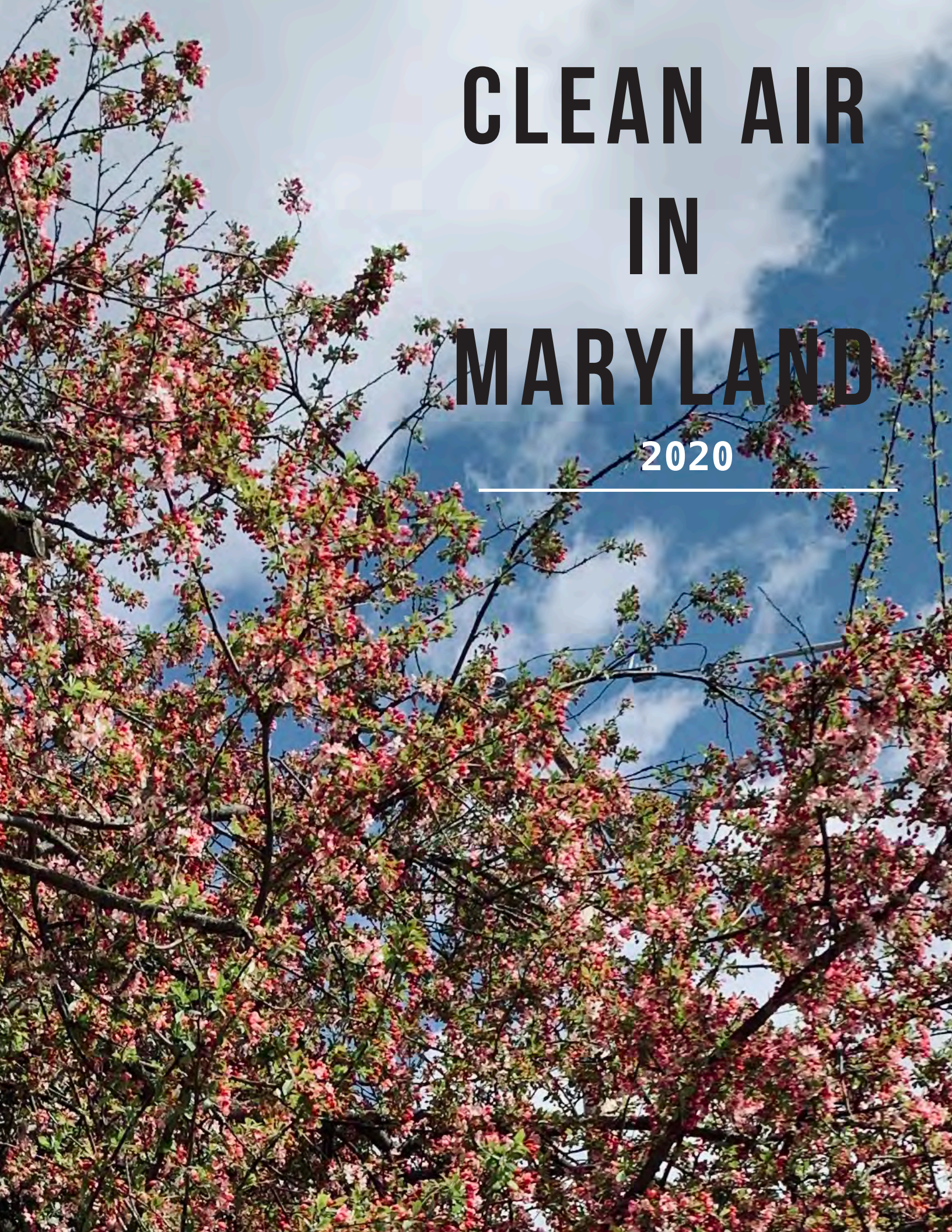


CLEAN AIR IN MARYLAND

2020

Maryland Department of the Environment
Air and Radiation Administration
1800 Washington Boulevard
Baltimore, Maryland 21230
https://mde.maryland.gov/programs/Air

CLEAN AIR HIGHLIGHTS

Maryland's air quality continues to improve. Emissions of air pollutants continue to decrease because of Maryland and federal regulations, improvements in technology and good operating practices from businesses. These impacts are experienced within the state and extend throughout the northeastern states.

For nearly 30 years, Maryland's air quality has dramatically improved. Air quality policies and regulations have lowered levels of six common pollutants — particles, ozone, lead, carbon monoxide, nitrogen dioxide, and sulfur dioxide — as well as numerous toxic pollutants. Reductions of these harmful pollutants have brought dramatic improvements in the quality of the air that we breathe. Public health is better protected. These improvements in our air quality have allowed Maryland to meet most of the national air quality standards set to protect public health and the environment.

