parking-lot-paint-calculator using 168,666.7 square feet

Waterborne paint VOC content uses COMAR 26.11.39.05 traffic marking coatings VOC content limit of 100 g / L.

Architectural Surface Coatings Emissions

Pollutant	VOC (tpy)
Total Architectural Surface Coatings Emissions	4.46E+00

Total emissions are from residential, commercial, and asphalt striping architectural surface coatings.

Chapter 5: Chemical Usage

Data for Chemical Usage Emissions (includes laboratory chemicals and miscellaneous c

2023 VOC-related Waste Generation Report from DPW-ED TSDF			
Category	**Weight AA (lb)**	**Weight EA (lb)**	**Total Weight (lb)**
Gasoline	292	85	377
Flammable Liquid (IPA)	824	0	824
Aerosols	979	420	1399
Flammable Paints	1588	467	2055
Diesel Fuel	1328	576	1904
Acetylene	0	36	36
Ethyl Ether	13	0	13
Propane	6	22	28
MAPP Gas	20	0	20
Total	**1116**	**85**	**1201**

Note: Data for CY 2023 taken from CY 2020.

Emissions Calculations

Pollutant	**VOC (lb/yr)**	**VOC (tpy)**
AA Chemical Usage Emissions	5.87E+01	2.94E-02
EA Chemical Usage Emissions	4.47E+00	2.24E-03
Total Chemical Usage Emissions	**6.32E+01**	**3.16E-02**

Assumed that 95% of total chemicals supplied is collected as waste and 5% evaporates.

Asphalt Paving Operations Emissions

Data from DPW ECD CY 2023 Completed Individual Job Orders (IJOs)

Project Title	AEI Project Type	AEI Est. Data Quantity	AEI Data Type	Volume Estimate	AEI Data Type
MD Aberdeen Intersection	Asphalt Paving	35000	Asphalt Paving Amount (linear feet)	175000	Asphalt Paving Amount (cubic feet)
Phillips Runway	Asphalt Paving	150000	Asphalt Paving Amount (square feet)	100000	Asphalt Paving Amount (cubic feet)
Perryman 3-mile straightway	Asphalt Paving	21000	Asphalt Paving Amount (linear feet)	105000	Asphalt Paving Amount (cubic feet)
Total				**380000**	**c.f.**

Assumptions: 1. Road pavement in lateral feet is assumed to be for a 15 foot wide lane, with two 2 inch lifts of asphalt

2. Phillips Runway is assumed to be thicker with 8 inches of asphalt applied

Asphalt Paving Operations Emission Factors (lb emissions/ton material)

PM-10	0.0098
PM-2.5	0.0083
CO	0.4
NOx	0.12
SO2	0.088
VOC	0.032

From AP-42, Chapter 11, Hot Mix Asphalts, Tables 11.1-2, 11.1-5, and 11.1-8 (USEPA)

Emissions Calculations

Pollutant	CO (tpy)	NOX (tpy)	PM10 (tpy)	PM2.5 (tpy)	SOX (tpy)	VOC (tpy)
Asphalt paving operations emissions for AA	5.62E+00	1.69E+00	1.38E-01	1.17E-01	1.24E+00	4.50E-01
Asphalt paving operations emissions for EA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Asphalt Paving Operations Emissions	**5.62E+00**	**1.69E+00**	**1.38E-01**	**1.17E-01**	**1.24E+00**	**4.50E-01**

Assumptions: 1. Asphalt density is 148 lb/cubic foot

2. 100% of asphalt paving operations occurred at AA

Construction Operations Emissions

Construction Operations Emissions include emissions from dust generation, non-mobile construction equipment, mobile construction equipment, and demolition.

Data from DPW ECD CY 2020 Completed Individual Job Orders (IJOs)

Location	Status	StatusDate	ProjectTitle	ProjectType	AEI Project Type	AEI Est. Data Quantity	AEI Data Type	Est. Duration (days)
1	COMP	September 30, 2020	FY20 LIFECYCLE S	ENV	Demolition	Unknown		
1	COMP	September 30, 2020	FY20 Storm Water M	ENV	n/a	n/a		
E5127AST	COMP	November 19, 2020	Replace Containmer	ENV	n/a	n/a		
LANDA	COMP	January 2, 2020	FY19 Emergency Mc	GRPR	n/a	n/a		
4305	COMP	January 13, 2020	Repair Exterior Conc	GRPR	Construction	<100	Area of Disturbance	90
1120C	COMP	January 29, 2020	Replace Fire Pump a	GRPR	n/a	n/a		
E3401	COMP	February 1, 2020	SCIF Door	GRPR	n/a	n/a		
6000	COMP	February 12, 2020	Install 4 Automatic B	GRPR	Construction	Unknown		
1	COMP	June 29, 2020	E2901 Install IR Win	GRPR	Construction	n/a		
E2900	COMP	July 29, 2020	E2900 F Wing Install	GRPR	Construction	~200	Area of Disturbance	90
E2900	COMP	July 29, 2020	E2900 Install White M	GRPR	n/a	n/a		
E2900	COMP	July 29, 2020	E2900 Door Modifica	GRPR	n/a	n/a		
E2900	COMP	July 29, 2020	E2900 Library Workr	GRPR	n/a	n/a		
E2900	COMP	July 29, 2020	E2900 Combine Roo	GRPR	n/a	n/a		
E2901	COMP	July 29, 2020	E2901 Emergency E	GRPR	n/a	n/a		
E2900	COMP	July 29, 2020	E2900 Fire Damage	GRPR	n/a	n/a		
3070	COMP	August 5, 2020	Replace Overhead R	GRPR	n/a	n/a		
2521	COMP	August 6, 2020	New vinyl flooring for	GRPR	n/a	n/a		
4403	COMP	August 6, 2020	Replace one set exte	GRPR	Construction	<100	Area of Disturbance	60
4504	COMP	August 6, 2020	Alter 1st floor restroo	GRPR	n/a	n/a		
5016	COMP	August 6, 2020	5016 High Bay Drain	GRPR	n/a	n/a		
3200	COMP	August 6, 2020	Exterior window seal	GRPR	n/a	n/a		
3090	COMP	August 10, 2020	Fire Sprinkler Replac	GRPR	n/a	n/a		
1	COMP	September 2, 2020	Emergency lighting a	GRPR	n/a	n/a		
4305	COMP	September 9, 2020	1st Floor General Re	GRPR	n/a	n/a		
402	COMP	September 30, 2020	Emergency Repairs t	GRPR	Construction	<100	Area of Disturbance	30
E2901	COMP	October 15, 2020	E2901 Replace Insul	GRPR	n/a	n/a		
E4210	COMP	October 20, 2020	Hoyle Fitness Center	GRPR	Asphalt Paving	20300	Asphalt Paving Amo	30
4305	COMP	October 20, 2020	1st floor interior repa	GRPR	n/a	n/a		
2485	COMP	October 20, 2020	SOFFIT TRIM MISSI	GRPR	n/a	n/a		
E1463	COMP	October 21, 2020	Install Ground Fault I	GRPR	n/a	n/a		
463	COMP	October 21, 2020	CONSTRUCT REST	GRPR	n/a	n/a		
1105	COMP	October 21, 2020	Renovation of Bldg 1	GRPR	n/a	n/a		
1120B	COMP	October 22, 2020	Renovation of room 1	GRPR	n/a	n/a		
3409	COMP	October 22, 2020	3409 Maintenence	GRPR	Construction	1509 (Roof replacemer	Area of Disturbance	90
459	COMP	October 26, 2020	RENOVATE DIRECT	GRPR	n/a	n/a		
E3835	COMP	October 26, 2020	E3835- Replace Fire	GRPR	n/a	n/a		
1	COMP	October 26, 2020	4727 - Replace hand	GRPR	n/a	n/a		
E5242	COMP	October 26, 2020	E5242 New Entrance	GRPR	Construction	1250	Area of Disturbance	90
390	COMP	October 28, 2020	Range Renovations	GRPR	n/a	n/a		
331	COMP	October 29, 2020	Main water line inside	GRPR	n/a	n/a		
525	COMP	November 23, 2020	Replace OH Door	GRPR	n/a	n/a		
2485	COMP	December 8, 2020	Remove existing pair	GRPR	n/a	n/a		
3071	COMP	January 29, 2020	03071 Bsmt IT Rm S	HVAC	n/a	n/a		
6002	COMP	February 4, 2020	Replace heating coil	HVAC	n/a	n/a		
400	COMP	May 11, 2020	DX Coil and Conden	HVAC	n/a	n/a		
4600	COMP	July 28, 2020	Update Boiler sampli	HVAC	n/a	n/a		
2485	COMP	August 6, 2020	Clean Air Ducts	HVAC	n/a	n/a		
2521	COMP	August 6, 2020	Clean Air Ducts	HVAC	n/a	n/a		

2522	COMP	August 6, 2020	Clean Air Ducts	HVAC	n/a	n/a		
2522	COMP	August 6, 2020	Install 3 New Conder	HVAC	n/a	n/a		
1	COMP	August 6, 2020	HVAC & Boiler-Chille	HVAC	n/a	n/a		
4305	COMP	August 6, 2020	Replace VAV Boxes	HVAC	n/a	n/a		
1	COMP	September 30, 2020	FY20 CHILLER PM	HVAC	n/a	n/a		
316	COMP	September 30, 2020	FY20 RNEC Bldg 31	HVAC	n/a	n/a		
4507	COMP	September 30, 2020	FY20 Barrack HVAC	HVAC	n/a	n/a		
1	COMP	September 30, 2020	FY20 GEOTHERMA	HVAC	n/a	n/a		
1	COMP	September 30, 2020	FY20 CDC HVAC PM	HVAC	n/a	n/a		
1	COMP	September 30, 2020	FY20 BOILER PM	HVAC	n/a	n/a		
345	COMP	October 20, 2020	345 Blr Plt - #3 blr re	HVAC	n/a	n/a		
1188	COMP	October 22, 2020	ARL Bldg 01188 Inst	HVAC	n/a	n/a		
367	COMP	December 15, 2020	HVAC Engineer Ass	HVAC	n/a	n/a		
E3109	COMP	December 15, 2020	E3109 Install 5 Ton U	HVAC	n/a	n/a		
LANDA	COMP	January 2, 2020	FY19 LIFECYCLE S	OTH	Demolition	Unknown		
WARET	COMP	February 12, 2020	Replace Storm Wate	OTH	n/a	n/a		
2514	COMP	February 27, 2020	Repair UST at AA Sh	OTH	n/a	n/a		
460AST1	COMP	June 1, 2020	Remove two storage	OTH	Demolition	~500 (1000-gal & 2000	Bldg./Structure Qty	90
R0049	COMP	August 26, 2020	Mow/Till J-Field Ope	OTH	n/a			
936AST	COMP	August 26, 2020	Replace Storage Tar	OTH	Demolition	~200 (1000-gal tank)	Bldg./Structure Qty	30
445AST	COMP	August 26, 2020	Replace fuel tank at	OTH	Demolition	~400 (2000-gal tank)	Bldg./Structure Qty	30
3558AST	COMP	December 8, 2020	Remove storage tan	OTH	Demolition	~400 (2000-gal tank)	Bldg./Structure Qty	30
3409AST	COMP	December 8, 2020	Remove gasoline sto	OTH	Demolition	~100 (275-gal tank)	Bldg./Structure Qty	30
3245AST	COMP	December 8, 2020	Remove storage tan	OTH	Demolition	~400 (2000-gal tank)	Bldg./Structure Qty	30
RDPVE	COMP	January 2, 2020	FY19 EA POTHOLE	PAVE	Asphalt Paving	Unknown		
RDPVA	COMP	January 2, 2020	FY19 AA POTHOLE	PAVE	Asphalt Paving	Unknown		
1	COMP	February 10, 2020	QRP Scrapyard Re-p	PAVE	Asphalt Paving	10000	Asphalt Paving Amount (ft3)	
WALKS	COMP	June 2, 2020	Connect sidewalk in	PAVE	Asphalt Paving	436	Asphalt Paving Amount (ft3)	
WALKE	COMP	August 6, 2020	Repair Concrete Sid	PAVE	Asphalt Paving	n/a (Concrete)		
BIKPA	COMP	August 6, 2020	Repair Aberdeen Blv	PAVE	Asphalt Paving	n/a (Concrete)		
3326	COMP	August 6, 2020	AA REC CTR CONC	PAVE	Asphalt Paving	n/a (Concrete)		
RDPVA	COMP	September 30, 2020	FY20 AA POTHOLE	PAVE	Asphalt Paving	Unknown		
WALKS	COMP	September 30, 2020	Repair Sidewalks an	PAVE	Asphalt Paving	9513.333333	Asphalt Paving Amount (ft3)	
RDPVE	COMP	September 30, 2020	FY20 EA POTHOLE	PAVE	Asphalt Paving	Unknown		
E4305NP1	COMP	October 5, 2020	Parking Lot & Access	PAVE	Asphalt Paving	37200	Asphalt Paving Amount (ft3)	
R0017	COMP	November 18, 2020	Emergency Culvert R	PAVE	Asphalt Paving	<100	Asphalt Paving Amount (ft3)	
WALKS	COMP	December 10, 2020	Repair sidewalk betv	PAVE	Asphalt Paving	n/a (Concrete)		
R0026	COMP	December 28, 2020	Pave Parking Lot at I	PAVE	Asphalt Paving	32400	Asphalt Paving Amount (ft3)	
935NP1	COMP	December 28, 2020	Re-Pave 00935 Park	PAVE	Asphalt Paving	14133.33333	Asphalt Paving Amount (ft3)	
E3106	COMP	June 29, 2020	Roof E3106	ROOF	Construction	3400	Area of Disturbance	90
746	COMP	August 6, 2020	Replace Roof	ROOF	Construction	11000	Area of Disturbance	120
390	COMP	August 6, 2020	Roof replacement	ROOF	Construction	58025	Area of Disturbance	360
345	COMP	August 6, 2020	Repair roof membran	ROOF	Construction	n/a		
6006	COMP	August 6, 2020	Phase two roof repai	ROOF	Construction	265045	Area of Disturbance	360
E2900	COMP	August 10, 2020	E2900 18RICD006 R	ROOF	Construction	10000	Area of Disturbance	120
E5360	COMP	August 27, 2020	Roof and Exterior Wa	ROOF	Construction	23700	Area of Disturbance	360
1	COMP	September 30, 2020	FY20 EMERGENCY	ROOF	Construction	Unknown		
E4301	COMP	October 22, 2020	E4301 Evaluate & Re	ROOF	Construction	290000	Area of Disturbance	360
E4516	COMP	October 22, 2020	E4516 Roof Replace	ROOF	Construction	64000	Area of Disturbance	120
E4470	COMP	November 19, 2020	Roof Replacement	ROOF	Construction	17000	Area of Disturbance	120
E5357	COMP	November 30, 2020	Replace Damaged T	ROOF	Construction	4730	Area of Disturbance	90
E1901	COMP	November 30, 2020	Edgewood CDC Roo	ROOF	Construction	10000	Area of Disturbance	90
E5951	COMP	December 10, 2020	E5951 Roof Replace	ROOF	Construction	52000	Area of Disturbance	120
1183	COMP	December 29, 2020	Roof/Gutter/LPS Rep	ROOF	Construction	650	Area of Disturbance	90
E3330	COMP	January 2, 2020	FY19 ACLS Excavation and Digging ECBC		n/a	n/a		
Total Area of Disturbance (s.f.) and Duration of Construction (days) - roof construction excluded due to no land disturbance						**26000**		**780**
Total Area of Bldg Construction (s.f.)						**810800**		
Total Volume of Bldg Demolition (c.f.)						**2000**		

Note: Data for CY 2023 taken from CY 2020.

CY 2020 Data from APG Contaminated Bldg Demolition and APG Facility Reduction Program, c.f. data from DPW-ED

Contaminated Building Demo Program

Facilities Reduction Program

BUILDING	PREDOM_CUR_USE_CATCODE_DESC	BLDGQTY	BLDGUM	Est. Bldg. Floors	Est. Bldg. Qty (ft3)
E3219	STR SHED GP INS	192	FT2	1	2880
E3222	MED RES LAB	32901	FT2	2	987030
E3222NP1	NONORG PK PAVD	249	SY	0	0
E3223	PWR PLT BLDG	320	FT2	1	4800
E3223	STANDBY GEN	204	KW	0	0
E3224	LAB/TST BLDG GP	5981	FT2	1	89715
E3224NP1	NONORG PK PAVD	1583.21	SY	0	0
E3226	LAB/TST BLDG GP	18834	FT2	2	565020
E3228	LAB/TST BLDG GP	4742	FT2	1	71130
E3230	LAB/TST BLDG GP	5850	FT2	1	87750
E3232	LAB/TST BLDG GP	4799	FT2	1	71985
E3234	LAB/TST BLDG GP	5709	FT2	1	85635
E3234NP1	NONORG PK PAVD	713.57	SY	0	0
E3302	HEAT PLANT OIL	42	2I	0	0
E3302	HEAT PLT BLDG	1599	FT2	1	23985
E3326	ADMIN GEN PURP	2671	FT2	1	40065
379	RANGE BUILDINGS	4066	FT2	1	60990
5112	FIX AMMO MAG IN	415	FT2	1	6225
5114	MOUT TNG (SM)	1	FT2	1	15
379NP1	NONORG PK PAVD	702.57		0	0
379NP1	NONORG PK PAVD	702.57	SY	0	0
5114DEM1	VERHEAD PROTE	496		1	7440
5114DEM1	VERHEAD PROTE	496	FT2	1	7440
E1426	AMMO STRHS INST	461	FT2	1	6915
E1441	SAFETY SHELTER	1	FT2	0	0
E1453	SAFETY SHELTER	1	FT2	0	0
E2300	ACCESS CNT FAC	64		1	960
E2300	ACCESS CNT FAC	64	FT2	1	960
E2338	HAZ MAT STR INS	3970	FT2	1	59550
E2340	CARE/PRES SHOP	3970		1	59550
E2344	ACCESS CNT FAC	64		1	960
E2344	ACCESS CNT FAC	64	FT2	1	960
E4455	ADMIN GEN PURP	16784	FT2	1	251760
E5782	FLAM MAT STR IN	522	FT2	1	7830
E5783	STORAGE GP INST	259	FT2	1	3885
E5784	STORAGE GP INST	320	FT2	1	4800
E5785	STORAGE GP INST	216	FT2	1	3240
E5785NP1	NONORG PK PAVD	202		1	3030
E5785NP1	NONORG PK PAVD	202	SY	1	3030
E5785NP2	NONORG PK PAVD	589.87		1	8848.05
E5785NP2	NONORG PK PAVD	589.87	SY	1	8848.05
E7012	IGLOO STR INST	1069		1	16035
E7401	STORAGE GP INST	256	FT2	1	3840
E7402	VEH STR SHED IN	440	FT2	1	6600
E7931	PAD	640	FT2	0	0
E7931	PAD	640	SY	0	0
E7931GA	ENTRANCE GATE	30		0	0
E7931GA	ENTRANCE GATE	30	FT	0	0
Total					**2563706.1**

Note: Bldg c.f. was estimated by DPW-ED by multiplying area of bldg by 15 ft.

Note: Data for CY 2023 taken from CY 2020.

Construction Operations Emission Factors and Emissions Calculation Information taken from February 2017 APG DPW-ED RONA Excel spreadsheet.

Construction emissions estimates are based on AP-42 Section 13.2.3-1.							
	Calculation of PM10				*Calculation of PM2.5*		
	lb/yr = E x VMT				lb/yr = E x VMT		
	$E=k(s/12)^a \times (W/3)^b$				$E=k(s/12)^a \times (W/3)^b$		
Construction traffic							
	Where:				Where:		
	k =	1.5			k =	0.23	
	E =	2.286619707			E =	0.350615022	
	s =	7	%		s =	7	%
	W =	22.5	tons		W =	22.5	tons
	a =	0.9			a =	0.9	
	b =	0.45			b =	0.45	
Land Clearing, material loading							
	PM10 =	0.75			PM2.5 =	0.105	
	TSP =	0.058	lbs/ton	(scraper)			
	TSP =	0.037	lbs/ton	(loading)			
Assumptions							
	No. pieces of eqpt		31				
	Depth Cleared		2	feet			
	Density of Soil		80	lb/ft^3			

	2010 Emissions Factors (g/hp-hr)					
Equipment Type	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
PROPANE HEATE	322.35	3.56	0.12	0.11	0.22	6.67
TOWER, LIGHT, 4(	5.88	4.68	0.63	0.62	0.13	0.72
LIGHT TOWER	5.88	4.68	0.63	0.62	0.13	0.72
LIGHT TOWER	5.88	4.68	0.63	0.62	0.13	0.72
LIGHT TOWER/400	5.88	4.68	0.63	0.62	0.13	0.72
LIGHT TOWER	5.88	4.68	0.63	0.62	0.13	0.72
Welder, Big 40	5.88	4.68	0.63	0.62	0.13	0.72
PORTABLE DIESE	5.88	4.68	0.63	0.62	0.13	0.72
GENERATOR	3.21	5.77	0.6	0.59	0.13	0.71

Emission factors for non-mobile heavy construction equipment originate from EPA NONROAD2008 model (adapted from APG RONA file).

	2010 Emissions Factors (g/hp-hr)						
Equipment Type	Brake-Specific Fuel Consumpt	VOC	CO	NO_x	PM_{10}	SO_2	$PM_{2.5}$
	(lb/hp-hr)						
Roller	0.4	0.46	3.96	4.57	0.57	0.13	0.56
Crane (Boom Lift)	0.36	0.45	2.61	4.79	0.45	0.13	0.44
Crane (14 ton)	0.36	0.45	2.61	4.79	0.45	0.13	0.44
Crane (18 ton)	0.36	0.45	2.61	4.79	0.45	0.13	0.44
Crane (50 ton)	0.36	0.32	1.03	4.29	0.26	0.11	0.25
Crane (65 ton)	0.36	0.32	1.03	4.29	0.26	0.11	0.25
Crane (75 ton)	0.36	0.32	1.03	4.29	0.26	0.11	0.25
Crane (125 ton)	0.36	0.29	0.88	4.09	0.2	0.11	0.19
Crane (150 ton)	0.36	0.29	0.88	4.09	0.2	0.11	0.19
Grader	0.36	0.3	1.45	3.73	0.34	0.12	0.33
Truck	0.433	0.23	1.24	2.96	0.25	0.12	0.24
Excavator	0.433	1.46	7.63	6.29	1.17	0.15	1.14
Bulldozer	0.433	0.95	3.62	6.01	0.62	0.13	0.6
Forklifts (Wiggins)	0.481	0.3	1.77	4.74	0.3	0.13	0.29

Emission factors for mobile heavy construction equipment originate from EPA NONROAD2008 model (adapted from APG RONA file).

Emissions Calculations

The following data was entered into the February 2017 APG DPW-ED RONA Excel spreadhsheet which generated the following emissions estimates:

Worksheet	Input Description	Input	Input Units of Measure	CO (tpy)	NOX (tpy)	PM10 (tpy)	PM2.5 (tpy)	SOX (tpy)	VOC (tpy)
Intro	Emissions Sources	Checked Construction and Demolition boxes	N/A						
Construction Dust Input	Area in LOD	26000	Area of Disturbance (ft2)						
Construction Dust Input	Construction Duration	780	Days						
Construction Nonmob Eqpt Input	Bldg. Construction Area	810800	Area of Disturbance (ft2)						
Construction Mob Eqpt Input	Bldg. Construction Area	810800	Area of Disturbance (ft2)						
Demolition	Volume of bldg. demolished	2565706.1	Bldg./Structure Qty (ft3)						
Total Construction Operations Emissions				**1.72E+01**	**3.59E+01**	**1.43E+01**	**4.67E+00**	**5.29E-01**	**7.32E+00**

Consumer Products Emissions Calculations

Source Category	Per Capita Emission Factor (lb VOC/person)	2023 AA Residential Population	AA VOC Emitted (lbs/yr)	AA VOC Emitted (tpy)	2023 EA Residential Population	EA VOC Emitted (lbs/yr)	EA VOC Emitted (tpy)	VOC (tpy)
Personal Care Products	2.32	925	2.15E+03	1.07E+00	356	8.26E+02	4.13E-01	
Household Products	0.79	925	7.31E+02	3.65E-01	356	2.81E+02	1.41E-01	
Automotive Aftermarket Products	1.36	925	1.26E+03	6.29E-01	356	4.84E+02	2.42E-01	
Adhesives and Sealants	0.57	925	5.27E+02	2.64E-01	356	2.03E+02	1.01E-01	
Miscellaneous Products	0.07	925	6.48E+01	3.24E-02	356	2.49E+01	1.25E-02	
Totals			**4.73E+03**	**2.36E+00**		**1.82E+03**	**9.10E-01**	
Total Consumer Products Emissions								**3.27E+00**

Consumer Products Emissions = Population * Per Capita Emission Factor

EF from Emission Inventory Improvement Program, Volume III, August 1996, Table 5.4-1

Chapter 8: Fuel Spills

Data for Fuel Spills Emissions

Fuel spills for CY 2023 at APG 12973 gallons (35 spill events)

Note: Data for CY 2023 taken from CY 2017.

Fuel Spills Emission Factor and Emissions Calculations

Fuel spills (gal/yr)	Emission Factor (lb/1000 gal)	VOC (lb/yr)	VOC (tpy)
12973	0.7	9.08E+00	4.54E-03

Emission factor from AP42 Table 5.2-7

Used the EF from spillage at a gasoline service station (only spillage EF in the document)

VOCs are the emission of interest

Data for Insignificant External Combustion Sources Emissions

List of Insignificant External Combustion Sources from DPW

AA Building #	Size (MMBTU/hr)	Fuel Type
300	0.43	Fuel Oil
327	0.48	Fuel Oil
342	0.76	Fuel Oil
398	0.43	Fuel Oil
413	0.91	Fuel Oil
430	0.29	Fuel Oil
434	0.95	Fuel Oil
437	0.98	Fuel Oil
439	0.78	Fuel Oil
455	0.29	Fuel Oil
600	0.29	Fuel Oil
607	0.24	Fuel Oil
701	0.14	Fuel Oil
714	0.5	Fuel Oil
1059	0.49	Fuel Oil
1065	0.959	Fuel Oil
1067	0.102	Electric
1078	0.23	Fuel Oil
1089	0.43	Fuel Oil
1114	0.43	Fuel Oil
1171	0.3	Propane
1185	0.895	Fuel Oil
1196	0.4	Fuel Oil
2478	0.13	Fuel Oil
3240	0.78	Fuel Oil
3326	0.14	Dual Fuel
4125	0.5	Fuel Oil
4302	0.78	Fuel Oil
4603	0.63	Natural Gas
4603	0.63	Natural Gas
4725	0.48	Fuel Oil

AA Building #	Size (MMBTU/hr)	Fuel Type
5016	0.75	Natural Gas
5016	0.75	Natural Gas
5016	0.75	Natural Gas
5109	0.72	Fuel Oil
5650	0.76	Fuel Oil
1193 (1188 A)	0.375	Fuel Oil
269 D	0.98	Fuel Oil
280 A	0.47	Fuel Oil
280 C	0.5	Fuel Oil
460 B	0.59	Fuel Oil
737 B	0.2	Fuel Oil
744 M	0.78	Fuel Oil
746 A	0.23	Fuel Oil
Total AA Fuel Oil	19.351	
Total AA NG	3.51	
Total AA Propane	0.3	

EA Building #	Size (MMBTU/hr)	Fuel Type
E1260	0.13	Fuel Oil
E1401	0.17	Fuel Oil
E1407	0.96	Fuel Oil
E1431	0.58	Fuel Oil
E1901	0.9	Natural Gas
E1942	0.63	Fuel Oil
E1946	0.12	Fuel Oil
E2169	0.15	Fuel Oil
E2187	0.64	Fuel Oil
E2188	0.68	Fuel Oil
E2800	0.5	Natural Gas
E2800	0.5	Natural Gas
E2800	0.5	Natural Gas
E3857	0.62	Fuel Oil
E3949	0.42	Fuel Oil
E3956	0.15	Fuel Oil
E4060	0.12	Fuel Oil
E4110	0.50	Natural Gas
E4630	0.27	Fuel Oil
E5642	0.62	Fuel Oil
E5642	0.59	Fuel Oil
E5685	0.44	Fuel Oil
E5844	0.59	Fuel Oil
E6110	0.98	Fuel Oil
E6810	0.47	Fuel Oil
E6810	0.47	Fuel Oil
E6811	0.43	Fuel Oil
E6812	0.35	Fuel Oil
Total EA Fuel Oil	10.58	
Total EA NG	2.9	
Total EA Propane	0	

Insignificant External Combustion Sources Emission Factors

Pollutant	Fuel Oil EF (lb/1000 gal)	NG EF (lb/MMscf)	Propane EF (lb/1000 gal)
CO	5	84	7.5
NOx	20	100	13
PM-10	3.30	7.6	0.7
PM-2.5	3.30	7.6	0.7
SO2	7.20	0.60	0.05
VOC	0.34	5.5	0.8

Fuel oil EF Source: Criteria Pollutant Emission Factors from Table 1.3-1, 1.3-2 and 1.3-3 of AP-42.

NG EF Source: Criteria Pollutant Emission Factors from Table 1.4-1 and 1.4-2 of AP-42.

Propane EF Source: Criteria Pollutant and GHG Emission Factors from Table 1.5-1 of AP-42.

Assumed low sulfur fuel oil (0.05%)

Insignificant External Combustion Sources Emissions Calculations

	Rated Heat Input Capacity (MMBtu/hr)	CY 2023 Operating Hours (hr/yr)	Heat Value	Criteria Pollutant Emissions					
				CO (tpy)	NOX (tpy)	PM10 (tpy)	PM2.5 (tpy)	SOX (tpy)	VOC (tpy)
AA Fuel Oil	19.4	2,027	0.14	7.00E-01	2.80E+00	4.62E-01	4.62E-01	1.01E+00	4.76E-02
AA NG	3.51	2,027	1037	2.88E-01	3.43E-01	2.61E-02	2.61E-02	2.06E-03	1.89E-02
AA Propane	0.3	2,027	0.091452	2.49E-02	4.32E-02	2.33E-03	2.33E-03	1.80E-04	2.66E-03
EA Fuel Oil	10.58	2,027	0.14	3.83E-01	1.53E+00	2.53E-01	2.53E-01	5.51E-01	2.60E-02
EA NG	2.9	2,027	1037	2.38E-01	2.83E-01	2.15E-02	2.15E-02	1.70E-03	1.56E-02
EA Propane	0	2,027	0.091452	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Insignificant External Combustion Sources Emissions				**1.63E+00**	**5.00E+00**	**7.65E-01**	**7.65E-01**	**1.56E+00**	**1.11E-01**

Operating hours for insignificant boilers assumed to be 2,027 hr/yr, one third of the potential operating hours for space heating boilers (the period from Oct. 31 - Mar. 31 divided by 60% = [(30+31+31+28+31+1) * 24]/0.6 = 6,080 hr/yr)

Heat value of fuel oil = 140,000 Btu/gal from AP 42, 5th Edition, Volume I: 1.3 Fuel Oil Combustion, Sept. 1999, corrected May 2010.

Heat value of natural gas = 1,037 Btu/scf from: https://www.eia.gov/tools/faqs/faq.php?id=45&t=7.

Heat value of propane = 91,452 Btu/gal from: https://www.eia.gov/energyexplained/units-and-calculators/.

Data for Insignificant Internal Combustion Sources Emissions

List of Insignificant Internal Combustion Sources from DPW

AA Bldg. No.	Rating (HP)
276	99
300	66
314	166
325	40
334	44
335	284
345	469
348	284
350	180
367	132
394	131
400	268
400	380
434	33
436	284
450	11
469	40
469	80
606	145
646	132
669	96
670	80
770	99
860	49
861	284
1043	288
1059	66
1067	277
1134	158
2200	287
2502	277
3000	99
3200	385
3330	402
3400	335

AA Bldg. No.	Rating (HP)
3500	99
3660A	200
4402	34
4603	180
5200	99
5402	99
5615	99
5701	402
6004	399
6008	399
6011	94
6280	201
10306	168
038-C	20
1060 BLK (1063	100
1099 A	180
1114 (1114A)	96
1193 C	377
2832 F	284
3323 A (3323)	99
3660 A	150
383 A	47
400 A	99
400 B	96
460 A	166
714 A	34
714 E	99
737 B (714)	70
744 A	99
800 (C Tower)	80
CTA Commo	49
PTCMC	100
Total	**11168**

Note: All insignificant internal combustion sources burn diesel fuel.

EA Bldg. No.	Rating (HP)
E1451	166
E1474	100
E1474	470
E1521 (E1523)	284
E1900 (E1944)	66
E1930	134
E1930	385
E1950	422
E2101	299
E2188	20
E2193	180
E2390	209
E2410	418
E3000	99
E3150	40
E3150	110
E3160	70
E3240	20
E3250	168
E3250B	201
E3312	390
E3331	322
E3461	99
E3462	315
E3511	20
E3516	166
E3612	402
E3726	134
E3726	201
E3832	440
E328332 (E330	45
E3840 (E3835)	284
E3840 (E3835)	99
E3948	499
E4000 (E4055)	66

EA Bldg. No.	Rating (HP)
E4081	145
E4110	170
E4160	66
E4160	174
E4223	284
E4224	369
E4301	102
E4383	166
E4500	99
E4502	10
E4670 (E4650)	66
E5016	408
E5103	168
E5180	355.0
E5126	353.0
E5234	490.0
E5236	134.0
E5240	201.0
E5296	166.0
E5307	66.0
E5560	66.0
E5600	99.0
E5664	166.0
E5800	180.0
E5951	134.0
E6110 (E3853)	250.0
E7010	40.0
E7152	440.0
E7239	96.0
E7525	315.0
E7525	64.0
E7525	463.0
PTCMC	100.0
Total	**13748**

Note: All insignificant internal combustion sources burn diesel fuel.

Chapter 10: Insignificant Internal Combustion Sources

Insignificant Internal Combustion Sources Emission Factors

	Emission Factor (lb/10^3 HP-hr)	
Constituent	**Diesel**	**Gasoline**
CO	6.68	6.96
NOx	31	11
PM-10	2.2	0.721
PM-2.5	2.2	0.721
SOx	2.05	0.591
VOC	2.5	15

Emission Factors for Criteria Pollutants, derived from AP-42, Section 3.3. Table 3.3-1 (10/96)

Insignificant Internal Combustion Sources Emissions Calculations

	Aggregated Ratings (HP)	CY 2020 Operating Hours (hr/yr)	Annual Power Output (HP-hr/yr)	Criteria Pollutant Emissions					
				CO (tpy)	NOX (tpy)	PM10 (tpy)	PM2.5 (tpy)	SOX (tpy)	VOC (tpy)
AA Insignificant Internal Combustion Sources	11168.0	50	558,400	1.87E+00	8.66E+00	6.14E-01	6.14E-01	5.72E-01	6.98E-01
EA Insignificant Internal Combustion Sources	13748.0	50	687,400	2.30E+00	1.07E+01	7.56E-01	7.56E-01	7.05E-01	8.59E-01
Total Insignificant Internal Combustion Sources Emissions				**4.16E+00**	**1.93E+01**	**1.37E+00**	**1.37E+00**	**1.28E+00**	**1.56E+00**

Emissions (tpy) = [Emission Factor (lb/10^3 hp-hr) x (Power Output (hp-hr/yr)/1000)]/2000 lb per ton

CY 2020 operating hours assumed at 50 hours. This assumes 2 hours per month load test plus 2 hours usage per month, then rounded up to 50 hours.

Data for Insignificant Storage Tanks Emissions

List of Insignificant Storage Tanks from DPW

Building #	Capacity (gal)	Tank Type	Fuel Type
345	300,000	AST	#2 Fuel Oil
E5127	300,000	AST	#2 Fuel Oil
E5127	300,000	AST	#2 Fuel Oil
E2851	20,000	AST	#2 Fuel Oil
E2851	20,000	AST	#2 Fuel Oil
E2851	20,000	AST	#2 Fuel Oil
507	15,000	AST	#2 Fuel Oil
E3312	15,000	AST	#2 Fuel Oil
6002	12,000	AST	#2 Fuel Oil
6002	12,000	AST	#2 Fuel Oil
6007	12,000	AST	#2 Fuel Oil
6007	12,000	AST	#2 Fuel Oil
E1574	12,000	AST	#2 Fuel Oil
E4081	12,000	AST	#2 Fuel Oil
E4081	12,000	AST	#2 Fuel Oil
E4081	12,000	AST	#2 Fuel Oil
E4160	12,000	AST	#2 Fuel Oil
402	10,000	AST	#2 Fuel Oil
455	10,000	AST	#2 Fuel Oil
459	10,000	AST	#2 Fuel Oil
1064	10,000	AST	#2 Fuel Oil
3070	10,000	AST	#2 Fuel Oil
4119	10,000	AST	#2 Fuel Oil
6003	10,000	AST	#2 Fuel Oil
6003	10,000	AST	#2 Fuel Oil
6006	10,000	AST	#2 Fuel Oil
6006	10,000	AST	#2 Fuel Oil
E2188	10,000	AST	#2 Fuel Oil
E3312	10,000	AST	#2 Fuel Oil
E4902	10,000	AST	#2 Fuel Oil
E5828	10,000	AST	#2 Fuel Oil
394	8,000	AST	#2 Fuel Oil
469	8,000	AST	#2 Fuel Oil
1193	8,000	AST	#2 Fuel Oil
2207	8,000	AST	#2 Fuel Oil
2352	8,000	AST	#2 Fuel Oil

Building #	Capacity (gal)	Tank Type	Fuel Type
1114	2000	AST	#2 Fuel Oil
1115	2000	AST	#2 Fuel Oil
1185	2000	AST	#2 Fuel Oil
3554	2000	AST	#2 Fuel Oil
4019	2000	AST	#2 Fuel Oil
4125	2000	AST	#2 Fuel Oil
4725	2000	AST	#2 Fuel Oil
5109	2000	AST	#2 Fuel Oil
1193C	2000	AST	#2 Fuel Oil
280B	2000	AST	#2 Fuel Oil
699A	2000	AST	#2 Fuel Oil
745A	2000	AST	#2 Fuel Oil
E1431	2000	AST	#2 Fuel Oil
E1942	2000	AST	#2 Fuel Oil
E1950	2000	AST	#2 Fuel Oil
E2162	2000	AST	#2 Fuel Oil
E2162	2000	AST	#2 Fuel Oil
E2194	2000	AST	#2 Fuel Oil
E2200	2000	AST	#2 Fuel Oil
E3928	2000	AST	#2 Fuel Oil
E3934	2000	AST	#2 Fuel Oil
E3949	2000	AST	#2 Fuel Oil
E5642	2000	AST	#2 Fuel Oil
E5685	2000	AST	#2 Fuel Oil
E5884	2000	AST	#2 Fuel Oil
E6110	2000	AST	#2 Fuel Oil
E6810	2000	AST	#2 Fuel Oil
E6810	2000	AST	#2 Fuel Oil
E6811	2000	AST	#2 Fuel Oil
607	1500	AST	#2 Fuel Oil
E4585	1500	AST	#2 Fuel Oil
E6812	1500	AST	#2 Fuel Oil
45	1000	AST	#2 Fuel Oil
262	1000	AST	#2 Fuel Oil
263	1000	AST	#2 Fuel Oil
327	1000	AST	#2 Fuel Oil

Building #	Capacity (gal)	Tank Type	Fuel Type
922	500	AST	#2 Fuel Oil
922	500	AST	#2 Fuel Oil
937	500	AST	#2 Fuel Oil
983	500	AST	#2 Fuel Oil
986	500	AST	#2 Fuel Oil
986	500	AST	#2 Fuel Oil
1089	500	AST	#2 Fuel Oil
1096	500	AST	#2 Fuel Oil
1138	500	AST	#2 Fuel Oil
1141	500	AST	#2 Fuel Oil
1190	500	AST	#2 Fuel Oil
2477	500	AST	#2 Fuel Oil
1052A	500	AST	#2 Fuel Oil
1052D	500	AST	#2 Fuel Oil
1089A	500	AST	#2 Fuel Oil
280A	500	AST	#2 Fuel Oil
535A	500	AST	#2 Fuel Oil
5608A	500	AST	#2 Fuel Oil
714B	500	AST	#2 Fuel Oil
733A	500	AST	#2 Fuel Oil
740L	500	AST	#2 Fuel Oil
744M	500	AST	#2 Fuel Oil
746A	500	AST	#2 Fuel Oil
937B	500	AST	#2 Fuel Oil
E1400	500	AST	#2 Fuel Oil
E1485	500	AST	#2 Fuel Oil
E1946	500	AST	#2 Fuel Oil
E2169	500	AST	#2 Fuel Oil
E2851	500	AST	#2 Fuel Oil
E2851	500	AST	#2 Fuel Oil
E3842	500	AST	#2 Fuel Oil
E3857	500	AST	#2 Fuel Oil
E3956	500	AST	#2 Fuel Oil
E4041	500	AST	#2 Fuel Oil
E4306	500	AST	#2 Fuel Oil
E4306	500	AST	#2 Fuel Oil

List of Insignificant Storage Tanks from DPW

Building #	Capacity (gal)	Tank Type	Fuel Type
2377	8,000	AST	#2 Fuel Oil
2502	8,000	AST	#2 Fuel Oil
3062	8,000	AST	#2 Fuel Oil
3601	8,000	AST	#2 Fuel Oil
4219	8,000	AST	#2 Fuel Oil
4312	8,000	AST	#2 Fuel Oil
4404	8,000	AST	#2 Fuel Oil
906C	8,000	AST	#2 Fuel Oil
E4225	8,000	AST	#2 Fuel Oil
E4305	8,000	AST	#2 Fuel Oil
E4516	8,000	AST	#2 Fuel Oil
4302	6,000	AST	#2 Fuel Oil
E3844	6,000	AST	#2 Fuel Oil
E4040	6,000	AST	#2 Fuel Oil
E1930	5,000	AST	#2 Fuel Oil
439	4,000	AST	#2 Fuel Oil
469	4,000	AST	#2 Fuel Oil
643	4,000	AST	#2 Fuel Oil
643	4,000	AST	#2 Fuel Oil
3011	4,000	AST	#2 Fuel Oil
4728	4,000	AST	#2 Fuel Oil
1100F	4,000	AST	#2 Fuel Oil
700M	4,000	AST	#2 Fuel Oil
E1958	4,000	AST	#2 Fuel Oil
E4081	4,000	AST	#2 Fuel Oil
E5664	4,000	AST	#2 Fuel Oil
E5951	4,000	AST	#2 Fuel Oil
608	3,000	AST	#2 Fuel Oil
5116	3,000	AST	#2 Fuel Oil
269C	3,000	AST	#2 Fuel Oil
342	2,000	AST	#2 Fuel Oil
384	2,000	AST	#2 Fuel Oil
390	2,000	AST	#2 Fuel Oil
399	2,000	AST	#2 Fuel Oil
400	2,000	AST	#2 Fuel Oil
430	2,000	AST	#2 Fuel Oil
434	2,000	AST	#2 Fuel Oil
445	2,000	AST	#2 Fuel Oil

Building #	Capacity (gal)	Tank Type	Fuel Type
392	1000	AST	#2 Fuel Oil
439	1000	AST	#2 Fuel Oil
456	1000	AST	#2 Fuel Oil
600	1000	AST	#2 Fuel Oil
642	1000	AST	#2 Fuel Oil
650	1000	AST	#2 Fuel Oil
670	1000	AST	#2 Fuel Oil
936	1000	AST	#2 Fuel Oil
1078	1000	AST	#2 Fuel Oil
1103	1000	AST	#2 Fuel Oil
1134	1000	AST	#2 Fuel Oil
3240	1000	AST	#2 Fuel Oil
3554	1000	AST	#2 Fuel Oil
3556	1000	AST	#2 Fuel Oil
6004	1000	AST	#2 Fuel Oil
6004	1000	AST	#2 Fuel Oil
6008	1000	AST	#2 Fuel Oil
6008	1000	AST	#2 Fuel Oil
1116B	1000	AST	#2 Fuel Oil
269D	1000	AST	#2 Fuel Oil
280C	1000	AST	#2 Fuel Oil
460B	1000	AST	#2 Fuel Oil
714F	1000	AST	#2 Fuel Oil
714G	1000	AST	#2 Fuel Oil
737B	1000	AST	#2 Fuel Oil
737D	1000	AST	#2 Fuel Oil
E1401	1000	AST	#2 Fuel Oil
E1407	1000	AST	#2 Fuel Oil
E1464	1000	AST	#2 Fuel Oil
E2200	1000	AST	#2 Fuel Oil
E2330	1000	AST	#2 Fuel Oil
E2590	1000	AST	#2 Fuel Oil
E3109	1000	AST	#2 Fuel Oil
E3934	1000	AST	#2 Fuel Oil
E5234	1000	AST	#2 Fuel Oil
691	550	AST	#2 Fuel Oil
1196	550	AST	#2 Fuel Oil
3329	550	AST	#2 Fuel Oil

Building #	Capacity (gal)	Tank Type	Fuel Type
E5642	500	AST	#2 Fuel Oil
E5840	500	AST	#2 Fuel Oil
E5844	500	AST	#2 Fuel Oil
E3150	280	AST	#2 Fuel Oil
398	275	AST	#2 Fuel Oil
631	275	AST	#2 Fuel Oil
1191	275	AST	#2 Fuel Oil
5005	275	AST	#2 Fuel Oil
924 AA5	275	AST	#2 Fuel Oil
E2556	275	AST	#2 Fuel Oil
E3516	275	AST	#2 Fuel Oil
E4630	275	AST	#2 Fuel Oil
E3840	250	AST	#2 Fuel Oil
E3511	150	AST	#2 Fuel Oil
E4301	25000	UST	#2 Fuel Oil
E4301	25000	UST	#2 Fuel Oil
1078	25000	UST	JP-8
E4057	20000	UST	F24
E4057	20000	UST	F24
4029	15000	UST	diesel
4029	15000	UST	diesel
E4010	12000	UST	gasoline
E4010	12000	UST	gasoline
E4010	12000	UST	gasoline
2514	10000	UST	gasoline
2514	10000	UST	gasoline
2514	10000	UST	gasoline
421	10000	UST	diesel
421	10000	UST	diesel
421	10000	UST	diesel
421	10000	UST	JP-8
896	10000	UST	JP-8
896	10000	UST	diesel
896	10000	UST	JP-8
10309	10000	UST	diesel
10309	10000	UST	JP-8
740C	5000	UST	#2 Fuel Oil
E3832	5000	UST	#2 Fuel Oil

Chapter 11: Insignificant Storage Tanks

List of Insignificant Storage Tanks from DPW

Building #	Capacity (gal)	Tank Type	Fuel Type
445	2,000	AST	#2 Fuel Oil
449	2,000	AST	#2 Fuel Oil
463	2,000	AST	#2 Fuel Oil
526	2,000	AST	#2 Fuel Oil
688	2,000	AST	#2 Fuel Oil
702	2,000	AST	#2 Fuel Oil
714	2,000	AST	#2 Fuel Oil
860	2,000	AST	#2 Fuel Oil
938	2,000	AST	#2 Fuel Oil
1065	2,000	AST	#2 Fuel Oil
1105	2,000	AST	#2 Fuel Oil

Building #	Capacity (gal)	Tank Type	Fuel Type
800A	550	AST	#2 Fuel Oil
E3007	550	AST	#2 Fuel Oil
270	500	AST	#2 Fuel Oil
300	500	AST	#2 Fuel Oil
423	500	AST	#2 Fuel Oil
437	500	AST	#2 Fuel Oil
457	500	AST	#2 Fuel Oil
473	500	AST	#2 Fuel Oil
638	500	AST	#2 Fuel Oil
644	500	AST	#2 Fuel Oil
899	500	AST	#2 Fuel Oil

Building #	Capacity (gal)	Tank Type	Fuel Type
30	3000	UST	#2 Fuel Oil
5600	2500	UST	#2 Fuel Oil
740B	2500	UST	#2 Fuel Oil
E2172	2000	UST	gasoline
E1451	600	UST	diesel
1	600	UST	#2 Fuel Oil
2	600	UST	#2 Fuel Oil
5	600	UST	#2 Fuel Oil
84	600	UST	#2 Fuel Oil
Total	**1,939,130**		

Insignificant Storage Tanks Emission Factor and Emissions Calculations

Total Insignificant Storage Tank Capacity (gal)	CY 2020 Insignificant Storage Tank Fuel Throughput (gal/yr)	Emission Factor (lb/1000 gal)	VOC (tpy)
1939130	1939130	3.1	3.01E+00

AST and UST capacities were aggregated. CY 2020 throughput was assumed equal to the aggregated storage tank capacity.

Emission factor from AP-42 Chapter 5, Table 5.2-7.

An average emission factor was created for Stage I/II vapor control

Landfills Emissions Calculations for CY 2023

	Annual Waste Aceptance (tpy)	VOC (Mg/yr)	VOC (tpy)
Michaelsville Landfill	76,266		
Total AA Landfill Emissions		**2.191E+00**	**2.41E+00**
Total EA Landfill Emissions		**0.00E+00**	**0.00E+00**
Total Landfill Emissions		**2.191E+00**	**2.41E+00**

Calculation of Losses

Losses were calculated using LandGEM, version 3.03.

Assumptions:

All losses of nonmethane organic compounds (NMOC) are considered to be VOC.

A methane generation rate (k value) of 0.04/year was used.

A potential methane generation capacity (L_o value) of 100 m^3/Mg was used.

A nonmethane organic compound (NMOC) concentration of 600 ppmv was used.

Waste acceptance rate for 1970 through 1979 is 76,266 tpy and for 1969 and 1980 is 38,133 tpy.

Note: 1 megagram = 1 metric ton = 2204 lbs

Data for Gasoline Non-Road Vehicles Emissions

ECBC (CCDC CBC) Gasoline Non-Road Vehicles

Equipment Type	Model Year	Fuel Type	2023 hours
Forklift	2008	Gasoline	38
Forklift	1988	Gasoline	3

Note: Data for CY 2023 taken from CY 2020.

MWR Golf Courses (Exton and Ruggles) Gasoline Non-Road Vehicles

Vehicle Type	Fuel Type	Engine Rating (HP)	Quantity
Golf Carts	Gasoline	11.5	80
Jacobsen Greens Mower	Gasoline	16	2
Toro Triplex Mower	Gasoline	18	1
Toro Workman Utility Vel	Gasoline	31	1
Salsco Greens Roller	Gasoline	11	1
Toro Multi Pro Sprayer	Gasoline	45	1
Toro Pro Core Aerator	Gasoline	23	1
Toro Zero Turn Rotary M	Gasoline	23	1
Toro Workman Utility Vel	Gasoline	31	1
Toro Triplex Mower	Gasoline	18	1
Golf Carts	Gasoline	11.5	30

Note: Data for CY 2023 taken from CY 2020.

MRICD Gasoline Non-Road Vehicles

Vehicle/ Equipment Type	# of Units	Engine Rating (Per Unit) (hp)1	Model Year	Model Year Base (B)/ Default (D)	Total Operating Time (hr/yr)	Operating Time Base (B)/ Default (D) 2	Load Factor (Percent of Max. Power)
Golf Cart (John Deere)	1	23	2009	B	228.5	B	72%
ATV (Yamaha)[5]	1	24	2005	B	No Data	B	72%
ATV (Kawasaki)[5]	1	18	2005	B	402.8	B	72%
Golf Cart (Cub Cadet)	1	20	2008	B	109	**B**	72%

Note: Data for CY 2023 taken from CY 2020.

Gasoline Non-Road Vehicles Emissions Factors and Emissions Calculations

Gasoline Vehicle Data							Emission Parameter	Emissions Factors[4]							Annual Actual Emissions [7]					
Vehicle/ Equipment Type	# of Units	Engine Rating (Per Unit) (hp)[1]	Model Year	Model Year Base (B) or Default (D)	Total Operating Time (hr/yr)	Operating Time Source Base (B) or Default (D) [2]	Load Factor [3] (Percent of Max. Power)	Brake-Specific Fuel Consumption (lb/hp-hr)	CO Emission Factor (g/hp-hr)	NOx Emission Factor (g/hp-hr)	PM-10 Emission Factor (g/hp-hr)	Factor for PM10 to PM2.5	SO_2 Emission Factor (g/hp-hr)	VOC Emission Factor (g/hp-hr)	CO (lb/yr)	NOx (lb/yr)	PM-10 (lb/yr)	PM-2.5 (lb/yr)	SO_2 (lb/yr)	VOC (lb/yr)
ECBC (CCDC CBC)																				
Forklift	2	150	Average	B	41	B	30%	0.484	20.9	1.1	0.06	0.92	0.14	0.43	8.50E+01	4.48E+00	2.44E-01	2.25E-01	5.70E-01	1.75E+00
DPW [6]																				
Forklift	11	150	Average	B	233	B	30%	0.484	20.9	1.1	0.06	0.92	0.14	0.43	4.83E+02	2.54E+01	1.39E+00	1.28E+00	3.24E+00	9.94E+00
MWR Golf Courses (Exton and Ruggles)																				
Toro Aerator	1	23	Average	B	35	B	65%	0.83	376	2.89	0.060	0.92	0.24	5.48	4.33E+02	3.33E+00	6.92E-02	6.37E-02	2.77E-01	6.32E+00
Toro Workman Utility Vehicle	2	31	Average	B	1000	B	65%	0.83	376	2.89	0.060	0.92	0.24	5.48	1.67E+04	1.28E+02	2.67E+00	2.45E+00	1.07E+01	2.43E+02
Salsco Greens Roller	1	11	Average	B	500	B	65%	0.83	376	2.89	0.060	0.92	0.24	5.48	2.96E+03	2.28E+01	4.73E-01	4.35E-01	1.89E+00	4.32E+01
John Deere Sand Pr	1	45	Average	B	35	B	64%	0.83	376	2.89	0.060	0.92	0.24	5.48	8.35E+02	6.42E+00	1.33E-01	1.23E-01	5.33E-01	1.22E+01
Golf Carts	110	11.5	Average	B	55000	B	49%	0.83	376	2.89	0.060	0.92	0.24	5.48	2.57E+05	1.97E+03	4.10E+01	3.77E+01	1.64E+02	3.74E+03
Lawn Mowers	2	16	Average	B	1045.38462	B	64%	0.83	376	2.89	0.060	0.92	0.24	5.48	8.87E+03	6.82E+01	1.42E+00	1.30E+00	5.66E+00	1.29E+02
Toro Zero Turn Rotary Mower	1	23	Average	B	555	B	64%	0.83	376	2.89	0.060	0.92	0.24	5.48	6.77E+03	5.21E+01	1.08E+00	9.94E-01	4.32E+00	9.87E+01
Toro Triplex Mower	2	18	Average	B	1110	B	64%	0.83	376	2.89	0.060	0.92	0.24	5.48	1.06E+04	8.15E+01	1.69E+00	1.56E+00	6.77E+00	1.55E+02
MRICD																				
Golf Cart (John Deere)	1	23	2009	B	228.5	B	72%	0.83	376	2.89	0.060	0.92	0.24	5.48	3.13E+03	2.41E+01	5.01E-01	4.61E-01	2.00E+00	4.57E+01
ATV (Yamaha)[5]	1	24	2005	B	0	B	72%	0.17	46.6	0.36	0.06	0.92	0.05	2.1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ATV (Kawasaki)[5]	1	18	2005	B	402.8	B	72%	0.17	46.6	0.36	0.06	0.92	0.05	2.1	8.28E+02	6.39E+00	1.07E+00	9.81E-01	8.88E-01	3.73E+01
Golf Cart (Cub Cade	1	20	2008	B	109	B	72%	0.83	376	2.89	0.060	0.92	0.24	5.48	1.30E+03	1.00E+01	2.08E-01	1.91E-01	8.31E-01	1.90E+01
Total Gasoline Non-Road Vehicles Emissions															3.10E+05	2.41E+03	5.19E+01	4.78E+01	2.02E+02	4.55E+03
Total Gasoline Non-Road Vehicles Emissions (tpy)															**1.55E+02**	**1.20E+00**	**2.60E-02**	**2.39E-02**	**1.01E-01**	**2.27E+00**

Notes

[1] If engine rating was not provided, defaults were taken from APG RONA which are based on EPA NONROAD 2005c model data files.

[2] Default operating times obtained from EPA's NONROAD 2005c model data files (from APG RONA).

[3] Load factor is the fraction of available power at which the engine normally operates. Source: Table 2-1, Air Emissions Inventory Guidance Document for Mobile Sources, IERA, Jan 2002.

[4] Emission factors taken from USEPA, 2010. Exhaust Emission Factors for Nonroad Engine Modeling - Spark-Ignition. NR-010f. EPA-420-R-10-019. July 2010.

Average emission factors were created by averaging Phase I and Phase II emission factors; the baseline was not used as it is assumed that all equipment is newer than the base year.

An average emission factor was created for all ATVs by averaging emission factors for all 4-stroke engines.

[5] Emission factors are in grams/mile, BSFC in lb/mile, an average speed of 20 miles per hour is used.

[6] CY 2020 data was not available, thus data was taken from the APG (2017) report.

[7] Annual Estimated Emissions (lb/yr) = Engine Rating (hp) * Loading Factor (%) * Operating Time per Unit (hr/yr) * Number of Units * Emission Facotr (g/hp-hr) * Conversion Factor (0.002205 lb/g)

[8] Total Operating Times for MWR Golf Courses are pro-rated from CY 2017 data.

Reference: USEPA, 2010. Exhaust Emission Factors for Nonroad Engine Modeling - Spark-Ignition. NR-010f. EPA-420-R-10-019. July 2010.

Table 1. Emissions and BSFCs for Class III Handheld Small SI Engines (< 20cc)*

Engine Tech Type	HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr
G2H3 (gas 2-stroke handheld Class III, baseline)	261	718.87	0.97	7.7	1.365
G2H31 (Phase 1)	219.99	480.31	0.78	7.7	1.184
G2H3C1 (Phase 1 with catalyst)	219.99	480.31	0.78	7.7	1.184
G2H3C2 (Phase 2 with catalyst)	26.87	141.69	1.49	7.7	0.822

* Assigned NONROAD hp range: 0-1 hp

Table 2. Emissions and BSFCs for Class IV Handheld Small SI Engines (≥20cc and <50cc)*

Engine Tech Type	HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr
G2H4 (gas 2-stroke handheld Class IV, baseline)	261.00	718.87	0.94	7.7	1.365
G2H41 (Phase 1)	179.72	407.38	0.51	7.7	1.184
G2H4C1 (Phase 1 with catalyst)	179.72	407.38	0.51	7.7	1.184
G4H41 (Phase 1 4-stroke)	22.37	533.42	1.79	0.06	0.847
G2H4C2 (Phase 2 with catalyst)	26.87	141.69	1.49	7.7	0.822
G4H42 (Phase 2 4-stroke)	25.83	432.51	1.13	0.06	0.847

* Assigned NONROAD hp range: 1-3 hp

Average of Phase I and II emission factors					
HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr	SO2 g/hp-hr
86.90	384.48	1.09	4.64	0.98	0.23

Table 3. Emissions and BSFCs for Class V Handheld Small SI Engines (>50cc)*

Engine Tech Type	HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr
G2H5 (gas 2-stroke handheld Class V, baseline)	159.58	519.02	0.97	7.7	0.921
G2H51 (Phase 1)	120.06	351.02	1.82	7.7	0.870
G2H5C1 (Phase 1 with catalyst)	120.06	351.02	1.82	7.7	0.870
G2H52 (Phase 2)	47.98	283.37	0.91	7.7	0.608

* Assigned NONROAD hp range: 3-6 hp

Table 4. Emissions and BSFCs for Class I Nonhandheld Small SI Engines (< 225cc)*

Engine Tech Type	HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr
G2N1 (gas 2-stroke nonhandheld Class I, baseline)	207.92	485.81	0.29	7.7	0.870
G4N1S (side-valve, 4-stroke, baseline)	38.99	430.84	2.00	0.06	1.365
G4N1O (overhead-valve, 4-stroke, baseline)	13.39	408.84	1.80	0.06	0.991
G4N1S1 (Phase 1 side-valve, 4-stroke)	8.40	353.69	3.60	0.06	0.921
G4N1O1 (Phase 1 overhead-valve, 4-stroke)	8.40	351.16	3.24	0.06	0.781
G4N1S2 (Phase 2 side-valve, 4-stroke)	7.68	288.24	1.92	0.26	0.921
G4N1O2 (Phase 2 overhead valve, 4-stroke)	6.51	293.01	2.45	0.04	0.781
G4N1S3 (Phase 3 side-valve, 4-stroke)	4.18	238.45	1.04	0.18	0.921
G4N1O3 (Phase 3 overhead valve, 4-stroke)	3.80	242.40	1.42	0.04	0.781

* Assigned NONROAD hp range: 3-6 hp

Table 5. Emissions and BSFCs for Class II Nonhandheld Small SI Engines (≥ 225cc)*

Engine Tech Type	HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr
G2N2 (gas 2-stroke nonhandheld Class II, baseline)	207.92	485.81	0.29	7.7	0.870
G4N2S (side-valve, 4-stroke, baseline)	9.66	430.84	2.06	0.06	0.937
G4N2O (overhead-valve, 4-stroke, baseline)	5.20	408.84	3.50	0.06	0.937
G4N2S1 (Phase 1 side-valve, 4-stroke)	5.50	387.02	4.50	0.06	0.868
G4N2O1 (Phase 1 overhead valve, 4-stroke)	5.20	352.57	3.50	0.06	0.740
G4N2O2 (Phase 2 overhead valve, 4-stroke)	4.16	352.57	2.77	0.06	0.740
G4N23a (Phase 3 overhead-valve, 4-stroke)	3.17	321.94	1.01	0.06	0.735

* Assigned NONROAD hp range: 6-25 hp

Average of Phase I and II for 4-stroke engines					
HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr	SO2 g/hp-hr
5.48	375.63	2.89	0.06	0.83	0.24

Table 6. Steady-State Emission Factors and BSFCs for Spark-Ignition Engines > 25 HP*

Engine Tech Type	HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr
Uncontrolled					
G2GT25 (gas, 2-stroke, baseline)	208	486	0.29	7.7	1.300
G4GT25 (gas, 4-stroke, baseline)	3.85	107.23	8.43	0.06	0.605
LGT25 (LPG, baseline)	1.68	28.23	11.99	0.05	0.507
NGT25 (CNG, baseline)	24.64	28.23	11.99	0.05	0.507
Phase 1					
G4GT251 (gas, 4-stroke, used for 2-stroke SCCs)	0.85	24.49	1.51	7.7	0.484
G4GT251 (gas, 4-stroke, used for 4-stroke SCCs)	0.59	29.86	1.51	0.06	0.484
LGT251 (LPG)	0.25	24.49	2.10	0.05	0.406
NGT251 (CNG)	3.69	24.49	2.10	0.05	0.406
Phase 2					
G4GT252 (gas, 4-stroke, used for 2-stroke SCCs)	0.28	13.24	0.69	7.7	0.484
G4GT252 (gas, 4-stroke, used for 4-stroke SCCs)	0.27	11.94	0.69	0.06	0.484
LGT252 (LPG)	0.10	3.92	0.85	0.05	0.406
NGT252 (CNG)	1.57	3.92	0.89	0.05	0.406

* There are very few uncontrolled 2-stroke engines >25 hp; these can be found in 2-stroke specialty vehicle cart and pump equipment. For these 2-stroke source classification codes (SCCs), 4-stroke engines are assumed to meet the Phase 1 and Phase 2 standards, with different Phase 1 and Phase 2 emission factors in some cases than the 4-stroke SCCs.

Average of Phase I and II for 4-stroke engines					
Uncontrolled					
HC g/hp-hr	CO g/hp-hr	NO_x g/hp-hr	PM g/hp-hr	BSFC lb/hp-hr	SO2 g/hp-hr
0.43	20.90	1.10	0.06	0.48	0.14

Table 7. Emission Factors and BSFCs for Offroad Motorcycles, ATVs, and Snowmobiles

Equipment/Tech Type	HC g/mile	CO g/mile	Nox g/mile	PM g/mile	BSFC lb/mile
Offroad Motorcycles					
RM2 (Precontrol 2-stroke)	53.90	54.10	0.15	2.10	0.268 0.201*
RM4 (Precontrol 4-stroke)	2.40	48.50	0.41	0.06	0.158
RM40 (Closed crankcase 4-stroke)	2.40	48.50	0.41	0.06	0.158
RM41 (Phase 1 4-stroke)	2.10	30.60	0.34	0.06	0.158
All Terrain Vehicles					
RA2 (Precontrol 2-stroke)	53.90	54.10	0.15	2.10	0.213 0.160*
RA4 (Precontrol 4-stroke)	2.40	48.50	0.41	0.06	0.167
RA40 (Closed crankcase 4-stroke)	2.40	48.50	0.41	0.06	0.167
RA41 (Phase 1 4-stroke)	1.60	42.90	0.26	0.06	0.167
Snowmobiles					
RS2 (Precontrol 2-stroke)	111.0	296.0	0.86	2.70	1.660

Average of all emission factors for 4-stroke engines					
HC g/mile	CO g/mile	Nox g/mile	PM g/mile	BSFC lb/mile	SO2 g/mile
2.13	46.63	0.36	0.06	0.167	0.05

RS21 (Modified 2-stroke)	53.70	146.9	0.86	2.70	1.660
RS22 (Direct injection 2-stroke)	21.80	90.0	2.8	0.57	1.245
RS40 (Closed crankcase 4-stroke)	7.80	123.0	9.2	0.15	1.245

* The standards for off-road motorcycle and ATV recreational engines allow the engine manufacturers to meet the controlled 4stroke engine standard with a 2-stroke engine. If a manufacturer succeeds in meeting the 4-stroke controlled standard with a two-stroke engine, this is the estimate of what the BSFC for the controlled 2-stroke engine would be.

SO2 emission factors are calculated by:

SO2 = [BSFC*453.6*(1-soxcnv)-HC]*0.01*soxbas*2

Where

SO2	g/hp-hr	
soxcnv =	fraction of fuel sulfur converted to direct PM =	0.03
HC =	hydrocarbon emission factor, g/hp-hr	
soxbas =	episodic weight percent of sulfur in the fuel =	0.0339

The conversion factor from PM-10 to PM2.5 = 0.92

Data for Diesel Non-Road Vehicles Emissions

(a) Obtain information from the base about the type and number of vehicle/equipment, model year, engine hp rating, and hours of operation.
(b) Emission factors are obtained from USEPA, 2010. Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition. NR-009d. EPA-420-R-10-018. July 2010.
(c) In cases where engine rating and/or operating time are not available, obtain information on fuel used by the equipment.

ECBC (CCDC CBC) Diesel Non-Road Vehicles

Equipment Type	Model Year	Fuel Type	2023 hours
Forklift	2001	Diesel	4
Forklift	2003	Diesel	1
Forklift	2005	Diesel	21
Forklift	1997	Diesel	14
Forklift	2005	Diesel	57
Forklift	2008	Diesel	62
Forklift	2009	Diesel	48
Forklift	2009	Diesel	51
Forklift	2009	Diesel	33
Forklift	2005	Diesel	16
Forklift	2012	Diesel	118
Forklift	2013	Diesel	30
Forklift	1989	Diesel	16
Forklift	2004	Diesel	32
Forklift	2000	Diesel	3
Forklift	2000	Diesel	5
Forklift	1995	Diesel	3
ATV, John Deere Gator	2001	Diesel	20
ATV, John Deere Gator	2001	Diesel	25
ATV, John Deere Gator A1	2010	Diesel	35

Note: Data for CY 2023 taken from CY 2020.

MWR Golf Courses (Exton and Ruggles) Diesel Non-Road Vehicles

Vehicle Type	Fuel Type	Engine Rating (HP)	Quantity
Toro 5610 Fairway Mower	Diesel	35	1
Toro 300D Approach Mower	Diesel	35	1
Toro 4000 Rough Mower	Diesel	55	2
Ford New Holland Tractor	Diesel	65	3
Kubota Tractor	Diesel	85.3	1
Toro 5610 Fairway Mower	Diesel	35	1
Toro 4000 Rough Mower	Diesel	55	1

Note: Data for CY 2023 taken from CY 2020.

ATC Diesel Non-Road Vehicles

Data table from ATC has 7860 entries, so total light, medium, and heavy duty CY 2020 mileage calculated in a separate file: "ATC Non-Road Vehicles Summary_dlh".

Total Light Duty CY 2020 Mileage	219386.2
Total Medium Duty CY 2020 Mileage	116903.2
Total Heavy Duty CY 2020 Mileage	522004.6
Total CY 2020 Mileage	858294

Diesel Non-Road Vehicles Emissions Factors and Emissions Calculations

Diesel Vehicle Data							Emission Parameter	Emissions Factors [3,4]							Annual Actual Emissions [7]					
Vehicle/Equipment Type	# of Units or CY 2020 Mileage for ATC Vehicles	Average Engine Rating (Per Unit) [1] (hp)	Average Model Year	Model Year Base (B) or Default (D)	Total Operating Time (hr/yr)	Operating Time Source Base (B) or Default (D) [1]	Load Factor [2] (Percent of Max. Power)	Brake-Specific Fuel Consumption (lb/hp-hr)	CO Emission Factor (g/hp-hr)	NOx Emission Factor (g/hp-hr)	PM-10 Emission Factor (g/hp-hr)	Factor for PM-10 to PM-2.5 5	SO_2 Emission Factor (g/hp-hr)	VOC Emission Factor (g/hp-hr)	CO (lb/yr)	NOx (lb/yr)	PM-10 (lb/yr)	PM-2.5 (lb/yr)	SO_2 (lb/yr)	VOC (lb/yr)
ECBC (CCDC CBC)																				
Forklift	17	150	Average	B	514	B	30%	0.408	1.83	4.07	0.23	0.97	0.90	0.30	9.35E+01	2.08E+02	1.19E+01	1.15E+01	4.59E+01	1.53E+01
ATV, John Deere Gator	3	20	Average	B	80	B	55%	0.408	4.11	4.5	0.38	0.97	0.90	0.60	7.98E+00	8.79E+00	7.37E-01	7.15E-01	1.75E+00	1.16E+00
MWR Golf Course																				
Fairway and Approach Mowe	3	35	Average	B	1,665	B	55%	0.408	2.16	4.4	0.27	0.97	0.90	0.44	1.53E+02	3.14E+02	1.91E+01	1.85E+01	6.36E+01	3.11E+01
Ford New Holland Tractor	3	65	2000	B	312	B	55%	0.408	4.11	4.5	0.38	0.97	0.90	0.60	1.01E+02	1.11E+02	9.35E+00	9.07E+00	2.21E+01	1.48E+01
Kubota Tractor	1	85.3	2000	B	312	B	55%	0.408	4.11	4.5	0.38	0.97	0.90	0.60	1.33E+02	1.46E+02	1.23E+01	1.19E+01	2.90E+01	1.94E+01
Rough Mowers	3	55	Average	B	1,665	B	64%	0.408	2.16	4.4	0.27	0.97	0.90	0.44	2.79E+02	5.74E+02	3.49E+01	3.38E+01	1.16E+02	5.69E+01
DPW [5]																				
Boomlift Aerial	1	150	2008	B	72	B	46%	0.367	0.55	3.69	0.14	0.97	0.81	0.22	6.02E+00	4.04E+01	1.53E+00	1.49E+00	8.87E+00	2.41E+00
Forklift	21	150	1995	B	1,188	B	30%	0.367	0.55	3.69	0.14	0.97	0.81	0.22	6.48E+01	4.35E+02	1.65E+01	1.60E+01	9.55E+01	2.59E+01
Forklift Reach Telehandler	1	150	2008	B	98	B	30%	0.367	0.55	3.69	0.14	0.97	0.81	0.22	5.35E+00	3.59E+01	1.36E+00	1.32E+00	7.88E+00	2.14E+00
ATC [6]																				
Heavy duty	522004.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0	6.05	0.249	0.229	0.013	0.54	2.30E+03	6.95E+03	2.86E+02	2.63E+02	1.49E+01	6.20E+02
Medium duty	116903.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0	6.05	0.249	0.229	0.013	0.54	5.14E+02	1.56E+03	6.40E+01	5.89E+01	3.34E+00	1.39E+02
Light duty	219386.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.4	0.56	0.008	0.007	0.004	0.37	2.60E+03	2.71E+02	3.86E+00	3.38E+00	1.93E+00	1.79E+02
Total Diesel Non-Road Vehicles Emissions															6.25E+03	1.06E+04	4.61E+02	4.30E+02	4.11E+02	1.11E+03
Total Diesel Non-Road Vehicles Emissions (tpy)															**3.13E+00**	**5.32E+00**	**2.31E-01**	**2.15E-01**	**2.06E-01**	**5.53E-01**

Notes

[1] Missing engine ratings taken from 2017 AEI. Default operating times obtained from EPA's NONROAD 2002a model data files, if needed.

[2] Load factor is the fraction of available power at which the engine normally operates. Source: Table 2-1, Air Emissions Inventory Guidance Document for Mobile Sources, IERA, Jan 2002.

[3] Emission Factors were obtained from: USEPA, 2010. Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition. NR-009d. EPA-420-R-10-018. July 2010.

[4] Emission factors are averages for Tier 1 through Tier 4 engine categories.

Factor to estimate PM-2.5 emissions from PM-10 emissions obtained from USEPA, 2010.

Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition. NR-009d. EPA-420-R-10-018. July 2010.

[5] CY 2020 data was not available, thus data was taken from the APG (2017) report.

[6] ATC information was reported in miles driven for the year; emission factors for HDDV and LDDV are used and are in grams/mile; used HDDV EFs for medium duty vehicles; emissions factors for ATC non-road vehicles adapted from the APG RONA spreadsheet which is based on Mobile Emissions from Guide to Air force Mobile Sources which are based on the EPA MOVES2014a Model.

[7] Annual Estimated Emissions (lb/yr) = Engine Rating (hp) * Loading Factor (%) * Operating Time per Unit (hr/yr) * Number of Units * Emission Facotr (g/hp-hr) * Conversion Factor (0.002205 lb/g)

Non-Road Vehicles Emissions

Pollutant	CO (tpy)	NOX (tpy)	PM10 (tpy)	PM2.5 (tpy)	SOX (tpy)	VOC (tpy)
Total Gasoline Non-Road Vehicle Emissions	1.55E+02	1.20E+00	2.60E-02	2.39E-02	1.01E-01	2.27E+00
Total Diesel Non-Road Vehicle Emissions	3.13E+00	5.32E+00	2.31E-01	2.15E-01	2.06E-01	5.53E-01
Total Non-Road Vehicles Emissions	**1.58E+02**	**6.53E+00**	**2.57E-01**	**2.39E-01**	**3.06E-01**	**2.83E+00**

Reference: USEPA, 2010. Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition. NR-009d. EPA-420-R-10-018. July 2010.

Table A4. Zero-Hour, Steady-State Emission Factors for Nonroad CI Engines[a]

Engine Power (hp)	Technology Type	BSFC (lb/hp-hr)[b]	Emission Factors (g/hp-hr)				Average Emission Factors for Tier 1 through Tier 4				
			HC	CO	NO_x	PM	HC	CO	Nox	PM10	SO2
>0 to 11	Base	0.408	1.5	5	10	1	0.60	4.11	4.53	0.38	0.90
	Tier 0		1.5	5	10	1					
	Tier 1		0.7628	4.1127	5.2298	0.4474					
	Tier 2		0.5508	4.1127	4.3	0.5					
	Tier 4A		0.5508	4.1127	4.3	0.28					
	Tier 4B		0.5508	4.1127	4.3	0.28					
>11 to 16	Base	0.408	1.7	5	8.5	0.9	0.44	2.16	4.44	0.27	0.90
	Tier 0		1.7	5	8.5	0.9					
	Tier 1		0.438	2.161	4.4399	0.2665					
	Tier 2		0.438	2.161	4.4399	0.2665					
	Tier 4A		0.438	2.161	4.4399	0.28					
	Tier 4B		0.438	2.161	4.4399	0.28					
>16 to 25	Base	0.408	1.7	5	8.5	0.9	0.44	2.16	4.44	0.27	
	Tier 0		1.7	5	8.5	0.9					
	Tier 1		0.438	2.161	4.4399	0.2665					
	Tier 2		0.438	2.161	4.4399	0.2665					
	Tier 4A		0.438	2.161	4.4399	0.28					
	Tier 4B		0.438	2.161	4.4399	0.28					
>25 to 50	Base	0.408	1.8	5	6.9	0.8	0.24	1.19	4.30	0.22	
	Tier 0		1.8	5	6.9	0.8					
	Tier 1		0.2789	1.5323	4.7279	0.3389					
	Tier 2		0.2789	1.5323	4.7279	0.3389					
	Tier 4A		0.2789	1.5323	4.7279	0.2					
	Tier 4		0.1314	0.153	3	0.0184					
>50 to 75	Base	0.408	Vary by application, see NEVES				0.30	1.83	4.07	0.23	0.90
	Tier 0		0.99	3.49	6.9	0.722					
	Tier 1		0.5213	2.3655	5.5988	0.473					
	Tier 2		0.3672	2.3655	4.7	0.24					
	Tier 4A		0.1836	2.3655	3	0.2					
	Tier 4		0.1314	0.237	3	0.0184					

Table A4. Zero-Hour, Steady-State Emission Factors for Nonroad CI Engines (cont.)

Engine Power (hp)	Technology Type	BSFC (lb/hp-hr)	Emission Factors (g/hp-hr)				Average Emission Factors for Tier 1 through Tier 4				
			HC	CO	NO_x	PM	HC	CO	Nox	PM10	SO2
>75 to 100	Base	0.408	Vary by application, see NEVES				0.27	1.51	3.31	0.19	
	Tier 0		0.99	3.49	6.9	0.722					
	Tier 1		0.5213	2.3655	5.5988	0.473					
	Tier 2		0.3672	2.3655	4.7	0.24					
	Tier 3B		0.1836	2.3655	3	0.2					
	Tier 4		0.1314	0.237	3	0.0092					
	Tier 4N		0.1314	0.237	0.276	0.0092					
>100 to 175	Base	0.367	Vary by application, see NEVES				0.22	0.55	3.69	0.14	0.81
	Tier 0		0.68	2.7	8.38	0.402					
	Tier 1		0.3384	0.8667	5.6523	0.2799					
	Tier 2		0.3384	0.8667	4.1	0.18					
	Tier 3		0.1836	0.8667	2.5	0.22					
	Tier 4		0.1314	0.087	2.5	0.0092					
	Tier 4N		0.1314	0.087	0.2760.402	0.0092					

Engine Power (hp)	Technology Type	BSFC (lb/hp-hr)	Emission Factors (g/hp-hr) HC	CO	NO_x	PM	Average Emission Factors for Tier 1 through Tier 4 HC	CO	Nox	PM10	SO2
>175 to 300	Base	0.367	Vary by application, see NE0.2799VES				0.21	0.48	2.97	0.11	
	Tier 0		0.68	2.7	8.38	0.402					
	Tier 1		0.3085	0.7475	5.5772	0.2521					
	Tier 2		0.3085	0.7475	4	0.1316					
	Tier 3		0.1836	0.7475	2.5	0.15					
	Tier 4		0.1314	0.075	2.5	0.0092					
	Tier 4N		0.1314	0.075	0.276	0.0092					
>300 to 600	Base	0.367	Vary by application, see NEVES				0.16	0.63	3.13	0.10	
	Tier 0		0.68	2.7	8.38	0.402					
	Tier 1		0.2025	1.306	6.0153	0.2008					
	Tier 2		0.1669	0.8425	4.3351	0.1316					
	Tier 3		0.1669	0.8425	2.5	0.15					
	Tier 4		0.1314	0.084	2.5	0.0092					
	Tier 4N		0.1314	0.084	0.276	0.0092					
>600 to 750	Base	0.367	Vary by application, see NEVES								
	Tier 0		0.68	2.7	8.38	0.402					
	Tier 1		0.1473	1.3272	5.8215	0.2201					

Table A4. Zero-Hour, Steady-State Emission Factors for Nonroad CI Engines (cont.)

Engine Power (hp)	Technology Type	BSFC (lb/hp-hr)	Emission Factors (g/hp-hr) HC	CO	NO_x	PM
	Tier 2		0.1669	1.3272	4.1	0.1316
	Tier 3		0.1669	1.3272	2.5	0.15
	Tier 4		0.1314	0.133	2.5	0.0092
	Tier 4N		0.1314	0.133	0.276	0.0092
>750 except generator sets	Base	0.367	Vary by application, see NEVES			
	Tier 0		0.68	2.7	8.38	0.402
	Tier 1		0.2861	0.7642	6.1525	0.1934
	Tier 2		0.1669	0.7642	4.1	0.1316
	Tier 4		0.2815	0.7642	2.392	0.069
	Tier 4N		0.1314	0.076	2.392	0.0276
Gen sets	Base	0.367	Vary by application, see NEVES			
>750 to 1200	Tier 0		0.68	2.7	8.38	0.402
	Tier 1		0.2861	0.7642	6.1525	0.1934
	Tier 2		0.1669	0.7642	4.1	0.1316
	Tier 4		0.2815	0.7642	2.392	0.069
	Tier 4N		0.1314	0.076	0.46	0.0184
Gen sets	Base	0.367	Vary by application, see NEVES			
>1200	Tier 0		0.68	2.7	8.38	0.402
	Tier 1		0.2861	0.7642	6.1525	0.1934
	Tier 2		0.1669	0.7642	4.1	0.1316
	Tier 4		0.2815	0.7642	0.46	0.069
	Tier 4N		0.1314	0.076	0.46	0.0184

a
Prior to listing in NONROAD input files, these ISO-C1 emission factors are adjusted for in-use operation as explained in Appendix F. The emission factors in the input files are rounded to two decimal places. The emission factors for recreational marine CI engines are provided in Table 10. Underground mining equipment inputs are just the Base (NEVES) and Tier 2 values from this table.
b
BSFC for engines <50 hp is assumed to be the same as 50-100 hp engines

Assumption: HC = VOC emissions

Notes: From USEPA 2010:

The PM10 to PM2.5 conversion factor is 0.97
Emission Factor for SO2 = [BSFC*453.6*(1-soxcnv)-HC]*0.01*soxdsl*2
Where: soxcnv = 0.02247
soxdsl = 0.25
HC = Emission Factor for HC

Data for On-road POV Emissions

(a) Obtain the vehicle type, the number of vehicles, and the vehicle mileage traveled on the bas

(b) All vehicles must be classified and included under one of the following vehicle categorie
- **CNG - Compressed Natural Gas**
- **HDDBS - Diesel School Buses**
- **HDDBT - Diesel Transit and Urban Buses**
- **HDDV - Heavy-Duty Diesel Vehicles (> 8,500 lbs GVWR)**
- **HDGB - Gasoline Buses (School, Transit, and Urban**
- **HDGV - heavy duty gasoline-fueled vehicles with a GVWR exceeding 8,500 pounds**
- **LDDT - Light-Duty Diesel Trucks (0 - 8,500 lbs GVWR**
- **LDDV - Light-Duty Diesel Vehicles (Passenger Cars**
- **LDGT12 - Light-Duty Gasoline Trucks (0 - 6,000 lbs GVWR)**
- **LDGT34 - Light-Duty Gasoline Trucks (6,001 - 8,500 lbs GVWR)**
- **LDGV - Light-Duty Gasoline Vehicles (Passenger Cars**

(c) Emission factors for on-road vehicles adapted from the APG RONA spreadsheet which is based on Mobile Emissions fro
Guide to Air Force Mobile Sources which are based on the EPA MOVES2014a Mode

CY 2018 Traffic Study of On-Road POVs

GATE	Location	Single Occ. Vehicles	Carpool - 2 -4 adults	Carpool - 1 adult plus child(ren)	Vanpool	Bus	Total POVs
715	AA	4591	244	27	9	5	
22	AA	4389	243	119	16	18	
24	EA	2152	110	9	1	2	
Wise Road	EA	710	24	4	0	2	
TOTALS		**11842**	**621**	**159**	**26**	**27**	**12675**

Did not include motorcycles as they are less than 0.2 % of vehicles.

POV Categorization

Gate	Location	Daily Vehicle Miles On-base (miles/day per POV)	Annual Vehicle Miles On-base (miles/yr per POV)	Vehicle Type and Fuel	POVs	Annual On-base Mileage (miles/yr)	POV Category
715	AA	9.00	2250	Passenger Car - gasoline	2,917	6,563,700	LDGV
715	AA	9.00	2250	SUV/Pickup - diesel	58	131,274	LDDT
715	AA	9.00	2250	SUV/Pickup - gasoline	1,886	4,244,526	LDGT12
715	AA	9.00	2250	Vanpool - gasoline	9	20,250	HDGV
715	AA	9.00	2250	Bus - diesel	5	11,250	HDDBT
22	AA	3.41	852.2727273	Passenger Car - gasoline	2,851	2,429,489	LDGV
22	AA	3.41	852.2727273	SUV/Pickup - diesel	57	48,590	LDDT
22	AA	3.41	852.2727273	SUV/Pickup - gasoline	1,843	1,571,069	LDGT12
22	AA	3.41	852.2727273	Vanpool - gasoline	16	13,636	HDGV
22	AA	3.41	852.2727273	Bus - diesel	18	15,341	HDDBT
24	EA	2.84	710.2272727	Passenger Car - gasoline	1,363	967,756	LDGV
24	EA	2.84	710.2272727	SUV/Pickup - diesel	27	19,355	LDDT
24	EA	2.84	710.2272727	SUV/Pickup - gasoline	881	625,815	LDGT12
24	EA	2.84	710.2272727	Vanpool - gasoline	1	710	HDGV
24	EA	2.84	710.2272727	Bus - diesel	2	1,420	HDDBT
Wise Road	EA	2.65	662.8787879	Passenger Car - gasoline	443	293,523	LDGV
Wise Road	EA	2.65	662.8787879	SUV/Pickup - diesel	9	5,870	LDDT
Wise Road	EA	2.65	662.8787879	SUV/Pickup - gasoline	286	189,811	LDGT12
Wise Road	EA	2.65	662.8787879	Vanpool - gasoline	0	0	HDGV
Wise Road	EA	2.65	662.8787879	Bus - diesel	2	1,326	HDDBT
Totals					**12,675**	**17,154,712**	

The one-way mileage was estimated as the distance from the gate to a midpoint on the base.

The mileage was doubled to account for the daily on-base mileage.

Assumed that 60 % of single occupancy and carpool vehicles are passenger cars and 40% of single occupancy and carpool vehicles are SUVs/light pickup trucks.

Assumed all buses and 3 % of SUVs/light pickup trucks are diesel, other POVs are gasoline.

On-Road POV Emissions Calculations

Vehicle Category	POVs	Annual On-base Mileage	Emission Factors (gram/mile)						Criteria Pollutant Emissions (tpy)					
			CO	NO_X	PM-10	PM-2.5	SO_2	VOC	CO	NO_X	PM-10	PM-2.5	SO_2	VOC
HDDBT	27	29,337	1.98E+00	6.05E+00	2.49E-01	2.29E-01	1.30E-02	5.38E-01	6.40E-02	1.95E-01	8.04E-03	7.39E-03	4.20E-04	1.74E-02
HDGV	26	34,597	1.93E+01	1.52E+00	3.00E-02	2.60E-02	5.00E-03	9.49E-01	7.35E-01	5.77E-02	1.14E-03	9.89E-04	1.90E-04	3.61E-02
LDDT	151	205,089	5.38E+00	5.61E-01	8.00E-03	7.00E-03	4.00E-03	3.70E-01	1.21E+00	1.27E-01	1.80E-03	1.58E-03	9.02E-04	8.35E-02
LDGT12	4,897	6,631,222	5.40E+00	5.74E-01	1.20E-02	1.10E-02	3.00E-03	4.66E-01	3.94E+01	4.19E+00	8.75E-02	8.02E-02	2.19E-02	3.40E+00
LDGV	7,573	10,254,467	3.63E+00	3.30E-01	1.00E-02	9.00E-03	2.00E-03	3.59E-01	4.10E+01	3.72E+00	1.13E-01	1.02E-01	2.26E-02	4.05E+00
Totals	**12,675**	**17,154,712**												
Total On-Road POV Emissions									**8.24E+01**	**8.29E+00**	**2.11E-01**	**1.92E-01**	**4.60E-02**	**7.59E+00**

Emission factors for on-road vehicles adapted from the APG RONA spreadsheet which is based on Mobile Emissions from Guide to Air force Mobile Sources which are based on the EPA MOVES2014a Model

Used Heavy duty vehicles (HDDV) for HDDBT because the APG RONA spreadsheet does not have EFs for HDDBT.

Emissions (tpy) = Emission Factor (gram/mile) x Annual On-base Mileage x 0.0022 (lb/gram)/ 2000 lb per ton

Data for On-Road GOV Emissions

ATC On-Road GOV

Type	Fuel	CY 2023 Mileage (miles/yr)	GOV Category
Auto Sedan	Gasoline/ E85	833	LDGV
Auto Sedan	Gasoline/ E85	1683	LDGV
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	3609	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	757	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	698	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	1870	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	1872	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	2553	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	2568	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	1099	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	12990	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	1582	LDGT12
Truck, Cargo 2DR, 4x4 Ext cab	Gasoline/ E85	1023	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2120	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	4469	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2585	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	3943	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	349	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1906	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2158	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2162	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1324	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2053	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1152	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1175	LDGT12
Truck, Cargo 2DR CAT-I/DOT Certified	Gasoline/ E85	590	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1360	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1283	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	5984	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1070	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	3778	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	2191	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	2675	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	1521	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	1434	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	1986	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	855	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	812	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	3657	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	661	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	5457	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	3556	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	483	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	1461	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	1239	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	1610	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1591	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2472	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	407	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2098	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2766	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1844	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	956	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1500	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	419	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2330	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	2077	LDGT12
Truck, Cargo 2DR, 4X2 Ext Cab	Gasoline/ E85	1135	LDGT12
Truck,Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	1255	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	509	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	4929	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	1399	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	1872	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	2833	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	1438	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	4530	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	875	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	825	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	2670	LDGT12
Truck, Cargo 2DR, 4x4 Ext Cab	Gasoline/ E85	4097	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	1220	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	2614	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	1260	LDGT12

LRC On-Road GOV

Type	Fuel	CY 2023 Mileage (miles/yr)	GOV Category
Sedan/St Wgn Compact	Gasoline Hybrid Electric	702	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	767	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	572	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	6951	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	2362	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	718	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	1256	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	598	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	6887	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	4204	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	8392	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	4425	LDGV
Sedan/St Wgn Midsize	Gasoline	17278	LDGV
Sedan/St Wgn Midsize	Gasoline	15511	LDGV
Sedan/St Wgn Midsize	Gasoline	12162	LDGV
Sedan/St Wgn Midsize	Gasoline	20449	LDGV
Sedan/St Wgn Midsize	Gasoline	20408	LDGV
Sedan/St Wgn Midsize	Gasoline	16075	LDGV
Sedan/St Wgn Midsize	Gasoline	2407	LDGV
Sedan/St Wgn Midsize	Gasoline	19679	LDGV
Sedan/St Wgn Midsize	Gasoline	15901	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	16812	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	14047	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	13931	LDGV
Sedan/St Wgn Midsize	Gasoline	15387	LDGV
Sedan/St Wgn Midsize	Gasoline	6712	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	16295	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	15586	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	16416	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	6183	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	9248	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	12338	LDGV
Sedan/St Wgn Midsize	Ethanol / Unleaded Gasolin	14343	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	1263	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	764	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	1865	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	1525	LDGV
Sedan/St Wgn Subcompact	Gasoline Hybrid Electric	1102	LDGV
Sedan/St Wgn Subcompact	Plug-In Hybrid Electric/Gas	140	LDGV
Sedan/St Wgn Subcompact	Plug-In Hybrid Electric/Gas	1022	LDGV
Sedan/St Wgn Subcompact	Plug-In Hybrid Electric/Gas	1031	LDGV
Sedan/St Wgn Subcompact	Plug-In Hybrid Electric/Gas	5	LDGV
Sedan/St Wgn Subcompact	Plug-In Hybrid Electric/Gas	522	LDGV
Sedan/St Wgn Subcompact	Dedicated Electric	127	LDGV
Sedan/St Wgn Subcompact	Dedicated Electric	2098	LDGV
Sedan/St Wgn Subcompact	Dedicated Electric	90	LDGV
Sedan/St Wgn Subcompact	Dedicated Electric	759	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	2749	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	2112	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	3184	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	79	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	1912	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	2624	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1257	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	4691	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	2205	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	465	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	6403	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	3523	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	756	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	2869	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1625	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	1034	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	1533	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	898	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	619	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	10	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1363	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1497	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	479	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	612	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	1925	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	2378	LDGV

Type	Fuel	CY 2023 Mileage (miles/yr)	GOV Category
MD Pickup	nol / Unleaded Gas	4047	LDGT12
MD Pickup	nol / Unleaded Gas	4774	LDGT12
MD SUV	Gasoline	5881	LDGT12
MD PICKUP	Gasoline	416	LDGT12
MD PICKUP	Gasoline	11	LDGT12
MD Pickup	nol / Unleaded Gas	4297	LDGT12
MD Pickup	nol / Unleaded Gas	3755	LDGT12
MD Pickup	nol / Unleaded Gas	5816	LDGT12
MD Pickup	nol / Unleaded Gas	739	LDGT12
MD PICKUP	nol / Unleaded Gas	3948	LDGT12
MD Pickup	Diesel	2502	LDGT12
MD PICKUP	nol / Unleaded Gas	118	LDGT12
MD PICKUP	nol / Unleaded Gas	311	LDGT12
MD PICKUP	nol / Unleaded Gas	4772	LDGT12
MD PICKUP	Gasoline	2180	LDGT12
MD PICKUP	nol / Unleaded Gas	4584	LDGT12
MD PICKUP	Gasoline	2438	LDGT12
MD PICKUP	nol / Unleaded Gas	10684	LDGT12
MD PICKUP	nol / Unleaded Gas	2997	LDGT12
MD PICKUP	Gasoline	82	LDGT12
MD Van (Cargo)	Gasoline	528	LDGT12
MD Van (Cargo)	Gasoline	1017	LDGT12
MD Van (Cargo)	Gasoline	2716	LDGT12
MD PICKUP	Diesel	2107	LDGT12
MD Van (Cargo)	Gasoline	2385	LDGT12
MD Bus	Diesel	512	LDGT12
LD Van 4x2 (Passe	Gasoline	2076	LDGT12
LD Van 4x2 (Cargo	Gasoline	3514	LDGT12
LD Pickup 4x2	Gasoline	615	LDGT12
LD Pickup 4x2	Gasoline	609	LDGT12
LD Pickup 4x2	Gasoline	2085	LDGT12
LD Pickup 4x2	nol / Unleaded Gas	965	LDGT12
LD Pickup 4x2	Gasoline	1378	LDGT12
LD Pickup 4x2	Gasoline	1931	LDGT12
LD Van 4x2 (Cargo	nol / Unleaded Gas	1129	LDGT12
LD Pickup 4x2	Gasoline	610	LDGT12
MD Van (Passenge	Gasoline	1283	LDGT12
MD Van (Cargo)	Gasoline	306	LDGT12
MD Van (Cargo)	Gasoline	373	LDGT12
MD Van (Cargo)	Gasoline	3	LDGT12
MD Van (Cargo)	nol / Unleaded Gas	1627	LDGT12
MD Van (Cargo)	Gasoline	1101	LDGT12
MD Pickup	nol / Unleaded Gas	598	LDGT12
MD Pickup	nol / Unleaded Gas	1535	LDGT12
MD Pickup	nol / Unleaded Gas	1002	LDGT12
MD Pickup	Gasoline	1724	LDGT12
LD Pickup 4x4	Gasoline	1464	LDGT12
LD Pickup 4x4	Gasoline	2960	LDGT12
LD Pickup 4x4	Gasoline	794	LDGT12
LD Pickup 4x4	Gasoline	704	LDGT12
LD Pickup 4x4	Gasoline	125	LDGT12
LD Pickup 4x4	nol / Unleaded Gas	2039	LDGT12
LD Pickup 4x4	nol / Unleaded Gas	2273	LDGT12
LD Pickup 4x4	nol / Unleaded Gas	897	LDGT12
LD Pickup 4x4	nol / Unleaded Gas	2697	LDGT12
LD Pickup 4x4	nol / Unleaded Gas	1695	LDGT12
LD Pickup 4x4	nol / Unleaded Gas	549	LDGT12
MD Pickup	nol / Unleaded Gas	418	LDGT12
MD PICKUP	nol / Unleaded Gas	834	LDGT12
MD PICKUP	Gasoline	1753	LDGT12
MD PICKUP	nol / Unleaded Gas	673	LDGT12
MD PICKUP	Gasoline	1069	LDGT12
MD PICKUP	Gasoline	574	LDGT12
MD PICKUP	Gasoline	8	LDGT12
MD Pickup	nol / Unleaded Gas	596	LDGT12
MD Pickup	nol / Unleaded Gas	332	LDGT12
MD Pickup	nol / Unleaded Gas	545	LDGT12
MD PICKUP	Gasoline	2635	LDGT12
MD PICKUP	Gasoline	997	LDGT12
MD PICKUP	nol / Unleaded Gas	2491	LDGT12
MD PICKUP	Gasoline	1235	LDGT12
MD Pickup	Gasoline	1238	LDGT12
MD PICKUP	nol / Unleaded Gas	1938	LDGT12

Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	588	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	2283	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	1672	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	1730	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	3076	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	1318	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	3712	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	1359	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	1372	LDGT12
Truck, Cargo 2DR, 4x2 Ext Cab	Gasoline/ E85	2817	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	1459	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	828	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	571	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	523	LDGT12
Truck SUV	Gasoline/ E85	1746	LDGT12
Truck, Cargo 2DR	Gasoline/ E85	225	LDGT12
Truck, Cargo 2DR	Gasoline/ E85	79	LDGT12
Truck, Cargo 4DR, 4x4 1T	Gasoline/ E85	1209	LDGT12
Truck, Cargo 4DR, 4x4 1T	Gasoline/ E85	99	LDGT12
Truck, Cargo 2DR	Gasoline/ E85	1631	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	3226	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	1340	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	3107	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	1893	LDGT12
Truck Cargo	Gasoline/ E85	1760	LDGT12
Truck, Cargo 4DR, 4x4	Gasoline/ E85	2674	LDGT12
Truck, Cargo 4DR, 4x4	Gasoline/ E85	3715	LDGT12
Truck, Cargo 4DR, 4x4	Gasoline/ E85	2483	LDGT12
Truck, Cargo 4DR, 4x4	Gasoline/ E85	5652	LDGT12
Truck, Cargo 4DR, 4x4	Gasoline/ E85	1948	LDGT12
Truck, Cargo 4DR, 4x4	Gasoline/ E85	7377	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	3404	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	4270	LDGT12
Truck, Cargo 4DR, 4X4	Gasoline/ E85	1272	LDGT12
Truck, Cargo 2DR	Gasoline/ E85	165	LDGT12
Truck Cargo 2DR, 4X4	Gasoline/ E85	1238	LDGT12
Truck Cargo 2DR, 4X4	Gasoline/ E85	358	LDGT12
Truck Cargo 2DR, 4X4	Gasoline/ E85	2221	LDGT12
Truck Cargo 2 1/2 T 4DR	Diesel	507	LDDT
Truck Cargo 2 1/2 T 4DR	Diesel	63	LDDT
Truck, Cargo 4DR, 4x4 Dually	Diesel	1386	LDDT
Truck, Cargo 4DR	Diesel	3246	LDDT
Truck, Cargo 4DR, 4x4 Dually	Diesel	1941	LDDT
Truck, Cargo 4DR, 4x4 Dually	Diesel	442	LDDT
Truck, Cargo 4DR, 4x4 Dually	Diesel	2809	LDDT
Truck, Cargo 4DR, 4x4 Dually	Diesel	2620	LDDT
Truck, Cargo 4DR, 4x4 Dually	Diesel	2609	LDDT
Truck, Cargo 4DR, 4X4	Diesel	1810	LDDT
Truck, Cargo 4DR, 4x4 Dually	Diesel	1813	LDDT
Truck, Cargo 4DR, 4x4 Dually	Diesel	1132	LDDT
Truck, Cargo 4DR, 4X4	Diesel	4141	LDDT
Truck, Cargo 4DR, 4X4	Diesel	2404	LDDT
Truck, Cargo 4DR, 4X4	Diesel	4538	LDDT
Chassis Truck MDL 4600 Street Sweeper	Diesel	202	HDDV
Truck, Stake Body 2DR, 4X4	Diesel	587	HDDV
Truck, Stake Body 2DR, 4X4	Diesel	2065	HDDV
Truck Maintenance Large	Diesel	22	HDDV
Truck Amb Type (Maintenance)	Diesel	4256	HDDV
Truck Bucket	Diesel	200	HDDV
Truck Rolloff	Diesel	1557	HDDV
Service Platform Truck Mtd - Bucket	Diesel	1987	HDDV
Truck Dump 20T International	Diesel	808	HDDV
Truck Dump 20T International	Diesel	389	HDDV
Truck Dump	Diesel	379	HDDV
Truck, Stake Body 6DR, 4x4	Diesel	242	HDDV
Truck, Stake Body 6DR, 4x4	Diesel	442	HDDV
Truck Box Refrigerator	Diesel	777	HDDV
Service Platform Truck Mtd - Bucket	Diesel	839	HDDV
Truck Dump 5T	Diesel	348	HDDV
Truck Dump 6x6	Diesel	3556	HDDV
Service Platform Truck	Diesel	323	HDDV
Service Platform Truck	Diesel	387	HDDV
Service Platform Truck	Diesel	765	HDDV
Truck, Stake Body 4DR, 4X4	Diesel	6888	HDDV
Truck, Dump 6x6	Diesel	4146	HDDV
Truck, Bucket	Diesel	2132	HDDV
Truck, Multi stop Deli	Diesel	24	HDDV

LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1577	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	2439	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	5563	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	2267	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	4948	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	3014	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	2546	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	3499	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	776	LDGV
Sedan/St Wgn Subcompact	Gasoline Hybrid Electric	371	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	1899	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	3070	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	4369	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	3104	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	3901	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	3077	LDGV
Sedan/St Wgn Subcompact	Gasoline Hybrid Electric	1944	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	1155	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	1415	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	1073	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	3002	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	55	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	4246	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	564	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	2515	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	347	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1165	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	5564	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	901	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	40	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	40	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	9119	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	532	LDGV
LD Minivan 4x2 (Cargo)	Gasoline	797	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	1419	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	2977	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	2740	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	3110	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	2588	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	5317	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	1040	LDGV
LD Minivan 4x2 (Passenger)	Gasoline	1041	LDGV
LD Minivan 4x2 (Cargo)	Ethanol / Unleaded Gasolin	3522	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	4546	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	5237	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	175	LDGV
Sedan/St Wgn Compact	Gasoline Hybrid Electric	1309	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1500	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	4007	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	2044	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	3003	LDGV
LD Minivan 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1610	LDGV
LD Pickup 4x2	Gasoline	1466	LDGT12
LD Pickup 4x2	Gasoline	3205	LDGT12
LD Van 4x2 (Passenger)	Ethanol / Unleaded Gasolin	1200	LDGT12
LD Pickup 4x2	Gasoline	3000	LDGT12
LD Pickup 4x2	Ethanol / Unleaded Gasolin	5382	LDGT12
LD Pickup 4x2	Gasoline	3316	LDGT12
LD Pickup 4x2	Ethanol / Unleaded Gasolin	3319	LDGT12
LD Van 4x2 (Passenger)	Ethanol / Unleaded Gasolin	0	LDGT12
LD Van 4x2 (Cargo)	Gasoline	1355	LDGT12
MD Van (Passenger)	Ethanol / Unleaded Gasolin	5484	LDGT12
MD Van (Cargo)	Gasoline	2560	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	2485	LDGT12
MD Van (Cargo)	Gasoline	1416	LDGT12
MD Van (Cargo)	Gasoline	1519	LDGT12
MD Van (Cargo)	Gasoline	334	LDGT12
MD Van (Cargo)	Gasoline	369	LDGT12
MD Van (Cargo)	Gasoline	1918	LDGT12
MD Van (Cargo)	Gasoline	1425	LDGT12
MD Van (Cargo)	Gasoline	2082	LDGT12
MD Van (Cargo)	Gasoline	655	LDGT12
MD Van (Cargo)	Gasoline	163	LDGT12
MD Van (Cargo)	Gasoline	4301	LDGT12
MD Pickup	Ethanol / Unleaded Gasolin	716	LDGT12
MD Van (Passenger)	Gasoline	5338	LDGT12
MD Van (Passenger)	Gasoline	2451	LDGT12

LD SUV 4x4	Gasoline	5	LDGT12
MD Van (Cargo)	Gasoline	425	LDGT12
MD Van (Cargo)	Gasoline	357	LDGT12
MD Van (Cargo)	Gasoline	1068	LDGT12
MD Van (Cargo)	nol / Unleaded Gas	862	LDGT12
MD Van (Passeng	Gasoline	6953	LDGT12
LD Van 4x2 (Cargo	Gasoline	882	LDGT12
MD Van (Passeng	Gasoline	316	LDGT12
MD Van (Passeng	Gasoline	1978	LDGT12
MD PICKUP	nol / Unleaded Gas	4772	LDGT12
MD PICKUP	nol / Unleaded Gas	5915	LDGT12
MD PICKUP	Diesel	1843	LDGT12
MD Van (Passeng	Gasoline	1380	LDGT12
MD Van (Passeng	nol / Unleaded Gas	1816	LDGT12
MD Van (Passeng	Gasoline	7604	LDGT12
LD Pickup 4x2	Gasoline	5085	LDGT12
LD Van 4x2 (Cargo	Gasoline	4535	LDGT12
LD Van 4x2 (Passe	nol / Unleaded Gas	709	LDGT12
LD Pickup 4x2	Gasoline	743	LDGT12
LD Pickup 4x2	Gasoline	3686	LDGT12
LD Pickup 4x2	nol / Unleaded Gas	4295	LDGT12
LD Van 4x2 (Passe	nol / Unleaded Gas	2364	LDGT12
LD Van 4x2 (Passe	nol / Unleaded Gas	292	LDGT12
MD Van (Cargo)	nol / Unleaded Gas	0	LDGT12
MD Van (Cargo)	Gasoline	956	LDGT12
MD Van (Cargo)	Gasoline	773	LDGT12
MD Pickup	nol / Unleaded Gas	3719	LDGT12
MD Van (Passeng	Gasoline	1972	LDGT12
MD Van (Cargo)	Gasoline	252	LDGT12
MD Van (Cargo)	Gasoline	4	LDGT12
MD Van (Passeng	nol / Unleaded Gas	1182	LDGT12
MD Van (Cargo)	nol / Unleaded Gas	2686	LDGT12
MD Van (Passeng	Gasoline	3233	LDGT12
MD Pickup	nol / Unleaded Gas	5173	LDGT12
MD Pickup	Gasoline	2866	LDGT12
LD Van 4x4 (Passe	nol / Unleaded Gas	3248	LDGT12
LD Van 4x4 (Passe	nol / Unleaded Gas	2686	LDGT12
LD Pickup 4x4	Gasoline	769	LDGT12
LD Pickup 4x4	nol / Unleaded Gas	7561	LDGT12
LD Pickup 4x4	Gasoline	4426	LDGT12
MD Pickup	nol / Unleaded Gas	1014	LDGT12
MD PICKUP	Gasoline	11	LDGT12
MD PICKUP	Gasoline	1607	LDGT12
MD PICKUP	Gasoline	3437	LDGT12
MD Pickup	Gasoline	2962	LDGT12
MD PICKUP	nol / Unleaded Gas	5751	LDGT12
MD PICKUP	nol / Unleaded Gas	1772	LDGT12
MD Pickup	nol / Unleaded Gas	443	LDGT12
MD PICKUP	nol / Unleaded Gas	1059	LDGT12
LD Pickup 4x2	nol / Unleaded Gas	1123	LDGT12
LD Pickup 4x2	nol / Unleaded Gas	975	LDGT12
MD Pickup	nol / Unleaded Gas	2163	LDGT12
MD Pickup	nol / Unleaded Gas	2638	LDGT12
MD Van (Cargo)	nol / Unleaded Gas	2445	LDGT12
MD Pickup	nol / Unleaded Gas	1163	LDGT12
MD PICKUP	Gasoline	1791	LDGT12
LD Van 4x2 (Passe	nol / Unleaded Gas	3278	LDGT12
LD Pickup 4x2	nol / Unleaded Gas	1969	LDGT12
LD Van 4x2 (Cargo	Gasoline	403	LDGT12
LD Pickup 4x2	Gasoline	303	LDGT12
LD Pickup 4x2	nol / Unleaded Gas	361	LDGT12
MD PICKUP	Gasoline	3963	LDGT12
LD Van 4x2 (Passe	nol / Unleaded Gas	2296	LDGT12
LD Pickup 4x4	nol / Unleaded Gas	2634	LDGT12
LD Pickup 4x4	Diesel	5341	LDDT
MD Pickup	Diesel	2502	LDDT
MD PICKUP	Diesel	2107	LDDT
MD Bus	Diesel	512	LDDT
MD PICKUP	Diesel	1843	LDDT
HD	Diesel	656	HDDV
HD	Diesel	17573	HDDV
HD	Diesel	436	HDDV
HD	Diesel	383	HDDV
HD	Diesel	609	HDDV
HD	Diesel	1349	HDDV
HD	Diesel	1634	HDDV
HD	Diesel	348	HDDV

Truck, Dump 6x6	Diesel	4304	HDDV
Truck Tractor	Diesel	2196	HDDV
Truck Tractor	Diesel	4428	HDDV
Truck Tractor	Diesel	9487	HDDV
Truck Tractor	Diesel	4598	HDDV
Truck Tractor	Diesel	3384	HDDV
Truck Tractor	Diesel	842	HDDV
Truck Tractor	Diesel	3360	HDDV
Truck Tractor	Diesel	2699	HDDV
Truck Tractor	Diesel	715	HDDV
Truck Stake Body Durastart lift gate	Gasoline/ E85	1388	HDGV
Truck, Maintenance Tel TY6 C/B	Gasoline/ E85	2578	HDGV
Truck, Maintenance Tel TY6 C/B	Gasoline/ E85	2634	HDGV
Truck, Maintenance Tel TY6 C/B	Gasoline/ E85	826	HDGV
Truck, Maintenance Tel TY6 C/B	Gasoline/ E85	8903	HDGV
Truck Maintenance 4x2	Gasoline/ E85	46	HDGV
Van Data Acquisition	Gasoline/ E85	1611	HDGV
Truck, Van Cargo	Gasoline/ E85	2497	HDGV
Truck, Van Cargo	Gasoline/ E85	1379	HDGV
Truck, Van Cargo	Gasoline/ E85	3976	HDGV
Truck, Van Cargo	Gasoline/ E85	1588	HDGV
Truck, Van Cargo	Gasoline/ E85	3182	HDGV
Truck, Van Cargo	Gasoline/ E85	1069	HDGV
Truck, Van Cargo	Gasoline/ E85	2450	HDGV
Truck, Van Cargo	Gasoline/ E85	235	HDGV
Truck, Van Cargo	Gasoline/ E85	3850	HDGV
Truck, Van Cargo	Gasoline/ E85	1931	HDGV
Truck, Van Cargo	Gasoline/ E85	1176	HDGV
Truck, Van Cargo	Gasoline/ E85	3759	HDGV
Truck, Van Cargo	Gasoline/ E85	451	HDGV
Truck, Van Cargo	Gasoline/ E85	2081	HDGV
Truck, Van Cargo	Gasoline/ E85	3146	HDGV
Truck, Van 12 passenger	Gasoline/ E85	245	HDGV
Truck, Panel Van	Gasoline/ E85	2	HDGV
Van Data Acquisition	Gasoline/ E85	26	HDGV
Van Data Acquisition	Gasoline/ E85	100	HDGV
Van Data Acquisition	Gasoline/ E85	265	HDGV
Van Data Acquisition	Gasoline/ E85	547	HDGV
Van Data Acquisition	Gasoline/ E85	216	HDGV
Van Data Acquisition	Gasoline/ E85	174	HDGV
Van Data Acquisition	Gasoline/ E85	407	HDGV
Van Chevrolet Step	Gasoline/ E85	1143	HDGV
Van Data Acquisition	Gasoline/ E85	402	HDGV
Van Data Acquisition	Gasoline/ E85	615	HDGV
Van Data Acquisition	Gasoline/ E85	959	HDGV
Van Data Acquisition	Gasoline/ E85	1041	HDGV
Van Data Acquisition	Gasoline/ E85	101	HDGV
Van Service Platform Lift	Gasoline/ E85	3673	HDGV
Truck, Van Cargo	Gasoline/ E85	2687	HDGV
Truck, Van Data	Gasoline/ E85	147	HDGV
Truck, Van Data	Gasoline/ E85	408	HDGV
Truck, Van Data	Gasoline/ E85	128	HDGV
Truck, Van Data	Gasoline/ E85	104	HDGV
Van Data Acquisition	Gasoline/ E85	3824	HDGV
Truck, Van 12 Passenger	Gasoline/ E85	964	HDGV
Van Cargo	Gasoline/ E85	806	HDGV
Van Cargo	Gasoline/ E85	2251	HDGV
Truck Step Van	Diesel	31	HDDBT
Van Data Acquisition	Diesel	260	HDDBT
Truck, Van Cargo	Diesel	289	HDDBT
Van Data Acquisition	Diesel	10	HDDBT
Van Data Acquisition	Diesel	72	HDDBT
Van Data Acquisition	Diesel	545	HDDBT
Truck, Van Cargo	Diesel	974	HDDBT
Van Cargo	Diesel	750	HDDBT
Truck, Van, Data	Diesel	1444	HDDBT
Total		**407678**	

GOV categories not provided, assumed service vehicles and tractors are heavy duty.

Note: Data for CY 2023 taken from CY 2020.

MD Van (Passenger)	Gasoline	4182	LDGT12
MD Van (Passenger)	Ethanol / Unleaded Gasolin	1382	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	2483	LDGT12
MD Van (Cargo)	Gasoline	2091	LDGT12
MD Van (Passenger)	Ethanol / Unleaded Gasolin	10212	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	1648	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	4548	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	4130	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	6684	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	1827	LDGT12
MD Van (Cargo)	Gasoline	8584	LDGT12
MD Van (Cargo)	Gasoline	10341	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	2686	LDGT12
MD Van (Cargo)	Gasoline	2371	LDGT12
MD Van (Cargo)	Gasoline	1519	LDGT12
MD Van (Cargo)	Ethanol / Unleaded Gasolin	497	LDGT12
LD Pickup 4x4	Gasoline	964	LDGT12
LD Pickup 4x4	Gasoline	1682	LDGT12
LD Pickup 4x4	Gasoline	3120	LDGT12
LD Pickup 4x4	Gasoline	2348	LDGT12
LD Pickup 4x4	Gasoline	794	LDGT12
LD Pickup 4x4	Gasoline	2461	LDGT12
LD Pickup 4x4	Diesel	5341	LDGT12
LD SUV 4x4	Gasoline	3163	LDGT12
LD Pickup 4x4	Gasoline	2438	LDGT12
LD SUV 4x4	Gasoline	2640	LDGT12
LD SUV 4x4	Gasoline	8825	LDGT12
LD Pickup 4x4	Gasoline	1660	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	12410	LDGT12
LD SUV 4x4	Gasoline	444	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	9541	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	8870	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	818	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	3845	LDGT12
LD Pickup 4x4	Gasoline	21773	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	3930	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	7448	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	17542	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	15493	LDGT12
LD Pickup 4x4	Gasoline	819	LDGT12
LD Pickup 4x4	Gasoline	15540	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	1832	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	1304	LDGT12
LD SUV 4x4	Ethanol / Unleaded Gasolin	1083	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	2848	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	1167	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	2554	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	5538	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	6420	LDGT12
LD Pickup 4x4	Ethanol / Unleaded Gasolin	6851	LDGT12
LD Pickup 4x4	Gasoline	5722	LDGT12
LD SUV 4x4	Ethanol / Unleaded Gasolin	12225	LDGT12
LD SUV 4x4	Gasoline	8416	LDGT12
LD SUV 4x4	Gasoline	2595	LDGT12
LD SUV 4x4	Gasoline	1130	LDGT12
MD Pickup	Ethanol / Unleaded Gasolin	1977	LDGT12
MD Pickup	Ethanol / Unleaded Gasolin	2612	LDGT12

GOV categories not provided, categories assumed based on vehicle type.

Note: Data for CY 2023 taken from CY 2020.

APG Fire Department On-Road GOV

Type	Fuel	Total mileage (miles/yr)	Category
Truck	Gasoline	40941	LDGT12
Fire Engine	Diesel	32725	HDDV
Truck	Diesel	6972	HDDV
Falcon/Decon system/Ambulance	Diesel	19899	HDDV
Total		**100537**	

CY 2023 and 2020 data received from APG Fire Dept. did not include mileage, so CY 2017 data is used for CY 2023.

HD	Diesel	2685	HDDV
HD	Biodiesel B20	2244	HDDV
HD	Biodiesel B20	126	HDDV
HD	Diesel	615	HDDV
HD	Diesel	261	HDDV
HD	Diesel	338	HDDV
HD	Diesel	1462	HDDV
HD	Diesel	2213	HDDV
HD	Biodiesel B20	562	HDDV
HD	Biodiesel B20	530	HDDV
HD	Biodiesel B20	189	HDDV
HD	Biodiesel B20	182	HDDV
HD	Biodiesel B20	448	HDDV
HD	Biodiesel B20	110	HDDV
HD	Biodiesel B20	1373	HDDV
HD	Biodiesel B20	1355	HDDV
HD	Diesel	176	HDDV
HD	Diesel	1286	HDDV
HD	Diesel	38	HDDV
HD	Diesel	481	HDDV
HD	Biodiesel B20	36	HDDV
HD	Diesel	284	HDDV
HD	Diesel	262	HDDV
HD	Diesel	2036	HDDV
HD	Diesel	710	HDDV
HD	Diesel	1488	HDDV
HD	Diesel	646	HDDV
HD	Diesel	3758	HDDV
HD	Biodiesel B20	704	HDDV
HD	Biodiesel B20	1973	HDDV
HD	Diesel	509	HDDV
HD	Biodiesel B20	402	HDDV
HD	Diesel	973	HDDV
HD	Diesel	766	HDDV
HD	Diesel	2459	HDDV
HD	Diesel	2447	HDDV
HD	Diesel	972	HDDV
HD	Diesel	1923	HDDV
HD	Diesel	2311	HDDV
HD	Biodiesel B20	1121	HDDV
HD	Biodiesel B20	4755	HDDV
HD	Biodiesel B20	667	HDDV
HD	Biodiesel B20	1584	HDDV
HD	Diesel	34	HDDV
HD	Diesel	4102	HDDV
HD	Diesel	304	HDDV
HD Bus	Diesel	394	HDDBT
Total		**1229176**	

GOV categories not provided, categories assumed based on vehicle type.

Note: Data for CY 2023 taken from CY 2020.

On-Road GOV Emissions Factors and Emissions Calculations

Vehicle Category	Annual On-Base Mileage	Vehicle Criteria Emission Factors (gram/mile)						Criteria Pollutant Emissions (tpy)					
		CO	NO_X	PM-10	PM-2.5	SO_2	VOC	CO	NO_X	PM-10	PM-2.5	SO_2	VOC
HDDBT	4,769	1.98E+00	6.05E+00	2.49E-01	2.29E-01	1.30E-02	5.38E-01	1.04E-02	3.18E-02	1.31E-03	1.20E-03	6.82E-05	2.82E-03
HDDV	205,818	1.98E+00	6.05E+00	2.49E-01	2.29E-01	1.30E-02	5.38E-01	4.49E-01	1.37E+00	5.64E-02	5.18E-02	2.94E-03	1.22E-01
HDGV	71,991	1.93E+01	1.52E+00	3.00E-02	2.60E-02	5.00E-03	9.49E-01	1.53E+00	1.20E-01	2.38E-03	2.06E-03	3.96E-04	7.52E-02
LDDT	43,766	5.38E+00	5.61E-01	8.00E-03	7.00E-03	4.00E-03	3.70E-01	2.59E-01	2.70E-02	3.85E-04	3.37E-04	1.93E-04	1.78E-02
LDGT12	884,335	5.40E+00	5.74E-01	1.20E-02	1.10E-02	3.00E-03	4.66E-01	5.26E+00	5.58E-01	1.17E-02	1.07E-02	2.92E-03	4.53E-01
LDGV	526,712	3.63E+00	3.30E-01	1.00E-02	9.00E-03	2.00E-03	3.59E-01	2.10E+00	1.91E-01	5.79E-03	5.21E-03	1.16E-03	2.08E-01
TOTALS	**1,737,391**												
Total On-Road GOV Emissions								**9.61E+00**	**2.30E+00**	**7.79E-02**	**7.14E-02**	**7.68E-03**	**8.79E-01**

Emission factors for on-road vehicles adapted from the APG RONA spreadsheet which is based on Mobile Emissions from Guide to Air force Mobile Sources which are based on the EPA MOVES2014a Model

Used Heavy duty vehicles (HDDV) for HDDBT because the APG RONA spreadsheet does not have EFs for HDDBT.

Emissions (tpy) = Emission Factor (gram/mile) x Annual On-base Mileage x 0.0022 (lb/gram)/ 2000 lb per ton

On-Road Vehicles Emissions

Pollutant	CO (tpy)	NOX (tpy)	PM10 (tpy)	PM2.5 (tpy)	SOX (tpy)	VOC (tpy)
Total On-Road POV Emissions	8.24E+01	8.29E+00	2.11E-01	1.92E-01	4.60E-02	7.59E+00
Total On-Road GOV Emissions	9.61E+00	2.30E+00	7.79E-02	7.14E-02	7.68E-03	8.79E-01
Total On-Road Vehicles Emissions	**9.20E+01**	**1.06E+01**	**2.89E-01**	**2.63E-01**	**5.36E-02**	**8.46E+00**

Data for Open Burning/Open Detonation of Explosives Emissions

AA OB/OD (ATC)

Disposal Method	Quantity (lbs/yr)
Open Burning	2103
Open Detonation	9222

EA OB/OD

Disposal Method	Quantity (lbs/yr)
Open Detonation	100

The EF developed by APG does not include the additional explosive materials added to the weapons to initiate the burning or detonation (APG, 2014), so the donor weight of 4,543 lb is not included for OD.

Note: Data for CY 2023 taken from CY 2020.

Open Burning/Open Detonation of Explosives Emission Factors and Emissions Calculations

Disposal Method	Quantity (lbs/yr)	Emission Factor (lb/lb)						Emissions					
		CO	NOx	PM_{10}	$PM_{2.5}$	SO2	VOC	CO (lb/yr)	NOx (lb/yr)	PM-10 (lb/yr)	PM-2.5 (lb/yr)	SO_2 (lb/yr)	VOC (lb/yr)
Open Burning Emissions	2103	0.00773	0.00693	0.2	0.011	0.000692	1.36E-04	1.63E+01	1.46E+01	4.21E+02	2.31E+01	1.46E+00	2.86E-01
Open Detonation Emissions	9322	0.0293	0.0169	19	9.3	0.00662	1.30E-03	2.73E+02	1.58E+02	1.77E+05	8.67E+04	6.17E+01	1.21E+01
Total OB/OD of Explosives Emissions								2.89E+02	1.72E+02	1.78E+05	8.67E+04	6.32E+01	1.24E+01
Open Burning Emisisons (tpy)								8.13E-03	7.29E-03	2.10E-01	1.16E-02	7.28E-04	1.43E-04
Open Detonation Emissions (tpy)								1.37E-01	7.88E-02	8.86E+01	4.33E+01	3.09E-02	6.06E-03
Total OB/OD of Explosives Emissions (tpy)								**1.45E-01**	**8.61E-02**	**8.88E+01**	**4.34E+01**	**3.16E-02**	**6.20E-03**

Open burning emissions are calculated using the total quantity burned and the EF selected by APG for use in the RCRA Permit application.

Open detonation emissions are calculated using EF selected by APG for use in the RCRA Permit application and APG's records for the total quantity of items detonated.

Data for Smoke Testing Emissions, Smoke Testing Emission Factors, and Smoke Testing Emissions Calculations

Item	Smoke Grenades Fired (item/yr)	Emission Factor (lb/item)						Emissions (lb/yr)					
		CO	NOx	PM_{10}	$PM_{2.5}$	SO2	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	SO2	VOC
G930	0	4.60E-02	1.00E-03	6.80E-01	1.10E-01	1.20E-04	1.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grenade L8A3 Smoke (G815)	0	2.00E-02	1.60E-03	8.00E-01	7.90E-01	1.20E-03	3.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total								**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Total (tpy)								**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Emission Factors for Criteria Pollutants, derived from AP-42, Section 15.5 Table 15.5.5-1 and 15.5.14 (7/09).

G930 used for unkown grenade type as most conservative option.

L8A1 was not found in the AP manual, so L8A3 was used instead.

Note: Data for CY 2023 taken from CY 2020.

Solvent Degreasers Emissions Calculations

Data Source	BLDG	Location	Volume (gal)	Density (lb/gal)	Solvent Removed as Waste (lb/yr)	VOC Emissions (lb/yr)	VOC Emissions (tpy)
ATC	280B	AA	32	6.43	205.6208	1.08E+01	5.41E-03
ATC	338	AA	128	6.43	822.4832	4.33E+01	2.16E-02
ATC	402	AA	5	6.43	32.12825	1.69E+00	8.45E-04
ATC	402	AA	256	6.43	1644.9664	8.66E+01	4.33E-02
ATC	402	AA	120	6.43	771.078	4.06E+01	2.03E-02
ATC	402	AA	120	6.43	771.078	4.06E+01	2.03E-02
ATC	436	AA	98	6.43	629.7137	3.31E+01	1.66E-02
ATC	525	AA	32	6.43	205.6208	1.08E+01	5.41E-03
ATC	525	AA	385	6.43	2473.87525	1.30E+02	6.51E-02
ATC	C10301	AA	45	6.43	289.15425	1.52E+01	7.61E-03
ATC	1060	AA	74	6.43	472.285275	2.49E+01	1.24E-02
ATC	1060	AA	74	6.43	472.285275	2.49E+01	1.24E-02
ATC	1089	AA	23	6.43	147.78995	7.78E+00	3.89E-03
ATC	1089	AA	96	6.43	616.8624	3.25E+01	1.62E-02
ATC	896	AA	74	6.43	472.285275	2.49E+01	1.24E-02
ATC	431	AA	64	6.43	411.2416	2.16E+01	1.08E-02
ATC	E1464	EA	49	6.43	314.85685	1.66E+01	8.29E-03
DPW-ED TSDF	various	AA	1,136	7	7952	4.19E+02	2.09E-01
DPW-ED TSDF	various	EA	503	7	3521	1.85E+02	9.27E-02
Auto Craft Center	2379	AA	42	8.804	369.76695	1.95E+01	9.73E-03
Auto Craft Center	2379	AA	5	8.078	40.3898	2.13E+00	1.06E-03
Totals AA			**2,807.5**		**18,800.6**	**9.90E+02**	**4.95E-01**
Totals EA			**552.0**		**3,835.9**	**2.02E+02**	**1.01E-01**
Totals APG			**3,359.5**		**22,636.5**	**1.19E+03**	**5.96E-01**

Assumed that 95% of total chemicals supplied is collected as waste and 5% evaporates.

ATC solvent degreaser density from SDS for Safety-Kleen MIL-PRF-680.

DPW-ED TSDF solvent degreaser density assumed at 7 lb/gal from 2/5/2021 email from Kenneth Menzies, III.

Auto Craft Center solvent degreaser densities from SDSs for ArmaKleen 4 in 1 Cleaner Concentrate and Safety-Kleen Professional Parts Cleaner ID 820012.

Note: Data for CY 2023 taken from CY 2020.

ATC Small Arms Training Exercises Emissions Calculations

Item	Items fired	Emission Factor (lb/item)					Emissions (lb/yr)				
		CO	NOx	PM_{10}	$PM_{2.5}$	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	VOC
0.22 caliber long rifle	13587	8.00E-05	5.00E-06	3.40E-06	2.60E-06	5.70E-07	1.09E+00	6.79E-02	4.62E-02	3.53E-02	7.74E-03
M2 0.30 cal	10019	3.00E-03	1.30E-05	9.40E-05	7.30E-05	2.78E-06	3.01E+01	1.30E-01	9.42E-01	7.31E-01	2.79E-02
.45 Cal	6071	2.60E-04	8.10E-06	3.70E-05	3.10E-05	6.40E-07	1.58E+00	4.92E-02	2.25E-01	8.06E-09	1.66E-10
M903 .50cal	113850	9.60E-03	8.50E-05	2.10E-04	1.80E-04	1.76E-05	1.09E+03	9.68E+00	2.39E+01	2.05E+01	2.00E+00
12 gage #9 shot	5723	1.00E-03	2.10E-05	2.10E-05	2.00E-05	1.11E-05	5.72E+00	1.20E-01	1.20E-01	1.14E-01	6.34E-02
14.5 mm	878	1.40E-04	1.10E-04	1.50E-03	1.40E-03	2.26E-06	1.23E-01	9.66E-02	1.32E+00	1.23E+00	1.98E-03
5.56 mm	104762	1.60E-03	8.50E-05	3.90E-05	2.80E-05	2.31E-06	1.68E+02	8.90E+00	4.09E+00	2.93E+00	2.42E-01
7.62 mm	633734	2.30E-03	9.70E-05	5.10E-05	3.80E-05	2.40E-07	1.46E+03	6.15E+01	3.23E+01	2.41E+01	1.52E-01
40 mm M383	11312	7.00E-03	1.60E-03	1.30E-02	6.60E-03	6.83E-05	7.92E+01	1.81E+01	1.47E+02	7.47E+01	7.72E-01
Total ATC Small Arms Training Exercises Emissions							**2.84E+03**	**9.86E+01**	**2.10E+02**	**1.24E+02**	**3.27E+00**
Total ATC Small Arms Training Exercises Emissions (tpy)							**1.42E+00**	**4.93E-02**	**1.05E-01**	**6.21E-02**	**1.63E-03**

Emission factors from EPA AP 42, Chapter 15, Table 15.1.10-1.

If more than one set of emission factors was available for a size fraction, the most conservative factors were used.

If an ammunition size fraction did not have an unique EF, it was grouped with the next largest size (0.338, 0.357 and 0.44 Cal are included in 0.45 Cal).

Add up largest VOCs listed to get average VOC emissions.

Note: Data for CY 2023 taken from CY 2020.

ATC Land Training Excercises Emissions Calculations

Item	Items fired	Emission Factor (lb/item)					Emissions (lb/yr)				
		CO	NOx	PM_{10}	$PM_{2.5}$	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	VOC
5.56 mm	3720	1.60E-03	8.50E-05	3.90E-05	2.80E-05	2.31E-06	5.95E+00	3.16E-01	1.45E-01	1.04E-01	8.59E-03
9 mm ball	1200	3.10E-04	1.50E-05	2.40E-05	2.00E-05	1.58E-06	3.72E-01	1.80E-02	2.88E-02	2.40E-02	1.90E-03
12 gage	93	1.00E-03	2.10E-05	2.10E-05	2.00E-05	1.11E-05	9.30E-02	1.95E-03	1.95E-03	1.86E-03	1.03E-03
.30 cal	974	3.00E-03	1.30E-05	9.40E-05	7.30E-05	2.78E-06	2.92E+00	1.27E-02	9.16E-02	7.11E-02	2.71E-03
.45 Cal	1330	2.60E-04	8.10E-06	3.70E-05	3.10E-05	6.40E-07	3.46E-01	1.08E-02	4.92E-02	4.12E-02	8.51E-04
.50 Caliber	5455	9.60E-03	8.50E-05	2.10E-04	1.80E-04	1.76E-05	5.24E+01	4.64E-01	1.15E+00	9.82E-01	9.58E-02
5.56 mm	8978	1.60E-03	8.50E-05	3.90E-05	2.80E-05	2.31E-06	1.44E+01	7.63E-01	3.50E-01	2.51E-01	2.07E-02
7.62 mm	4889	2.30E-03	9.70E-05	5.10E-05	3.80E-05	2.40E-07	1.12E+01	4.74E-01	2.49E-01	1.86E-01	1.17E-03
40 mm	1596	7.00E-03	1.60E-03	1.30E-02	6.60E-03	6.83E-05	1.12E+01	2.55E+00	2.07E+01	1.05E+01	1.09E-01
120 mm	0	2.10E-01	7.70E-02	1.80E-01	9.10E-02	1.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total ATC Land Training Exercises Emissions							**6.32E+00**	**3.34E-01**	**1.74E-01**	**1.28E-01**	**1.05E-02**
Total ATC Land Training Exercises Emissions (tpy)							**3.16E-03**	**1.67E-04**	**8.69E-05**	**6.41E-05**	**5.24E-06**

ATC Land Training Exercises include Mout Indoor Range (0 total rounds), Mout Outdoor Range (23916 total rounds), and the Light Rifle Range (4320 total rounds).

Emission factors from EPA AP 42 Chapter 15, the 120 mm used for the EF was M865.

If an ammunition size fraction did not have an unique EF, it was grouped with the next largest size (6.8 mm is included in 7.62 mm).

Note: Data for CY 2023 taken from CY 2020.

ATC Watercraft Training Exercises Emissions Calculations

Item	Items fired	Emission Factor (lb/item)					Emissions (lb/yr)				
		CO	NOx	PM_{10}	$PM_{2.5}$	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	VOC
60 mm mortar	34	7.80E-03	9.80E-05	1.40E-03	1.20E-03	2.48E-05	2.65E-01	3.33E-03	4.76E-02	4.08E-02	8.43E-04
5.56 mm	1600	1.60E-03	8.50E-05	3.90E-05	2.80E-05	2.31E-06	2.56E+00	1.36E-01	6.24E-02	4.48E-02	3.70E-03
7.62 mm	335422	2.30E-03	9.70E-05	5.10E-05	3.80E-05	2.40E-07	7.71E+02	3.25E+01	1.71E+01	1.27E+01	8.05E-02
40 mm	10754	7.00E-03	1.60E-03	1.30E-02	6.60E-03	6.83E-05	7.53E+01	1.72E+01	1.40E+02	7.10E+01	7.34E-01
.50 Caliber	140500	9.60E-03	8.50E-05	2.10E-04	1.80E-04	1.76E-05	1.35E+03	1.19E+01	2.95E+01	2.53E+01	2.47E+00
Total ATC Watercraft Training Exercises Emissions							**2.20E+03**	**6.18E+01**	**1.87E+02**	**1.09E+02**	**3.29E+00**
Total ATC Watercraft Training Exercises Emissions (tpy)							**1.10E+00**	**3.09E-02**	**9.33E-02**	**5.45E-02**	**1.64E-03**

Items fired as part of watercraft training at Abbey Point, Cherry Tree, and Stoney Point. Items do not include 36 flares fired at Cherry Tree and 12 flares fired at Stoney Point.

Emission factors from EPA AP 42 Chapter 15.

Note: Data for CY 2023 taken from CY 2020.

Training Exercises Emissions

Pollutant	CO (tpy)	NOX (tpy)	PM10 (tpy)	PM2.5 (tpy)	SOX (tpy)	VOC (tpy)
Total ATC Small Arms Training Exercises Emission	1.42E+00	4.93E-02	1.05E-01	6.21E-02	0.00E+00	1.63E-03
Total ATC Land Training Exercises Emissions	3.16E-03	1.67E-04	8.69E-05	6.41E-05	0.00E+00	5.24E-06
Total ATC Watercraft Training Exercises Emissions	1.10E+00	3.09E-02	9.33E-02	5.45E-02	0.00E+00	1.64E-03
Total Training Exercises Emissions	**2.52E+00**	**8.04E-02**	**1.98E-01**	**1.17E-01**	**0.00E+00**	**3.28E-03**

Data for Watercraft Emissions and Watercraft Emissions Calculations

Description	Number of Units	Size, HP	Inboard or Outboard	Fuel Type	On-Site Estimated Usage (hours/yr)	CO	NOx	PM_{10}	PM2.5	SO_2	VOC
Rohr MOD1 Landing Craft, LCM8522	1	800	Inboard	Diesel	30	5.03E+01	2.66E+02	5.56E+00	5.56E+00	1.94E+01	1.48E+01
Patrol Boat, Utility 41	1	900	Inboard	Diesel	85	1.60E+02	8.47E+02	1.77E+01	1.77E+01	6.19E+01	4.72E+01
Evans Boat, Patrol 42	1	900	Inboard	Diesel	18	3.39E+01	1.79E+02	3.75E+00	3.75E+00	1.31E+01	1.00E+01
Evans Boat, Patrol 43	7	900	Inboard	Diesel	828	1.56E+03	8.25E+03	1.73E+02	1.73E+02	6.03E+02	4.60E+02
Watercraft	0	350	Outboard	Gasoline	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Watercraft	0	250	Outboard	Gasoline	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Watercraft	0	150	Outboard	Gasoline	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Watercraft	0	50	Outboard	Gasoline	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AA privately owned watercraft at marina[1]	12		Outboard	Gasoline	120	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EA privately owned watercraft at marina[1,2]	17	62.5	Inboard	Gasoline	174	2.13E+03	1.20E+02	1.44E+00	1.44E+00	1.31E-02	8.18E+01
	70	62.5	Outboard	Gasoline	696	1.43E+04	3.85E+02	6.23E+01	6.23E+01	7.40E-02	3.26E+03
	30	62.5	Inboard	Gasoline	300	3.67E+03	2.07E+02	2.48E+00	2.48E+00	2.25E-02	1.41E+02
Drop-in privately owned watercraft[1,2]	120	62.5	Outboard	Gasoline	1200	2.46E+04	6.63E+02	1.07E+02	1.07E+02	1.28E-01	5.62E+03
Rental outboard motors[1]	11	25	Outboard	Gasoline	1320	1.67E+04	2.93E+02	8.51E+01	8.51E+01	6.13E-02	4.68E+03
Total Watercraft Emissions (lb/yr)						**6.32E+04**	**1.12E+04**	**4.58E+02**	**4.58E+02**	**6.98E+02**	**1.43E+04**
Total Watercraft Emissions (tpy)						**3.16E+01**	**5.60E+00**	**2.29E-01**	**2.29E-01**	**3.49E-01**	**7.16E+00**

The sulfur content of gasoline is 10 parts per million. SO_2 emissions are calculated based on the sulfur fuel content and fuel combustion data per EPA (2010).

Assumed the patrol boat and Evans boats have two 450 HP diesel Cummings inboard engines. Assumed the landing craft has two 400 HP inboard Detriot Diesel engines.

[1]Data for 2023 was not available, so data from APG (2014) was used including the following assumptions:

Privately owned boats launched in the Aberdeen Area are essentially off-site once they hit the water and do not contribute to on-base air pollution.

Assumed 80% of privately owned watercraft are outboard motor and 20% are inboard and all are gasoline fueled.

Drop-in privately owned watercraft are based on number of annual permits (75 to 125) and estimated illegal launchings.

Assumed rental outboards were used for 3 hours on-site per rental weekend and that there are 40 rentals per year.

Assumed privately owned watercraft were used 5 times per year and spent 2 hours on site each usage for a total of 10 hours per boat per year.

[2]The size of the engines was unavailable and taken from APG (2008)

Converted from grams to pounds using 1lb/453.6 grams.

Watercraft Emission Factors for Diesel Inboard Engines

Pollutant	Emission Factor Diesel (g/hp-hr)
CO	0.95
NOx	5.02
SOx	0.367
VOC	0.28
PM10	0.105

Derived from USEPA, 2010. Exhaust and Crankcase Emission Factors for Nonroad

Watercraft Emission Factors for Gasoline Outboard and Inboard Engines

Engine Size (HP)	Emission Factor			
	CO	NO_x	VOC	PM
Outboard	g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr
6-11	230.1	4.0	64.3	1.2
40-50	148.8	4.1	37.2	0.7
50-100	148.9	4.0	34.0	0.7
100-175	146.1	4.0	34.0	0.7
175+	142.8	3.8	34.1	0.7
Inboard				

Engine Modeling - Compression-Ignition. NR-009d. EPA-420-R-10-018. July 2010.

Emission factors determined by averaging the three emission factors provided in EPA (2010).

Emission factors for SO_2 calculated using the fuel sulfur content and fuel combustion data provided in EPA (2010).

≤600	88.8	5.0	3.4	0.1

Derived from USEPA, 2010. Exhaust Emission Factors for Nonroad Engine Modeling - Spark-Ignition. NR-010I

Emission factors determined by averaging emission factors provided in EPA (2010).

Emission factors for SO_2 calculated using the fuel sulfur content and fuel combustion data provided in EPA (201

Emission factors from EPA (July 2010)

Table 10. Outboard Emission Factors [g/bhp-hr]

Pollutant	HP Bin	Technology Type							
		MO2C	MO2I	MO2D	MO4C	MO4I	MO4D	MOC1	Average
HC	0-3	271.92	230.39	38.74	25.60	31.77	19.27	15.57	90.47
	3-6	236.73	200.58	33.73	19.09	23.69	14.37	16.49	77.81
	6-11	201.55	170.77	28.72	12.61	15.65	9.49	11.59	64.34
	11-16	166.37	140.96	23.70	8.89	11.03	6.69	8.67	52.33
	16-25	131.18	111.15	18.69	6.17	7.66	4.65	9.32	41.26
	25-40	126.53	107.21	18.03	5.31	6.59	4.00	7.63	39.33
	40-50	120.97	102.50	15.55	4.81	5.97	3.62	6.96	37.20
	50-100	109.11	92.45	15.55	4.69	5.82	3.53	6.88	34.00
	100-175	109.11	92.45	15.55	4.69	5.82	3.53	6.83	34.00
	175+	109.11	92.45	15.55	4.69	5.82	3.53	7.62	34.11
NOx	0-3	1.34	1.96	4.32	5.18	5.44	5.82	3.60	3.95
	3-6	1.34	1.96	4.32	5.18	5.44	5.82	2.69	3.82
	6-11	1.34	1.96	4.32	5.18	5.44	5.82	4.18	4.03
	11-16	1.34	1.96	4.32	5.18	5.44	5.82	5.04	4.16
	16-25	1.34	1.96	4.32	5.18	5.44	5.82	3.21	3.90
	25-40	1.34	1.96	4.32	5.18	5.44	5.82	4.24	4.04
	40-50	1.34	1.96	4.32	5.18	5.44	5.82	4.41	4.07
	50-100	1.34	1.96	4.32	5.18	5.44	5.82	4.03	4.01
	100-175	1.34	1.96	4.32	5.18	5.44	5.82	3.73	3.97
	175+	1.34	1.96	4.32	5.18	5.44	5.82	2.74	3.83
CO	0-3	522.44	443.81	168.07	404.36	442.11	417.79	404.36	400.42
	3-6	357.31	303.53	114.95	265.94	303.68	279.37	265.94	270.10
	6-11	316.77	269.10	101.91	217.89	255.64	231.32	217.89	230.07
	11-16	276.23	234.66	88.87	184.91	222.65	198.34	184.91	198.65
	16-25	240.34	204.16	77.32	153.03	190.78	166.46	153.03	169.30
	25-40	240.34	204.16	77.32	121.16	158.91	134.59	141.29	153.97
	40-50	240.34	204.16	77.32	114.51	152.25	127.94	124.74	148.75
	50-100	240.34	204.16	77.32	114.51	152.25	127.94	125.94	148.92
	100-175	240.34	204.16	77.32	114.51	136.58	120.62	128.93	146.07
	175+	240.34	204.16	77.32	114.51	140.71	120.31	102.09	142.78
PM	0-3	5.7	4.7	0.33	0.06	0.06	0.06	0.06	1.57
	3-6	4.8	4.1	0.33	0.06	0.06	0.06	0.06	1.35
	6-11	4.1	3.5	0.33	0.06	0.06	0.06	0.06	1.17
	11-16	3.4	2.9	0.30	0.06	0.06	0.06	0.06	0.98
	16-25	2.7	2.3	0.26	0.06	0.06	0.06	0.06	0.79
	25-40	2.6	2.2	0.26	0.06	0.06	0.06	0.06	0.76
	40-50	2.5	2.1	0.22	0.06	0.06	0.06	0.06	0.72
	50-100	2.2	1.9	0.22	0.06	0.06	0.06	0.06	0.65
	100-175	2.2	1.9	0.22	0.06	0.06	0.06	0.06	0.65
	175+	2.2	1.9	0.22	0.06	0.06	0.06	0.06	0.65

Table 11. Personal Watercraft Emission Factors [g/bhp-hr]

Pollutant	HP Bin	Technology Type								Average
		MP2C	MP2I	MP2D	MP2CA	MP4C	MP4I	MP4D	MPC1	
HC	0-3	271.92	205.35	60.78	106.70	25.84	31.75	30.09	15.57	93.50
	3-6	230.19	173.84	51.46	90.32	15.13	21.04	19.38	16.49	77.23
	6-11	188.47	142.33	42.13	73.95	4.43	10.33	8.67	11.59	60.24
	11-16	146.74	110.82	32.80	57.58	4.43	10.33	8.67	8.67	47.51
	16-25	105.02	79.31	23.48	41.21	4.43	10.33	8.67	9.32	35.22
	25-40	105.02	79.31	23.48	41.21	3.73	9.63	7.97	7.63	34.75
	40-50	105.02	79.31	23.48	41.21	3.73	9.63	7.97	6.96	34.66
	50-100	105.02	79.31	24.74	41.21	3.63	9.54	7.88	6.88	34.78
	100-175	105.02	79.31	24.37	41.21	3.63	9.54	7.88	6.83	34.72
	175+	105.02	79.31	15.76	41.21	3.63	9.54	7.88	7.62	33.75
NOx	0-3	1.08	1.31	3.78	0.27	1.47	4.90	3.55	3.60	2.50
	3-6	1.08	1.31	3.78	0.27	1.07	4.90	3.55	2.69	2.33
	6-11	1.08	1.31	3.78	0.27	5.98	4.90	3.55	4.18	3.13
	11-16	1.08	1.31	3.78	0.27	5.98	4.90	3.55	5.04	3.24
	16-25	1.08	1.31	3.78	0.27	5.98	4.90	3.55	3.21	3.01
	25-40	1.08	1.31	3.78	0.27	5.98	4.90	3.55	4.24	3.14
	40-50	1.08	1.31	3.78	0.27	5.98	4.90	3.55	4.41	3.16
	50-100	1.08	1.31	3.78	0.27	5.98	4.90	3.55	4.03	3.11
	100-175	1.08	1.31	3.78	0.27	5.98	4.90	3.55	3.73	3.08
	175+	1.08	1.31	3.78	0.27	5.98	4.90	3.55	2.74	2.95
CO	0-3	522.44	477.03	231.18	547.75	476.96	476.96	476.96	476.96	460.78
	3-6	444.63	405.98	196.75	469.94	401.31	401.31	401.31	401.31	390.32
	6-11	366.82	334.94	162.32	392.13	181.13	181.13	181.13	181.13	247.59
	11-16	289.01	263.89	127.89	314.32	171.94	171.94	171.94	171.94	210.36
	16-25	211.20	192.84	93.46	236.51	162.74	162.74	162.74	162.74	173.12
	25-40	211.20	192.84	93.46	236.51	153.54	153.54	153.54	153.54	168.52
	40-50	211.20	192.84	93.46	236.51	153.54	153.54	153.54	93.46	161.01
	50-100	211.20	193.65	100.82	236.51	153.54	153.54	153.54	153.54	169.54
	100-175	211.20	193.65	94.68	236.51	153.54	153.54	153.54	150.44	168.39
	175+	211.20	193.65	85.06	236.51	153.54	153.54	153.54	85.06	159.01
PM	0-3	5.5	4.7	0.33	2.16	0.06	0.06	0.06	0.06	1.62
	3-6	4.8	4.1	0.33	1.88	0.06	0.06	0.06	0.06	1.42
	6-11	4.1	3.5	0.33	1.61	0.06	0.06	0.06	0.06	1.22
	11-16	3.4	2.9	0.30	1.33	0.06	0.06	0.06	0.06	1.02
	16-25	2.7	2.3	0.26	1.06	0.06	0.06	0.06	0.06	0.82
	25-40	2.6	2.2	0.26	1.02	0.06	0.06	0.06	0.06	0.79
	40-50	2.5	2.1	0.22	0.98	0.06	0.06	0.06	0.06	0.76
	50-100	2.2	1.9	0.22	0.86	0.06	0.06	0.06	0.06	0.68
	100-175	2.2	1.9	0.22	0.86	0.06	0.06	0.06	0.06	0.68
	175+	2.2	1.9	0.22	0.86	0.06	0.06	0.06	0.06	0.68

Table 12. Fuel Consumption Factors for Outboards and PWC [lbs/bhp-hr]

HP Bin	Technology Type							
	MO2C MP2C, MP2CA	MO2I MP2I	MO2D MP2D	MO4C MP4C	MO4I, MO4D MP4I, MP4D	MOC1	MPC1	Average
0-3	1.803	1.623	1.443	0.925	0.832	0.925	0.925	1.211
3-6	1.618	1.456	1.295	0.920	0.828	0.920	0.920	1.137
6-11	1.479	1.332	1.184	0.911	0.820	0.911	0.911	1.078
11-16	1.387	1.248	1.110	0.906	0.816	0.906	0.906	1.040
16-25	1.341	1.207	1.073	0.892	0.803	0.892	0.892	1.014
25-40	1.156	1.040	0.925	0.867	0.780	0.867	0.867	0.929
40-50	1.110	0.999	0.888	0.832	0.749	0.832	0.832	0.892
50-100	1.063	0.957	0.851	0.798	0.718	0.773	0.798	0.851
100-175	0.925	0.832	0.740	0.694	0.624	0.682	0.647	0.735
175+	0.832	0.749	0.666	0.624	0.562	0.635	0.624	0.670

Table 13. Emissions and Fuel Consumption for Inboard Engines (g/bhp-hr)

HP Bin	**Tech Type**	**HC g/hp-hr**	**CO g/hp-hr**	**NO_x g/hp-hr**	**PM g/hp-hr**	**BSFC lb/hp-hr**
≤600 hp	MS4C	5.88	153.7	5.35	0.06	0.657
	MS4D	3.02	71.8	8.48	0.06	0.567
	MSC1	1.34	41.0	1.19	0.06	0.567
	Average	**3.41**	**88.83**	**5.01**	**0.06**	**0.60**
>600 hp	MS4C	10.31	188.7	6.26	0.06	0.657
	MS4D	10.31	154.6	5.07	0.06	0.595
	MS4X	6.39	154.6	5.07	0.06	0.595
	Average	**9.00**	**165.97**	**5.47**	**0.06**	**0.62**

Table 10. NONROAD Model EF Inputs for Recreational Marine Diesel Engines

Engine Power	Model(hp)	Year Start	Tech Type	Emission Factor Modeling Inputs (g/hp-hr) HC	CO	NOx	PM	BSFC(lb/hp-hr)
hp < 11	Pre-2000	BaseM		1.5	5	10	1	0.408
	2000	T1M		0.76	4.11	5.23	0.45	
	2005	T2M		0.68	4.11	4.39	0.38	
	2009	T3M		0.43	4.11	4.39	0.24	
11 < hp < 25	Pre-2000	BaseM		1.7	5	8.5	0.9	0.408
	2000	T1M		0.44	2.16	4.44	0.27	
	2005	T2M		0.21	2.16	3.63	0.19	
	2009	T3M		0.21	2.16	3.63	0.19	
25 < hp < 50	Pre-1999	BaseM		1.8	5	6.9	0.8	0.408
	1999	T1M		0.28	1.53	4.73	0.34	
	2004	T2M		0.54	1.53	3.71	0.23	
	2009	T3M		0.41	1.53	3.71	0.18	
	2014	T4M		0.41	1.53	2.32	0.18	
50 < hp < 100	Pre-2007	BaseM		0.22	0.95	6.67	0.16	0.408
	2007	T2M		0.2	0.95	3.82	0.13	
	2009	T3M		0.2	0.95	3.82	0.13	
	2014	T4M		0.2	0.95	2.39	0.13	
100 < hp < 175	Pre-2006	BaseM		0.22	0.95	6.67	0.16	0.367
	2006	T2M		0.2	0.95	3.82	0.13	
	2012	T3M		0.13	0.95	3.34	0.088	
175 < hp < 300	Pre-2006	BaseM		0.22	0.95	6.67	0.16	0.367
	2006	T2M		0.25	0.95	4.46	0.09	
	2013	T3M		0.22	0.95	3.9	0.08	
300 < hp < 750	Pre-2006	BaseM		0.22	0.95	6.67	0.16	0.367
	2006	T2M		0.33	0.95	4.42	0.082	
	2014	T3M		0.29	0.95	3.98	0.072	
				HC	CO	NOx	PM	
	Average			0.28	0.95	5.023333333	0.10466667	
750 < hp ≤1200	Pre-2006	BaseM		0.22	0.95	6.67	0.16	0.367
	2006	T2M		0.33	0.95	4.42	0.082	
	2013	T3M		0.29	0.95	3.98	0.072	
>1200	Pre-2009	BaseM		0.22	0.95	6.67	0.16	0.367
	2009	T2M		0.33	0.95	4.42	0.082	
	2012	T3M		0.29	0.95	3.98	0.064	

An emission factor was determined by averaging all three emission factors based on year of manufacture together.

Data for Welding Emissions, Welding Emisison Factor, and Welding Emissions Calculations

Source	Type	Weight (lb/yr)	Emission Factor (lb/1000 lb)	PM_{10} (lb/yr)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Welding Wire	Mig wire 100S-1	2000	24.1	4.82E+01	2.41E-02	2.41E-02
Welding Wire	Mig wire 70S-6	4000	24.1	9.64E+01	4.82E-02	4.82E-02
Welding Wire	Mig wire Alum.4043	300	24.1	7.23E+00	3.62E-03	3.62E-03
Welding Wire	Mig Wire Alum. 5356	300	24.1	7.23E+00	3.62E-03	3.62E-03
Stick Electrodes	1/8"1018	2000	24.1	4.82E+01	2.41E-02	2.41E-02
Stick Electrodes	5/32" 1018	2000	24.1	4.82E+01	2.41E-02	2.41E-02
Stick Electrodes	5/32"7018	2000	24.1	4.82E+01	2.41E-02	2.41E-02
Stick Electrodes	5/32" 6011	200	24.1	4.82E+00	2.41E-03	2.41E-03
Stick Electrodes	308 S.S.	75	24.1	1.81E+00	9.04E-04	9.04E-04
Stick Electrodes	Carbon Rods	500	24.1	1.21E+01	6.03E-03	6.03E-03
Welding Wire	Lincoln Electrical UltraCore 71A85 .045"	330	24.1	7.95E+00	3.98E-03	3.98E-03
Welding Rod	Lincoln Electrical E7018	10	24.1	2.41E-01	1.21E-04	1.21E-04
Totals		**13715**		**3.31E+02**	**1.65E-01**	**1.65E-01**

Assumptions: Mig welding is GMAW; averaged listed emission factors all GMAW electrode/wire types

Note: Data for CY 2023 taken from CY 2020.

Estimated CY 2020 Emissions Summary from Non-permitted Sources

Emissions Sources	Criteria Pollutant Emissions, tons per year					
	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2	VOC
Aircraft Operations	9.09E+01	1.44E+01	2.49E-02	2.41E-02	3.27E+00	7.01E+01
Architectural Surface Coatings	--	--	--	--	--	4.46E+00
Asphalt Paving Operations	5.62E+00	1.69E+00	1.38E-01	1.17E-01	1.24E+00	4.50E-01
Chemical Usage	--	--	--	--	--	3.16E-02
Construction Operations	1.72E+01	3.59E+01	1.43E+01	4.67E+00	5.29E-01	7.32E+00
Consumer Products	--	--	--	--	--	3.27E+00
Fuel Spills	--	--	--	--	--	4.54E-03
Insignificant External Combustion Sources	1.63E+00	5.00E+00	7.65E-01	7.65E-01	1.56E+00	1.11E-01
Insignificant Internal Combustion Sources	4.16E+00	1.93E+01	1.37E+00	1.37E+00	1.28E+00	1.56E+00
Insignificant Storage Tanks	--	--	--	--	--	3.01E+00
Landfills	--	--	--	--	--	2.41E+00
Non-Road Vehicles	1.58E+02	6.53E+00	2.57E-01	2.39E-01	3.06E-01	2.83E+00
On-Road Vehicles	9.20E+01	1.06E+01	2.89E-01	2.63E-01	5.36E-02	8.46E+00
Open Burning/Open Detonation of Explosives	1.45E-01	8.61E-02	8.88E+01	4.34E+01	3.16E-02	6.20E-03
Smoke Testing	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Solvent Degreasers	--	--	--	--	--	5.96E-01
Training Exercises	2.52E+00	8.04E-02	1.98E-01	1.17E-01	0.00E+00	3.28E-03
Watercraft	3.16E+01	5.60E+00	2.29E-01	2.29E-01	3.49E-01	7.16E+00
Welding	--	--	1.65E-01	1.65E-01	--	--
Miscellaneous Sources	--	--	--	--	--	--
Total	**4.04E+02**	**9.92E+01**	**1.06E+02**	**5.13E+01**	**8.62E+00**	**1.12E+02**

APG Population Projections and Emissions Growth Calculations

Fiscal Year	Population	Growth Rate (%)	CO (tpy)	NOx (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)
2020	20,862	--	4.63E+02	1.16E+02	1.06E+02	5.08E+01	1.11E+01	1.29E+02
2021	21,149	1.38%	4.70E+02	1.17E+02	1.08E+02	5.15E+01	1.13E+01	1.31E+02
2022	21,162	1.44%	4.70E+02	1.17E+02	1.08E+02	5.15E+01	1.13E+01	1.31E+02
2023	21,180	1.52%	4.70E+02	1.17E+02	1.08E+02	5.16E+01	1.13E+01	1.31E+02
2024	21,082	1.05%	4.68E+02	1.17E+02	1.07E+02	5.13E+01	1.12E+01	1.31E+02
2025	20,924	0.30%	4.65E+02	1.16E+02	1.07E+02	5.10E+01	1.12E+01	1.30E+02
2026	20,924	0.30%	4.65E+02	1.16E+02	1.07E+02	5.10E+01	1.12E+01	1.30E+02

2023 Emission Inventory Analysis Baltimore/Washington International Thurgood Marshall Airport Technical Memorandum

Technical Memorandum

Introduction

HNTB was tasked to assist the Maryland Department of Transportation Maryland Aviation Administration (MDOT MAA) in support of a high-level emission inventory analysis at Baltimore/Washington International Thurgood Marshall Airport (BWI Marshall) in 2023. This technical memorandum documents the data sources, assumptions, and methodologies applied in this analysis.

BWI Marshall Airport Operations by Category

The fleet mix and operation categorization were developed using Noise and Operations Monitoring System (NOMS) data for the calendar year 2023. The NOMS data provided airlines, aircraft types, number of operations, origin/destination, and the time of operation. The total number of 2023 operations reported by NOMS is 236,155. The FAA's Operations Network (OPSNET) reported 239,417 operations in 2023. **Table 1** depicts the 2023 operations reported by OPSNET. There are a total of 239,417 itinerant operations and no local operations.

Table 1: FAA OPSNET for BWI Marshall Airport

Itinerant					Local		
Air Carrier	Air Taxi	GA	Military	Total	Civil	Military	Total
213,068	14,886	10,602	861	239,417	0	0	0

Source: FAA OPSNET, 2024.

To capture all operations at BWI Marshall Airport, operations reported by the NOMS were scaled up proportionally to match the operations reported by OPSNET by category (air carrier, air taxi, GA, and military).

Emission Inventory Model Inputs

FAA's Aviation Environmental Design Tool (AEDT) version 3g was used to estimate the emission inventory at BWI Marshall Airport in 2023. AEDT is a software system that models aircraft performance in space and time to estimate fuel consumption, emissions, noise, and air quality consequences. AEDT version 3g is the latest release when this analysis was conducted. AEDT inputs for an emission inventory study include the fleet mix, taxi times, stage length, and run-up operations. The following sections discuss each input in more detail.

Fleet Mix

The fleet mix input to AEDT includes aircraft types, engine configuration, Auxiliary Power Unit (APU), Ground Support Equipment (GSE), and the number of operations. The AEDT 3g includes engine configuration and corresponding fuel consumption data for a range of civilian and military fixed-wing aircraft and helicopters. Aircraft types reported by NOMS were converted to

representative aircraft types in AEDT 3g. Default GSE and APU for each aircraft type were used in this analysis. FAA's aircraft registry database was used to assign engine types to the NOMS aircraft types. Detailed fleet mix is shown in **Appendix A: Fleet Mix**.

Stage Length

Stage length is a fuel consumption modeling term referring to trip distance for an aircraft departure from origin to destination. The trip distance influences the take-off weight (and therefore the thrust and performance) of the aircraft, as more fuel is required to fly longer distances and therefore adds weight to the aircraft. Departure stage lengths were calculated by distances between BWI Marshall Airport and identified destinations in NOMS.

Taxi Times

Taxi times reflect the amount of time an aircraft needs to taxi from runway touchdown to a gate (arrival taxi-in time) and to taxi from a gate to takeoff (departure taxi-out time). In this analysis, the FAA Aviation System Performance Metrics (ASPM) data was used to obtain the average taxi-in and taxi-out times per operation in 2023. **Table 2** depicts the average taxi-in and taxi-out times at BWI Marshall Airport in 2023.

Table 2: 2023 BWI Marshall Airport Taxi Times

Taxi Times	Minutes
Taxi-Out	14.4
Taxi-In	6.0

Source: ASPM and HNTB analysis, 2024.

Run-up Operations

Aircraft maintenance engine run-ups can be modeled in AEDT 3g and can contribute to the overall fuel consumption. In this analysis, the run-up operations were based on the run-up operations reported by the BWI Ops. A total of three run-up operations were reported and modeled in AEDT.

Emission Inventory Model Outputs

Using the AEDT inputs described above, emission inventory by aircraft, APU, GSE, and run-up operations were estimated. **Table 3** depicts the emission inventory model outputs for BWI Marshall Airport in 2023 for National Ambient Air Quality Standard (NAAQS) Criteria Air Pollutants including Carbon Monoxide (CO), Volatile Organic Compound (VOC), Nitrogen Oxides (NO_x), Sulfur Dioxide (SO_x), and Particulate Matter ($PM_{2.5}$ and PM_{10}).

Table 3: Emission Inventory Model Outputs (in Short Tons)

Source Category	CO	VOC	NOx	SOx	PM_{10}	$PM_{2.5}$
Aircraft	1,055	152	1,043	110	8	8
APU	32	3	41	6	5	5
GSE	284	8	10	0	1	0
Total	1,371	163	1,095	116	14	13

Totals may not sum due to rounding.
Source: BWI Marshall NOMS data and HNTB analysis, 2024.

Appendix A

Fleet Mix

Table 1-1: AEDT Fleet Mix

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
1985 BUSINESS JET	TFE731-3	COMJET	1	1	-	1
Aerospatiale SA-350D Astar (AS-350)	TPE331-3	SA350D	1	4	10	14
Aerospatiale SA-355F Twin Star (AS-355)	250B17B	SA355F	1	1	1	2
Aerostar PA-60	TIO-540-J2B2	BEC58P	1	4	4	9
Airbus A220-100	PW1524G	737700	1	8	6	14
Airbus A220-100	PW1524G	737700	4	-	2	2
Airbus A220-300	PW1521G	737700	1	63	41	104
Airbus A220-300	PW1521G	737700	2	-	2	2
Airbus A220-300	PW1521G	737700	4	-	20	20
Airbus A220-300	PW1524G	737700	1	4	4	8
Airbus A300B4-600 Series	CF6-80C2A5	A300B4-203	1	15	10	25
Airbus A300B4-600 Series	CF6-80C2A5	A300B4-203	2	-	5	5
Airbus A300B4-600 Series	CF6-80CB42	A300B4-203	1	5	3	8
Airbus A300B4-600 Series	CF6-80CB42	A300B4-203	2	-	2	2
Airbus A300B4-600 Series	PW4158	A300-622R	1	59	53	111
Airbus A300B4-600 Series	PW4158	A300-622R	2	-	6	6
Airbus A300F4-600 Series	CF6-80C2A1	A300-622R	1	8	7	15
Airbus A300F4-600 Series	CF6-80C2A1	A300-622R	2	-	1	1
Airbus A300F4-600 Series	CF6-80C2A5	A300-622R	1	161	122	283
Airbus A300F4-600 Series	CF6-80C2A5	A300-622R	2	-	38	38
Airbus A300F4-600 Series	PW4158	A300-622R	1	191	185	376
Airbus A300F4-600 Series	PW4158	A300-622R	2	-	6	6
Airbus A300F4-600 Series	PW4x58	A300-622R	1	11	11	22
Airbus A318-100 Series	CFM56-5B9/2P	A319-131	1	275	95	370
Airbus A318-100 Series	CFM56-5B9/2P	A319-131	2	-	179	179
Airbus A318-100 Series	CFM56-5B9/2P	A319-131	3	-	1	1

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Airbus A318-100 Series	CFM56-5B9/2P	A319-131	4	-	1	1
Airbus A319-100 Series	CFM56-5B5/P	A319-131	1	3	2	5
Airbus A319-100 Series	CFM56-5B5/P	A319-131	3	-	1	1
Airbus A319-100 Series	CFM56-5B6/2	A319-131	1	13	-	13
Airbus A319-100 Series	CFM56-5B6/2	A319-131	2	-	12	12
Airbus A319-100 Series	CFM56-5B6/3	A319-131	1	2	-	2
Airbus A319-100 Series	CFM56-5B6/3	A319-131	2	-	2	2
Airbus A319-100 Series	CFM56-5B6/P	A319-131	1	1	1	2
Airbus A319-100 Series	CFM56-5B7/3	A319-131	1	17	2	19
Airbus A319-100 Series	CFM56-5B7/3	A319-131	2	-	15	15
Airbus A319-100 Series	CFM56-5B7/P	A319-131	1	21	10	31
Airbus A319-100 Series	CFM56-5B7/P	A319-131	2	-	10	10
Airbus A319-100 Series	CFM56-5B7/P	A319-131	3	-	1	1
Airbus A319-100 Series	V2522-A5	A319-131	1	1,096	72	1,168
Airbus A319-100 Series	V2522-A5	A319-131	2	-	610	610
Airbus A319-100 Series	V2522-A5	A319-131	3	-	312	312
Airbus A319-100 Series	V2522-A5	A319-131	4	-	107	107
Airbus A319-100 Series	V2524-A5	A319-131	1	672	2	674
Airbus A319-100 Series	V2524-A5	A319-131	2	-	331	331
Airbus A319-100 Series	V2524-A5	A319-131	3	-	225	225
Airbus A319-100 Series	V2524-A5	A319-131	4	-	117	117
Airbus A320-200 Series	CFM56-5B4	A320-211	1	34	14	48
Airbus A320-200 Series	CFM56-5B4	A320-211	2	-	16	16
Airbus A320-200 Series	CFM56-5B4	A320-211	3	-	2	2
Airbus A320-200 Series	CFM56-5B4	A320-211	4	-	2	2
Airbus A320-200 Series	CFM56-5B4/2	A320-211	1	690	477	1,167
Airbus A320-200 Series	CFM56-5B4/2	A320-211	2	-	207	207
Airbus A320-200 Series	CFM56-5B4/2	A320-211	3	-	3	3
Airbus A320-200 Series	CFM56-5B4/2	A320-211	4	-	2	2

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Airbus A320-200 Series	CFM56-5B4/2	A320-211	5	-	1	1
Airbus A320-200 Series	CFM56-5B4/3	A320-211	1	343	76	419
Airbus A320-200 Series	CFM56-5B4/3	A320-211	2	-	164	164
Airbus A320-200 Series	CFM56-5B4/3	A320-211	3	-	68	68
Airbus A320-200 Series	CFM56-5B4/3	A320-211	4	-	36	36
Airbus A320-200 Series	CFM56-5B4/P	A320-211	1	39	11	50
Airbus A320-200 Series	CFM56-5B4/P	A320-211	2	-	23	23
Airbus A320-200 Series	CFM56-5B4/P	A320-211	3	-	1	1
Airbus A320-200 Series	CFM56-5B4/P	A320-211	4	-	4	4
Airbus A320-200 Series	CFM56-5B5/P	A320-211	1	1	0	1
Airbus A320-200 Series	CFM56-5B5/P	A320-211	2	-	0	0
Airbus A320-200 Series	CFM56-5B5/P	A320-211	3	-	0	0
Airbus A320-200 Series	CFM56-5B5/P	A320-211	4	-	0	0
Airbus A320-200 Series	CFM56-5B6/P	A320-211	1	2	0	2
Airbus A320-200 Series	CFM56-5B6/P	A320-211	2	-	2	2
Airbus A320-200 Series	CFM56-5B6/P	A320-211	3	-	0	0
Airbus A320-200 Series	CFM56-5B6/P	A320-211	4	-	0	0
Airbus A320-200 Series	V2522-D5	A320-232	1	33	-	33
Airbus A320-200 Series	V2522-D5	A320-232	2	-	16	16
Airbus A320-200 Series	V2522-D5	A320-232	3	-	13	13
Airbus A320-200 Series	V2522-D5	A320-232	4	-	3	3
Airbus A320-200 Series	V2524-A5	A320-232	1	601	65	666
Airbus A320-200 Series	V2524-A5	A320-232	2	-	341	341
Airbus A320-200 Series	V2524-A5	A320-232	3	-	178	178
Airbus A320-200 Series	V2524-A5	A320-232	4	-	21	21
Airbus A320-200 Series	V2527-A5	A320-232	1	2,256	55	2,311
Airbus A320-200 Series	V2527-A5	A320-232	2	-	1,115	1,115
Airbus A320-200 Series	V2527-A5	A320-232	3	-	716	716
Airbus A320-200 Series	V2527-A5	A320-232	4	-	371	371

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Airbus A320-200 Series	V2527-A5	A320-232	5	-	1	1
Airbus A320-200 Series	V2527-A5 SelectOne? Upgrade Package	A320-232	1	11	6	17
Airbus A320-200 Series	V2527-A5 SelectOne? Upgrade Package	A320-232	2	-	4	4
Airbus A320-200 Series	V2527-A5 SelectOne? Upgrade Package	A320-232	3	-	2	2
Airbus A320-200 Series	V2527-A5 SelectOne? Upgrade Package	A320-232	4	-	0	0
Airbus A320-200 Series	V2527-A5E SelectOne? Upgrade Package	A320-232	1	0	0	1
Airbus A320-200 Series	V2527E-A5	A320-232	1	30	2	32
Airbus A320-200 Series	V2527E-A5	A320-232	2	-	14	14
Airbus A320-200 Series	V2527E-A5	A320-232	3	-	9	9
Airbus A320-200 Series	V2527E-A5	A320-232	4	-	5	5
Airbus A320-NEO	LEAP-1A26/26E1	A320-270N	1	2,011	6	2,017
Airbus A320-NEO	LEAP-1A26/26E1	A320-270N	2	-	938	938
Airbus A320-NEO	LEAP-1A26/26E1	A320-270N	3	-	562	562
Airbus A320-NEO	LEAP-1A26/26E1	A320-270N	4	-	526	526
Airbus A320-NEO	PW1124G-JM	A320-272N	1	1	1	2
Airbus A320-NEO	PW1127GA-JM	A320-270N	1	144	1	145
Airbus A320-NEO	PW1127GA-JM	A320-270N	2	-	78	78
Airbus A320-NEO	PW1127GA-JM	A320-270N	3	-	35	35
Airbus A320-NEO	PW1127GA-JM	A320-270N	4	-	30	30
Airbus A320-NEO	PW1127G-JM	A320-270N	1	1,681	8	1,689
Airbus A320-NEO	PW1127G-JM	A320-270N	2	-	869	869
Airbus A320-NEO	PW1127G-JM	A320-270N	3	-	459	459
Airbus A320-NEO	PW1127G-JM	A320-270N	4	-	356	356
Airbus A321-100 Series	V2530-A5	A321-232	1	245	175	420
Airbus A321-100 Series	V2530-A5	A321-232	2	-	49	49
Airbus A321-100 Series	V2530-A5	A321-232	3	-	21	21

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Airbus A321-100 Series	V2530-A5	A321-232	4	-	3	3
Airbus A321-100 Series	V2533-A5	A321-232	1	5	5	10
Airbus A321-200 Series	CFM56-5B2	A321-232	1	56	25	81
Airbus A321-200 Series	CFM56-5B2	A321-232	2	-	26	26
Airbus A321-200 Series	CFM56-5B2	A321-232	4	-	4	4
Airbus A321-200 Series	CFM56-5B3/3	A321-232	1	716	221	937
Airbus A321-200 Series	CFM56-5B3/3	A321-232	2	-	289	289
Airbus A321-200 Series	CFM56-5B3/3	A321-232	3	-	113	113
Airbus A321-200 Series	CFM56-5B3/3	A321-232	4	-	95	95
Airbus A321-200 Series	CFM56-5B3/P	A321-232	1	36	37	74
Airbus A321-200 Series	V2533-A5	A321-232	1	1,658	419	2,077
Airbus A321-200 Series	V2533-A5	A321-232	2	-	810	810
Airbus A321-200 Series	V2533-A5	A321-232	3	-	441	441
Airbus A321-200 Series	V2533-A5	A321-232	4	-	1	1
Airbus A321-NEO	CFM56-5B2/3	A321-232	1	309	4	313
Airbus A321-NEO	CFM56-5B2/3	A321-232	2	-	24	24
Airbus A321-NEO	CFM56-5B2/3	A321-232	3	-	20	20
Airbus A321-NEO	CFM56-5B2/3	A321-232	4	-	259	259
Airbus A321-NEO	CFM56-5B2/3	A321-232	5	-	4	4
Airbus A321-NEO	LEAP-1A35A/33/33B2/32/30	A321-232	2	-	1	1
Airbus A321-NEO	PW1133GA-JM	A321-232	1	216	-	216
Airbus A321-NEO	PW1133GA-JM	A321-232	2	-	148	148
Airbus A321-NEO	PW1133GA-JM	A321-232	3	-	65	65
Airbus A321-NEO	PW1133GA-JM	A321-232	4	-	1	1
Airbus A321-NEO	PW1133G-JM	A321-232	1	127	-	127
Airbus A321-NEO	PW1133G-JM	A321-232	2	-	84	84
Airbus A321-NEO	PW1133G-JM	A321-232	3	-	40	40
Airbus A321-NEO	PW1133G-JM	A321-232	4	-	3	3

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Airbus A330-200 Series	CF6-80E1A4	A330-301	1	27	8	35
Airbus A330-200 Series	CF6-80E1A4	A330-301	2	-	6	6
Airbus A330-200 Series	CF6-80E1A4	A330-301	3	-	3	3
Airbus A330-200 Series	CF6-80E1A4	A330-301	4	-	8	8
Airbus A330-200 Series	CF6-80E1A4	A330-301	7	-	1	1
Airbus A330-200 Series	Trent 772	A330-343	1	1	1	2
Airbus A330-300 Series	CF6-80E1A4	A330-301	1	1	1	2
Airbus A330-300 Series	CF6-80E1A4	A330-301	5	-	1	1
Airbus A330-300 Series	Trent 772	A330-343	1	1	1	2
Airbus A330-300 Series	Trent 772	A330-343	5	-	1	1
Airbus A330-900N Series (Neo)	Trent7000-72	A330-343	1	8	8	16
Airbus A340-300 Series	CFM56-5C2/P	A340-211	1	2	-	2
Airbus A340-300 Series	CFM56-5C2/P	A340-211	2	-	1	1
Airbus A340-300 Series	CFM56-5C2/P	A340-211	4	-	1	1
Airbus A340-500 Series	Trent 553-61	A340-642	1	1	-	1
Airbus A340-500 Series	Trent 553-61	A340-642	5	-	1	1
Airbus A350-1000 Series	Trent XWB-97	A350-941	1	2	1	3
Airbus A350-1000 Series	Trent XWB-97	A350-941	5	-	1	1
Airbus A350-900 series	Trent XWB-84	A350-941	1	1	-	1
Airbus A350-900 series	Trent XWB-84	A350-941	5	-	1	1
Beech 23 Musketeer Sundowner (FAS)	O-320	GASEPF	1	4	4	9
Beech 24 Musketeer Super Sierra (FAS)	IO-360-B	GASEPF	1	1	1	2
Beechcraft Bonanza 33 (FAS)	TIO-540-J2B2	GASEPV	1	1	1	2
Beechcraft Bonanza 35 (FAS)	TIO-540-J2B2	GASEPV	1	12	12	23
Bell 206 JetRanger	250B17B	B206L	1	-	1	1
Bell 407 / Rolls-Royce 250-C47B	250B17B	B407	1	2	21	23
Bell 429	TPE331-1	B429	1	30	63	93
Boeing 717-200 Series	BR700-715A1-30	717200	1	60	52	111
Boeing 717-200 Series	BR700-715A1-30	717200	2	-	8	8

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 717-200 Series	BR700-715C1-30	717200	1	6	6	12
Boeing 737-300 Series	CFM56-3C-1	737300	1	1	-	1
Boeing 737-300 Series	CFM56-3C-1	737300	2	-	1	1
Boeing 737-400 Series	CFM56-3C-1	737400	1	46	34	80
Boeing 737-400 Series	CFM56-3C-1	737400	2	-	7	7
Boeing 737-400 Series	CFM56-3C-1	737400	3	-	3	3
Boeing 737-400 Series	CFM56-3C-1	737400	4	-	1	1
Boeing 737-500 Series	CFM56-3C-1	737500	1	2	-	2
Boeing 737-500 Series	CFM56-3C-1	737500	3	-	1	1
Boeing 737-500 Series	CFM56-3C-1	737500	4	-	1	1
Boeing 737-700 Series	CFM56-7B20	737700	1	12,901	5,348	18,248
Boeing 737-700 Series	CFM56-7B20	737700	2	-	5,927	5,927
Boeing 737-700 Series	CFM56-7B20	737700	3	-	1,295	1,295
Boeing 737-700 Series	CFM56-7B20	737700	4	-	360	360
Boeing 737-700 Series	CFM56-7B22	737700	1	2,538	950	3,488
Boeing 737-700 Series	CFM56-7B22	737700	2	-	1,131	1,131
Boeing 737-700 Series	CFM56-7B22	737700	3	-	397	397
Boeing 737-700 Series	CFM56-7B22	737700	4	-	71	71
Boeing 737-700 Series	CFM56-7B24	737700	1	11,268	4,545	15,813
Boeing 737-700 Series	CFM56-7B24	737700	2	-	5,101	5,101
Boeing 737-700 Series	CFM56-7B24	737700	3	-	1,302	1,302
Boeing 737-700 Series	CFM56-7B24	737700	4	-	340	340
Boeing 737-700 Series	CFM56-7B24/3	737700	1	2,558	1,101	3,659
Boeing 737-700 Series	CFM56-7B24/3	737700	2	-	1,132	1,132
Boeing 737-700 Series	CFM56-7B24/3	737700	3	-	257	257
Boeing 737-700 Series	CFM56-7B24/3	737700	4	-	72	72
Boeing 737-700 Series	CFM56-7B24E	737700	1	431	198	629
Boeing 737-700 Series	CFM56-7B24E	737700	2	-	193	193
Boeing 737-700 Series	CFM56-7B24E	737700	3	-	27	27

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 737-700 Series	CFM56-7B24E	737700	4	-	13	13
Boeing 737-8	LEAP-1B25	7378MAX	1	185	5	190
Boeing 737-8	LEAP-1B25	7378MAX	2	-	176	176
Boeing 737-8	LEAP-1B25	7378MAX	3	-	4	4
Boeing 737-8	LEAP-1B27	7378MAX	1	1,831	627	2,458
Boeing 737-8	LEAP-1B27	7378MAX	2	-	509	509
Boeing 737-8	LEAP-1B27	7378MAX	3	-	281	281
Boeing 737-8	LEAP-1B27	7378MAX	4	-	412	412
Boeing 737-8	LEAP-1B28/28B1/28B2/28B3	7378MAX	1	16,613	6,968	23,581
Boeing 737-8	LEAP-1B28/28B1/28B2/28B3	7378MAX	2	-	5,924	5,924
Boeing 737-8	LEAP-1B28/28B1/28B2/28B3	7378MAX	3	-	2,471	2,471
Boeing 737-8	LEAP-1B28/28B1/28B2/28B3	7378MAX	4	-	1,270	1,270
Boeing 737-800 Series	CFM56-7B24	737800	1	40	22	63
Boeing 737-800 Series	CFM56-7B24	737800	2	-	11	11
Boeing 737-800 Series	CFM56-7B24	737800	3	-	7	7
Boeing 737-800 Series	CFM56-7B24/3	737800	1	725	281	1,006
Boeing 737-800 Series	CFM56-7B24/3	737800	2	-	127	127
Boeing 737-800 Series	CFM56-7B24/3	737800	3	-	320	320
Boeing 737-800 Series	CFM56-7B24E	737800	1	1,201	502	1,702
Boeing 737-800 Series	CFM56-7B24E	737800	2	-	215	215
Boeing 737-800 Series	CFM56-7B24E	737800	3	-	481	481
Boeing 737-800 Series	CFM56-7B24E	737800	4	-	3	3
Boeing 737-800 Series	CFM56-7B26	737800	1	315	199	514
Boeing 737-800 Series	CFM56-7B26	737800	2	-	72	72
Boeing 737-800 Series	CFM56-7B26	737800	3	-	30	30
Boeing 737-800 Series	CFM56-7B26	737800	4	-	16	16
Boeing 737-800 Series	CFM56-7B26/3	737800	1	162	9	171

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 737-800 Series	CFM56-7B26/3	737800	2	-	56	56
Boeing 737-800 Series	CFM56-7B26/3	737800	3	-	33	33
Boeing 737-800 Series	CFM56-7B26/3	737800	4	-	65	65
Boeing 737-800 Series	CFM56-7B26E	737800	1	655	269	925
Boeing 737-800 Series	CFM56-7B26E	737800	2	-	240	240
Boeing 737-800 Series	CFM56-7B26E	737800	3	-	99	99
Boeing 737-800 Series	CFM56-7B26E	737800	4	-	47	47
Boeing 737-800 Series	CFM56-7B27	737800	1	2,910	991	3,901
Boeing 737-800 Series	CFM56-7B27	737800	2	-	889	889
Boeing 737-800 Series	CFM56-7B27	737800	3	-	667	667
Boeing 737-800 Series	CFM56-7B27	737800	4	-	364	364
Boeing 737-800 Series	CFM56-7B27E	737800	1	11,698	5,026	16,724
Boeing 737-800 Series	CFM56-7B27E	737800	2	-	4,252	4,252
Boeing 737-800 Series	CFM56-7B27E	737800	3	-	1,721	1,721
Boeing 737-800 Series	CFM56-7B27E	737800	4	-	707	707
Boeing 737-800 Series	CFM56-7B27E/B1	737800	1	17	1	18
Boeing 737-800 Series	CFM56-7B27E/B1	737800	2	-	11	11
Boeing 737-800 Series	CFM56-7B27E/B1	737800	3	-	3	3
Boeing 737-800 Series	CFM56-7B27E/B1	737800	4	-	2	2
Boeing 737-800 Series	CFM56-7B27E/F	737800	1	12,988	5,581	18,569
Boeing 737-800 Series	CFM56-7B27E/F	737800	2	-	4,821	4,821
Boeing 737-800 Series	CFM56-7B27E/F	737800	3	-	1,793	1,793
Boeing 737-800 Series	CFM56-7B27E/F	737800	4	-	803	803
Boeing 737-800BCF	CFM56-7B24	737800	1	710	128	839
Boeing 737-800BCF	CFM56-7B24	737800	2	-	77	77
Boeing 737-800BCF	CFM56-7B24	737800	3	-	237	237
Boeing 737-800BCF	CFM56-7B24	737800	4	-	269	269
Boeing 737-800BCF	CFM56-7B26	737800	1	137	27	164
Boeing 737-800BCF	CFM56-7B26	737800	2	-	9	9

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 737-800BCF	CFM56-7B26	737800	3	-	38	38
Boeing 737-800BCF	CFM56-7B26	737800	4	-	62	62
Boeing 737-9	LEAP-1B27	7378MAX	1	7	-	7
Boeing 737-9	LEAP-1B27	7378MAX	4	-	7	7
Boeing 737-9	LEAP-1B28/28B1/28B2/28B3	7378MAX	1	795	5	800
Boeing 737-9	LEAP-1B28/28B1/28B2/28B3	7378MAX	2	-	56	56
Boeing 737-9	LEAP-1B28/28B1/28B2/28B3	7378MAX	3	-	330	330
Boeing 737-9	LEAP-1B28/28B1/28B2/28B3	7378MAX	4	-	402	402
Boeing 737-900 Series	CFM56-7B26/3	737800	1	171	-	171
Boeing 737-900 Series	CFM56-7B26/3	737800	2	-	1	1
Boeing 737-900 Series	CFM56-7B26/3	737800	3	-	163	163
Boeing 737-900 Series	CFM56-7B26/3	737800	4	-	8	8
Boeing 737-900-ER	CFM56-7B26	737800	1	77	7	84
Boeing 737-900-ER	CFM56-7B26	737800	2	-	19	19
Boeing 737-900-ER	CFM56-7B26	737800	3	-	23	23
Boeing 737-900-ER	CFM56-7B26	737800	4	-	27	27
Boeing 737-900-ER	CFM56-7B26/3	737800	1	128	5	134
Boeing 737-900-ER	CFM56-7B26/3	737800	2	-	34	34
Boeing 737-900-ER	CFM56-7B26/3	737800	3	-	36	36
Boeing 737-900-ER	CFM56-7B26/3	737800	4	-	53	53
Boeing 737-900-ER	CFM56-7B26E	737800	1	128	5	134
Boeing 737-900-ER	CFM56-7B26E	737800	2	-	28	28
Boeing 737-900-ER	CFM56-7B26E	737800	3	-	50	50
Boeing 737-900-ER	CFM56-7B26E	737800	4	-	45	45
Boeing 737-900-ER	CFM56-7B27	737800	1	262	38	300
Boeing 737-900-ER	CFM56-7B27	737800	2	-	142	142
Boeing 737-900-ER	CFM56-7B27	737800	3	-	5	5

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 737-900-ER	CFM56-7B27	737800	4	-	77	77
Boeing 737-900-ER	CFM56-7B27E	737800	1	1,421	101	1,522
Boeing 737-900-ER	CFM56-7B27E	737800	2	-	548	548
Boeing 737-900-ER	CFM56-7B27E	737800	3	-	134	134
Boeing 737-900-ER	CFM56-7B27E	737800	4	-	652	652
Boeing 737-900-ER	CFM56-7B27E/B3	737800	1	4	-	4
Boeing 737-900-ER	CFM56-7B27E/B3	737800	2	-	4	4
Boeing 737-900-ER	CFM56-7B27E/F	737800	1	53	1	54
Boeing 737-900-ER	CFM56-7B27E/F	737800	2	-	15	15
Boeing 737-900-ER	CFM56-7B27E/F	737800	3	-	12	12
Boeing 737-900-ER	CFM56-7B27E/F	737800	4	-	24	24
Boeing 747-400 Series	CF6-80C2B1F	747400	1	17	9	26
Boeing 747-400 Series	CF6-80C2B1F	747400	2	-	3	3
Boeing 747-400 Series	CF6-80C2B1F	747400	3	-	3	3
Boeing 747-400 Series	CF6-80C2B1F	747400	4	-	1	1
Boeing 747-400 Series	CF6-80C2B1F	747400	5	-	2	2
Boeing 747-400 Series	PW4056	747400	1	3	-	3
Boeing 747-400 Series	PW4056	747400	2	-	2	2
Boeing 747-400 Series	PW4056	747400	4	-	1	1
Boeing 747-400 Series	PW4056	747400	5	-	1	1
Boeing 747-400 Series Freighter	CF6-80C2B1F	747400	1	81	15	96
Boeing 747-400 Series Freighter	CF6-80C2B1F	747400	2	-	8	8
Boeing 747-400 Series Freighter	CF6-80C2B1F	747400	3	-	18	18
Boeing 747-400 Series Freighter	CF6-80C2B1F	747400	4	-	6	6
Boeing 747-400 Series Freighter	CF6-80C2B1F	747400	5	-	34	34
Boeing 747-400 Series Freighter	CF6-80C2B1F	747400	6	-	1	1
Boeing 747-8	GEnx-2B67	7478	1	1	1	2
Boeing 757-200 Series	PW2037	757PW	1	2,336	9	2,346
Boeing 757-200 Series	PW2037	757PW	2	-	2,413	2,413

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 757-200 Series	PW2037	757PW	3	-	0	0
Boeing 757-200 Series	PW2037	757PW	4	-	2	2
Boeing 757-200 Series	PW2040	757PW	1	106	0	106
Boeing 757-200 Series	PW2040	757PW	2	-	110	110
Boeing 757-200 Series	PW2040	757PW	3	-	0	0
Boeing 757-200 Series	RB211-535E4	757RR	1	1	1	2
Boeing 757-200 Series	RB211-535E4	757RR	3	-	1	1
Boeing 757-200 Series	RB211-535E4B	757RR	1	45	40	85
Boeing 757-200 Series	RB211-535E4B	757RR	3	-	1	1
Boeing 757-200 Series	RB211-535E4B	757RR	4	-	3	3
Boeing 757-200 Series	RB211-535E4B	757RR	5	-	1	1
Boeing 757-200 Series Freighter	PW2037	757PW	1	85	52	137
Boeing 757-200 Series Freighter	PW2037	757PW	2	-	0	0
Boeing 757-200 Series Freighter	PW2037	757PW	4	-	33	33
Boeing 757-200 Series Freighter	PW2040	757PW	1	7	5	12
Boeing 757-200 Series Freighter	PW2040	757PW	2	-	2	2
Boeing 757-200 Series Freighter	RB211-535E4	757RR	1	56	34	90
Boeing 757-200 Series Freighter	RB211-535E4	757RR	2	-	4	4
Boeing 757-200 Series Freighter	RB211-535E4	757RR	4	-	19	19
Boeing 757-200 Series Freighter	RB211-535E4B	757RR	1	0	0	0
Boeing 757-200 Series Freighter	RB211-535E4B	757RR	2	-	0	0
Boeing 757-300 Series	PW2043	757300	1	4	2	6
Boeing 757-300 Series	PW2043	757300	3	-	2	2
Boeing 757-300 Series	PW2043	757300	4	-	1	1
Boeing 757-300 Series	RB211-535E4	757300	1	4	1	5
Boeing 757-300 Series	RB211-535E4	757300	2	-	2	2
Boeing 757-300 Series	RB211-535E4	757300	4	-	1	1
Boeing 767-200 ER	RB211-524H	767300	1	4	2	6
Boeing 767-200 ER	RB211-524H	767300	2	-	1	1

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 767-200 ER	RB211-524H	767300	3	-	1	1
Boeing 767-200 ER	RB211-524H	767300	4	-	0	0
Boeing 767-200 Series	CF6-80C2B7F	767CF6	1	4	2	6
Boeing 767-200 Series	CF6-80C2B7F	767CF6	2	-	1	1
Boeing 767-200 Series	CF6-80C2B7F	767CF6	3	-	1	1
Boeing 767-200 Series	CF6-80C2B7F	767CF6	4	-	0	0
Boeing 767-200 Series Freighter	CF6-80A	767CF6	1	358	123	481
Boeing 767-200 Series Freighter	CF6-80A	767CF6	2	-	26	26
Boeing 767-200 Series Freighter	CF6-80A	767CF6	3	-	213	213
Boeing 767-200 Series Freighter	CF6-80A2	767CF6	1	159	88	247
Boeing 767-200 Series Freighter	CF6-80A2	767CF6	2	-	10	10
Boeing 767-200 Series Freighter	CF6-80A2	767CF6	3	-	62	62
Boeing 767-200 Series Freighter	JT9D-7R4D, -7R4D1	767JT9	1	10	8	17
Boeing 767-200 Series Freighter	JT9D-7R4D, -7R4D1	767JT9	2	-	1	1
Boeing 767-200 Series Freighter	JT9D-7R4D, -7R4D1	767JT9	3	-	1	1
Boeing 767-200 Series Freighter	JT9D-7R4D, -7R4D1	767JT9	4	-	0	0
Boeing 767-300 ER	CF6-80C2B6F	7673ER	1	40	12	52
Boeing 767-300 ER	CF6-80C2B6F	7673ER	2	-	5	5
Boeing 767-300 ER	CF6-80C2B6F	7673ER	3	-	6	6
Boeing 767-300 ER	CF6-80C2B6F	7673ER	4	-	8	8
Boeing 767-300 ER	CF6-80C2B6F	7673ER	5	-	11	11
Boeing 767-300 ER	CF6-80C2B6F	7673ER	6	-	1	1
Boeing 767-300 ER	PW4060	7673ER	1	46	-	46
Boeing 767-300 ER	PW4060	7673ER	5	-	46	46
Boeing 767-300 ER Freighter	CF6-80C2B2F	7673ER	1	704	87	791
Boeing 767-300 ER Freighter	CF6-80C2B2F	7673ER	2	-	354	354
Boeing 767-300 ER Freighter	CF6-80C2B2F	7673ER	3	-	32	32
Boeing 767-300 ER Freighter	CF6-80C2B2F	7673ER	4	-	228	228
Boeing 767-300 ER Freighter	CF6-80C2B2F	7673ER	5	-	3	3

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 767-300 ER Freighter	CF6-80C2B6F	7673ER	1	1,028	167	1,195
Boeing 767-300 ER Freighter	CF6-80C2B6F	7673ER	2	-	678	678
Boeing 767-300 ER Freighter	CF6-80C2B6F	7673ER	3	-	3	3
Boeing 767-300 ER Freighter	CF6-80C2B6F	7673ER	4	-	158	158
Boeing 767-300 ER Freighter	CF6-80C2B6F	7673ER	5	-	20	20
Boeing 767-300 ER Freighter	CF6-80C2B6F	7673ER	6	-	1	1
Boeing 767-300 ER Freighter	CF6-80C2B6F	7673ER	7	-	1	1
Boeing 767-300 ER Freighter	CF6-80C2B7F	7673ER	1	315	17	332
Boeing 767-300 ER Freighter	CF6-80C2B7F	7673ER	2	-	165	165
Boeing 767-300 ER Freighter	CF6-80C2B7F	7673ER	3	-	5	5
Boeing 767-300 ER Freighter	CF6-80C2B7F	7673ER	4	-	107	107
Boeing 767-300 ER Freighter	CF6-80C2B7F	7673ER	5	-	22	22
Boeing 767-300 Series	CF6-80A2	767300	1	3	3	6
Boeing 767-300 Series	CF6-80C2A5	767300	1	-	0	0
Boeing 767-300 Series	PW4056	767300	1	1	1	2
Boeing 767-300 Series	PW4060	767300	1	4	3	7
Boeing 767-300 Series	PW4060	767300	6	-	2	2
Boeing 767-300 Series	RB211-524H	767300	1	50	15	65
Boeing 767-300 Series	RB211-524H	767300	2	-	6	6
Boeing 767-300 Series	RB211-524H	767300	3	-	8	8
Boeing 767-300 Series	RB211-524H	767300	4	-	11	11
Boeing 767-300 Series	RB211-524H	767300	5	-	12	12
Boeing 767-300 Series	RB211-524H	767300	6	-	1	1
Boeing 767-300 Series	RB211-524H-T	767300	1	2	-	2
Boeing 767-300 Series	RB211-524H-T	767300	2	-	2	2
Boeing 767-300BCF	CF6-80C2B6	7673ER	1	398	45	442
Boeing 767-300BCF	CF6-80C2B6	7673ER	2	-	205	205
Boeing 767-300BCF	CF6-80C2B6	7673ER	3	-	11	11
Boeing 767-300BCF	CF6-80C2B6	7673ER	4	-	141	141

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 767-300BCF	PW4060	7673ER	1	89	10	99
Boeing 767-300BCF	PW4060	7673ER	2	-	32	32
Boeing 767-300BCF	PW4060	7673ER	3	-	5	5
Boeing 767-300BCF	PW4060	7673ER	4	-	27	27
Boeing 767-300BCF	PW4060	7673ER	5	-	16	16
Boeing 767-400 ER	CF6-80C2B7F	767400	1	5	3	8
Boeing 767-400 ER	CF6-80C2B7F	767400	4	-	1	1
Boeing 767-400 ER	CF6-80C2B7F	767400	5	-	1	1
Boeing 767-400 ER	CF6-80C2B8F	767400	1	1	1	2
Boeing 777-200 Series	GE90-90B	777200	1	1	-	1
Boeing 777-200 Series	GE90-90B	777200	3	-	1	1
Boeing 777-200 Series	PW4074	777200	1	1	-	1
Boeing 777-200 Series	PW4074	777200	2	-	1	1
Boeing 777-200 Series	Trent 892	777200	1	4	1	5
Boeing 777-200 Series	Trent 892	777200	2	-	1	1
Boeing 777-200 Series	Trent 892	777200	4	-	2	2
Boeing 777-200-ER	GE90-90B	777200	1	67	9	76
Boeing 777-200-ER	GE90-90B	777200	2	-	7	7
Boeing 777-200-ER	GE90-90B	777200	3	-	14	14
Boeing 777-200-ER	GE90-90B	777200	4	-	13	13
Boeing 777-200-ER	GE90-90B	777200	5	-	18	18
Boeing 777-200-ER	GE90-90B	777200	7	-	1	1
Boeing 777-200-ER	GE90-90B	777200	9	-	2	2
Boeing 777-200-LR	GE90-115B	777300	1	2	1	3
Boeing 777-200-LR	GE90-115B	777300	4	-	1	1
Boeing 777-300 ER	GE90-115B	7773ER	1	1	1	2
Boeing 787-10 Dreamliner	GEnx-1B74/75/P2	7879	1	13	-	13
Boeing 787-10 Dreamliner	GEnx-1B74/75/P2	7879	5	-	13	13
Boeing 787-10 Dreamliner	Trent 1000-M3	7879	1	13	-	13

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Boeing 787-10 Dreamliner	Trent 1000-M3	7879	5	-	13	13
Boeing 787-8 Dreamliner	GEnx-1B64/P2	7878R	1	244	-	244
Boeing 787-8 Dreamliner	GEnx-1B64/P2	7878R	5	-	244	244
Boeing 787-9 Dreamliner	GEnx-1B70/P1	7879	1	27	-	27
Boeing 787-9 Dreamliner	GEnx-1B70/P1	7879	5	-	27	27
Boeing DC-3	R-1820	DC3	1	5	3	8
Boeing DC-3	R-1820	DC3	2	-	1	1
Boeing DC-3	R-1820	DC3	3	-	1	1
Boeing KC-135R Stratotanker	CFM56-2A series	KC135R	1	1	-	1
Boeing MD-11 Freighter	CF6-80C2D1F	MD11GE	1	91	91	183
Boeing MD-11 Freighter	PW4062	MD11PW	1	3	3	6
Boeing MD-11 Freighter	PW4460	MD11PW	1	105	105	210
Boeing MD-81	JT8D-217	MD81	1	1	-	1
Boeing MD-81	JT8D-217	MD81	2	-	1	1
Boeing MD-83	JT8D-219	MD83	1	2	2	4
Bombardier Challenger 300	AE3007A1	CL600	1	598	596	1,193
Bombardier Challenger 350	AS907-2-1A (HTF7350)	CL600	1	111	114	224
Bombardier Challenger 600	CF34-3B/-3B1	CL600	1	277	276	554
Bombardier CRJ-200	CF34-3A1	CL600	1	263	264	527
Bombardier CRJ-200	CF34-3B/-3B1	CL600	1	3	3	6
Bombardier CRJ-700	CF34-3B/-3B1	CRJ9-ER	1	3	6	9
Bombardier CRJ-900	CF34-8C5	CRJ9-ER	1	1,233	1,230	2,463
Bombardier CRJ-900	CF34-8C5	CRJ9-ER	2	-	2	2
Bombardier Global 5000	BR700-710A2-20	BD-700-1A11	1	54	32	86
Bombardier Global 5000	BR700-710A2-20	BD-700-1A11	2	-	10	10
Bombardier Global 5000	BR700-710A2-20	BD-700-1A11	3	-	5	5
Bombardier Global 5000	BR700-710A2-20	BD-700-1A11	4	-	5	5
Bombardier Global 5000	BR700-710A2-20	BD-700-1A11	6	-	1	1
Bombardier Global 7500	Passport20-19BB1A	BD-700-1A10	1	24	10	34

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Bombardier Global 7500	Passport20-19BB1A	BD-700-1A10	2	-	1	1
Bombardier Global 7500	Passport20-19BB1A	BD-700-1A10	3	-	1	1
Bombardier Global 7500	Passport20-19BB1A	BD-700-1A10	4	-	5	5
Bombardier Global 7500	Passport20-19BB1A	BD-700-1A10	5	-	1	1
Bombardier Global 7500	Passport20-19BB1A	BD-700-1A10	6	-	2	2
Bombardier Global 7500	Passport20-19BB1A	BD-700-1A10	8	-	4	4
Bombardier Global Express	BR700-710A2-20	BD-700-1A10	1	140	70	209
Bombardier Global Express	BR700-710A2-20	BD-700-1A10	2	-	39	39
Bombardier Global Express	BR700-710A2-20	BD-700-1A10	3	-	8	8
Bombardier Global Express	BR700-710A2-20	BD-700-1A10	4	-	13	13
Bombardier Global Express	BR700-710A2-20	BD-700-1A10	5	-	5	5
Bombardier Global Express	BR700-710A2-20	BD-700-1A10	6	-	6	6
Bombardier Learjet 31	TFE731-2-2B	LEAR35	1	55	55	110
Bombardier Learjet 35	TFE731-2-2B	LEAR35	1	69	69	139
Bombardier Learjet 40	TFE731-2-2B	LEAR35	1	5	5	11
Bombardier Learjet 45	TFE731-2-2B	LEAR35	1	144	145	290
Bombardier Learjet 55	TFE731-3	LEAR35	1	39	39	78
Bombardier Learjet 60	PW306A	LEAR35	1	123	125	248
Bombardier Learjet 70	TFE731-3	LEAR35	1	1	1	2
Bombardier Learjet 75	TFE731-3	LEAR35	1	7	7	14
Cessna 150 Series	O-200	GASEPF	1	108	114	222
Cessna 152 (FAS)	O-200	GASEPF	1	2	2	4
Cessna 172 Skyhawk	IO-360-B	CNA172	1	90	87	177
Cessna 177 (FAS)	IO-360-B	CNA172	1	2	3	5
Cessna 177 Cardinal RG (FAS)	IO-360-B	GASEPV	1	2	2	4
Cessna 182	IO-360-B	CNA182	1	19	19	38
Cessna 182 R (FAS)	IO-360-B	CNA182	1	7	7	15
Cessna 206	TIO-540-J2B2	CNA206	1	66	62	128
Cessna 206	TIO-540-J2B2	CNA20T	1	1	2	3

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Cessna 208 Caravan	PT6A-114	CNA208	1	794	792	1,586
Cessna 210 Centurion	TIO-540-J2B2	GASEPV	1	11	11	21
Cessna 310	TIO-540-J2B2	BEC58P	1	9	9	17
Cessna 340	TIO-540-J2B2	BEC58P	1	4	4	9
Cessna 400 (FAS)	TSIO-360C	GASEPV	1	79	79	157
Cessna 402	TIO-540-J2B2	BEC58P	1	30	29	58
Cessna 414	TIO-540-J2B2	BEC58P	1	6	6	13
Cessna 421 Piston	TIO-540-J2B2	BEC58P	1	3	3	6
Cessna 441 Conquest II	TPE331-8	CNA441	1	6	5	12
Cessna 501 Citation ISP	JT15D-1 series	CNA500	1	4	5	10
Cessna 550 Citation Bravo	PW530	CNA55B	1	17	17	34
Cessna 550 Citation II	JT15D-4 series	CNA55B	1	131	132	264
Cessna 560 Citation Excel	PW530	CNA560XL	1	611	610	1,221
Cessna 560 Citation V	JT15D-5, -5A, -5B	CNA560U	1	126	124	251
Cessna 650 Citation III	TFE731-2-2B	CIT3	1	29	29	57
Cessna 680 Citation Sovereign	PW308C BS 1289	CNA680	1	154	152	306
Cessna 680-A Citation Latitude	PW306B	CNA680	1	637	636	1,274
Cessna 700 Citation Longitude	HTF7000 (AS907-1-1A)	CNA680	1	131	132	263
Cessna 750 Citation X	AE3007C1	CNA750	1	183	183	367
CESSNA CITATION 510	PW530	CNA510	1	4	4	9
Cessna CitationJet CJ/CJ1 (Cessna 525)	JT15D-1 series	CNA525C	1	83	84	166
Cessna CitationJet CJ2 (Cessna 525A)	JT15D-4 series	CNA525C	1	56	57	113
Cessna CitationJet CJ3 (Cessna 525B)	JT15D-5C	CNA525C	1	223	222	446
Cessna CitationJet CJ4 (Cessna 525C)	JT15D-5C	CNA525C	1	39	38	77
CIRRUS SF-50 Vision	JT15D-1 series	ECLIPSE500	1	121	113	234
CIRRUS SF-50 Vision	JT15D-1 series	ECLIPSE500	2	-	8	8
Cirrus SR20	IO-360-B	COMSEP	1	26	28	54
Cirrus SR22 (FAS)	TIO-540-J2B2	COMSEP	1	378	375	752
Cirrus SR22 Turbo (FAS)	TIO-540-J2B2	COMSEP	1	94	93	188

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Columbia Aircraft Lancair (COL3/4 All Types) (FAS)	TIO-540-J2B2	GASEPV	1	1	1	2
Commander 114/115 (FAS)	TIO-540-J2B2	GASEPV	1	24	26	50
Daher TBM 900 Series	PT6A-66	CNA208	1	1	1	2
Dassault Falcon 200	TFE731-3	FAL20	1	7	7	14
Dassault Falcon 2000	PW308C BS 1289	CNA750	1	373	335	708
Dassault Falcon 50	TFE731-3	FAL900EX	1	116	76	191
Dassault Falcon 50	TFE731-3	FAL900EX	2	-	27	27
Dassault Falcon 50	TFE731-3	FAL900EX	3	-	3	3
Dassault Falcon 50	TFE731-3	FAL900EX	4	-	10	10
Dassault Falcon 50	TFE731-3	FAL900EX	7	-	1	1
Dassault Falcon 900	TFE731-3	FAL900EX	1	107	61	168
Dassault Falcon 900	TFE731-3	FAL900EX	2	-	34	34
Dassault Falcon 900	TFE731-3	FAL900EX	3	-	9	9
Dassault Falcon 900	TFE731-3	FAL900EX	4	-	4	4
Dassault Mercure 100	JT8D-15	727EM2	1	19	15	34
Dassault Mercure 100	JT8D-15	727EM2	2	-	5	5
Dassault Mercure 100	JT8D-15	727EM2	3	-	1	1
DeHavilland DHC-8-100	PW120A	DHC8	1	2	2	4
Diamond DA40	IO-360-B	GASEPV	1	70	70	140
Dornier 328 Jet	PW306B	CNA750	1	9	9	18
EADS Socata TB-9 Tampico	IO-320-D1AD	GASEPF	1	2	2	4
EADS Socata TBM-700	PT6A-64	CNA208	1	77	77	155
Eclipse 500 / PW610F	PW610F	ECLIPSE500	1	20	17	37
Eclipse 500 / PW610F	PW610F	ECLIPSE500	2	-	3	3
Embraer EMB110 Bandeirante	PT6A-34	DHC6	1	1	1	2
Embraer EMB120 Brasilia	PW118	EMB120	1	1	1	2
Embraer ERJ135-LR	AE3007A1/1	EMB145	1	655	30	686
Embraer ERJ135-LR	AE3007A1/1	EMB145	2	-	615	615
Embraer ERJ135-LR	AE3007A1/1	EMB145	3	-	5	5

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Embraer ERJ135-LR	AE3007A1/1	EMB145	4	-	4	4
Embraer ERJ145	AE3007A1/1	EMB145	1	17	2	19
Embraer ERJ145	AE3007A1/1	EMB145	2	-	16	16
Embraer ERJ145-LR	AE3007A1	EMB14L	1	2	2	4
Embraer ERJ170	CF34-8E5A1	EMB170	1	546	103	649
Embraer ERJ170	CF34-8E5A1	EMB170	2	-	426	426
Embraer ERJ170	CF34-8E5A1	EMB170	3	-	20	20
Embraer ERJ170-LR	CF34-8E5	EMB170	1	156	154	310
Embraer ERJ170-LR	CF34-8E5	EMB170	2	-	2	2
Embraer ERJ175	CF34-8E5A1	EMB175	1	702	703	1,405
Embraer ERJ175-LR	CF34-8E5	EMB175	1	10	5	15
Embraer ERJ175-LR	CF34-8E5	EMB175	2	-	1	1
Embraer ERJ175-LR	CF34-8E5	EMB175	3	-	4	4
Embraer ERJ190	CF34-10E	EMB190	1	73	72	145
Embraer ERJ190	CF34-10E	EMB190	4	-	3	3
Embraer ERJ190	CF34-10E5	EMB190	1	2	-	2
Embraer ERJ190	CF34-10E5	EMB190	2	-	2	2
Embraer ERJ190	CF34-10E5A1	EMB190	1	12	6	18
Embraer ERJ190	CF34-10E5A1	EMB190	2	-	5	5
Embraer ERJ190	CF34-10E6	EMB190	1	702	702	1,404
Embraer ERJ190	CF34-8E5	EMB190	1	16	16	32
Embraer Legacy 450 (EMB-545)	AS907-3-1E-A1 (HTF7500E)	CNA510	1	114	114	228
Embraer Legacy 600	AE3007A1P	EMB145	1	10	3	13
Embraer Legacy 600	AE3007A1P	EMB145	2	-	6	6
Embraer Legacy 600	AE3007A1P	EMB145	3	-	1	1
Embraer Phenom 100 (EMB-500)	PW530	CNA510	1	49	49	98
Embraer Phenom 300 (EMB-505)	PW530	CNA55B	1	806	809	1,615
EPIC LT/Dynasty	PT6A-67A	CNA208	1	3	3	6

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Eurocopter EC 120	PT6A-27	SA341G	1	1	1	2
Eurocopter EC-130	TPE331-3	EC130	1	5	106	112
Eurocopter EC-155B1	T400-CP-400	SA365N	1	2	3	5
Fairchild SA-227-AC Metro III	PW125B	DHC6	1	2	2	4
Falcon 7X	PW307A	GIV	1	66	66	132
Glasair (FAS)	TIO-540-J2B2	GASEPV	1	2	2	4
Gulfstream Aerospace Gulfstream G500 (G-7)	PW814GA	GV	1	15	15	30
Gulfstream American GA-7 Cougar (FAS)	O-320	GASEPF	1	1	1	2
Gulfstream G150	TFE731-3	IA1125	1	35	34	68
Gulfstream G200	PW306A	CL600	1	68	67	134
Gulfstream G280	AS907-2-1G (HTF7250G)	CL601	1	75	75	151
Gulfstream G400	PW812GA	GIV	1	273	276	549
Gulfstream G-5 Gulfstream 5 / G-5SP Gulfstream G500	BR700-710A1-10	GV	1	219	218	436
Gulfstream G600	PW815GA	GV	1	37	37	74
Gulfstream G650	BR700-725A1-12	G650ER	1	76	42	118
Gulfstream G650	BR700-725A1-12	G650ER	2	-	19	19
Gulfstream G650	BR700-725A1-12	G650ER	3	-	3	3
Gulfstream G650	BR700-725A1-12	G650ER	4	-	4	4
Gulfstream G650	BR700-725A1-12	G650ER	5	-	4	4
Gulfstream G650	BR700-725A1-12	G650ER	7	-	1	1
Gulfstream III (FAS)	SPEY Mk511	GIIB	1	1	2	3
Honda HA-420 Hondajet	JT15D-4 series	CNA510	1	19	19	37
Honda HA-420 Hondajet	PW610F	CNA510	1	21	21	41
Ilyushin 76 Candid	D-30KP-2	C17	1	1	1	2
Israel IAI-1124 Westwind I	CJ610-6	IA1125	1	2	2	4
Israel IAI-1125 Astra	TFE731-3	IA1125	1	36	33	69
Kaman SH-2 Seasprite	T700-GE-401 -401C	SA330J	1	32	34	67
Mitsubishi MU-2	TPE331-10GT	DHC6	1	3	4	7

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Mitsubishi MU-300 Diamond	JT15D-5, -5A, -5B	MU3001	1	1	1	2
Mooney M20-K	TSIO-360C	GASEPV	1	31	30	60
Piaggio P.180 Avanti	PT6A-60	DHC6	1	12	12	23
Pilatus PC-12	PT6A-67B	CNA208	1	839	848	1,688
Pilatus PC-24	JT15D-5C	CNA55B	1	82	79	161
Piper PA-23 Apache/Aztec	TIO-540-J2B2	BEC58P	1	2	1	3
Piper PA-24 Comanche	TIO-540-J2B2	GASEPV	1	30	31	61
Piper PA-27 Aztec	TIO-540-J2B2	BEC58P	1	39	39	79
Piper PA-28 Cherokee Series	O-320	GASEPF	1	92	94	187
Piper PA-30 Twin Comanche	IO-320-D1AD	PA30	1	2	2	4
Piper PA-31 Navajo	TIO-540-J2B2	BEC58P	1	50	49	99
Piper PA-31T Cheyenne	PT6A-28	CNA441	1	10	10	19
Piper PA-32 Cherokee Six	TIO-540-J2B2	GASEPV	1	38	41	80
Piper PA-34 Seneca	TSIO-360C	BEC58P	1	6	6	13
Piper PA44 (FAS)	IO-320-D1AD	PA30	1	2	2	4
Piper PA46 (Piston)	TIO-540-J2B2	GASEPV	1	91	91	183
Piper PA46-TP Meridian	PT6A-42	CNA208	1	7	7	15
Piper PA46-TP Meridian	PT6A-66	CNA208	1	73	73	147
Raytheon Beech 18	R-1820	DHC6	1	2	2	4
Raytheon Beech 1900-D	PT6A-67D	1900D	1	9	9	17
Raytheon Beech 55 Baron	TIO-540-J2B2	BEC58P	1	17	17	34
Raytheon Beech 60 Duke	TIO-540-J2B2	BEC58P	1	1	1	2
Raytheon Beech 99	PT6A-28	DHC6	1	10	10	20
Raytheon Beech Baron 58	TIO-540-J2B2	BEC58P	1	156	157	313
Raytheon Beech Bonanza 36	TIO-540-J2B2	GASEPV	1	50	49	99
Raytheon Beechjet 400	JT15D-1 series	MU3001	1	290	295	585
Raytheon Hawker 1000	TFE731-3	LEAR35	1	8	8	17
Raytheon Hawker 4000 Horizon	PW308A	CNA750	1	10	10	19
Raytheon Hawker 800	TFE731-3	LEAR35	1	327	328	655

Aircraft Type	Engine Type	AEDT ANP	Stage Length	Arrival	Departure	Grand Total
Raytheon King Air 100	PT6A-28	DHC6	1	2	2	4
Raytheon King Air 90	PT6A-28	DHC6	1	46	46	91
Raytheon Premier I	JT15D-4 series	CNA55B	1	24	24	49
Raytheon Super King Air 200	PT6A-40	DHC6	1	112	111	224
Raytheon Super King Air 300	PT6A-60AG	DHC6	1	249	248	497
Robinson R22	O-320	R22	1	2	2	4
Robinson R44 Raven / Lycoming O-540-F1B5	TIO-540-J2B2	R44	1	2	4	6
Rockwell Sabreliner 65	TFE731-3	LEAR35	1	1	1	2
Ryan Navion B	TIO-540-J2B2	GASEPV	1	4	4	8
Saab 2000	AE3007A	HS748A	1	5	5	10
Sikorsky S-76 Spirit	T700-GE-700	S76	1	18	18	36
Sikorsky UH-60 Black Hawk	T700-GE-700	S70	1	-	1	1
SOCATA TBM 850	PT6A-66	CNA208	1	19	19	38
Tecnam P2006T (FAS)	O-200	PA30	1	1	2	3
Vans RV12 (FAS)	O-320	GASEPF	1	1	1	2
Vans RV4 (FAS)	O-320	GASEPF	1	1	1	2
Vans RV-7	IO-360-B	GASEPV	1	1	1	2
Zlin Aircraft Z 143 L	TSIO-360C	GASEPV	1	1	-	1
Grand Total				119,484	119,933	239,417

Source: NOMS data and HNTB analysis, 2024.