Beyond these achievements, Maryland continues the progress towards realizing attainment of the most pervasive air pollutant, ground-level ozone or smog. In recent years, Maryland has achieved the federal 2008 ozone standard and is moving closer towards achieving the more stringent 2015 ozone standard. In 2019, Maryland recorded the second-fewest number of bad ozone days ever recorded in a year. The key impediment that affects Maryland's ability to achieve this standard is nitrogen oxide (NO_x) emissions, which are both produced locally and transported into Maryland from other states.

NO_x pollution is emitted from vehicle exhaust, and the burning of fossil fuels, especially from electric power plants. The combustion of coal at electric generating plants and industrial facilities produces a large portion of NO_x pollution as well as another pollutant, sulfur dioxide (SO_2). Thanks to regulatory efforts, particularly the Maryland Healthy Air Act and Maryland's 2015 NO_x regulation for coal-fired power plants, NO_x and SO_2 emissions from coal combustion have been reduced by 90% and 95%, respectively, since 2002.

The vast majority of Maryland has consistently measured SO_2 concentrations below the 2010 SO_2 standard, however a portion of Baltimore and Anne Arundel counties is currently designated as nonattainment for the standard. Despite the nonattainment designation, the area has consistently measured SO_2 concentrations far below the standard and is likely to be re-designated as attainment. To ensure compliance with the standard the Maryland Department of the Environment (MDE) has placed additional SO_2 limitations on emissions in the area.

Another area in Western Maryland, near a recently closed paper mill, is expected to be designated as attainment for the SO_2 standard. With this final designation, all of Maryland should comply with the health benefits of the SO_2 standard.

Since 2010, particle levels throughout the state of Maryland have met both the daily and annual air quality standards. These levels continue to trend downward each year, with 2019 levels being the lowest ever recorded. Particle levels in Maryland are at levels below what the scientific and environmental community are considering for a new, more protective national particle standard. Reductions in particle pollution are strongly linked to lower mortality rates, improvements in lung growth and development in children and lower risk for chronic lung disease in adults. Improvements in particle pollution have largely been attributed to reductions in SO_2 and NO_x from power plants and other industrial sources.

Maryland's environment continues to benefit from reduced NO_x emissions from power plants and other large industrial sources. Reducing NO_x emissions not only helps reduce ozone and fine particle air pollution but also helps reduce nitrogen deposition to the Chesapeake Bay and regional haze. About one-third of the nitrogen pollution in the bay comes from airborne nitrogen deposition.

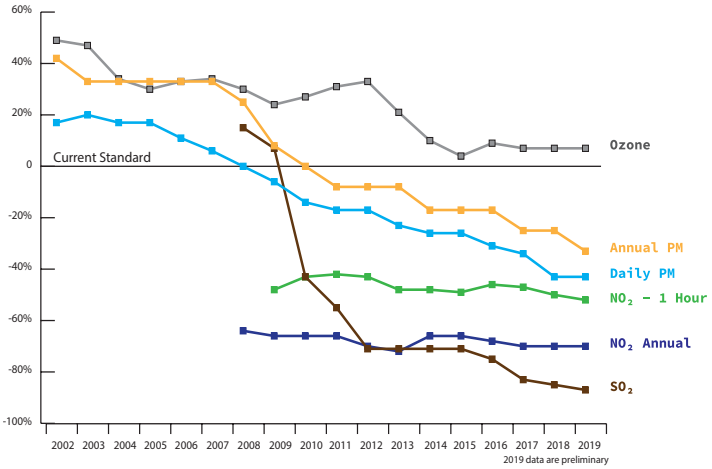
Transportation programs and policies designed to reduce NO_x emissions, like the Maryland Clean Car Program and the Tier 2 and 3 Vehicle and Fuel Standards, have resulted in significant air quality benefits, including the mitigation of greenhouse gas (GHG) emissions that contribute to climate change.

The state continues to be a leader in addressing climate change. With 3,100 miles of tidal shoreline, many of which include sensitive ecosystems, Maryland is disproportionately vulnerable to sea-level rise, one of the major consequences of climate change. In response, the state has adopted the Greenhouse Gas Emission Reduction Act (GGRA) and MDE, working with the Maryland Climate Change Commission, has developed a framework to address the issue. MDE is preparing a final plan to reduce GHG emissions by at least 40% by 2030 compared to a 2006 baseline.

In addition to regulating emissions from specific sources, Maryland is also engaged in several legal actions designed to reduce air pollution from other states and to strengthen federal policies that are critical to support our efforts. For more information about air quality in Maryland: https://mde.maryland.gov/air

Concentrations of Harmful Pollutants Continue to Decline

While ozone air pollution is a persistent problem in Maryland, all other air pollutants are below federal standards and concentrations continue to drop across the state. Ozone levels also continue to get lower and lower each year. The following chart illustrates the concentrations of air pollutants relative to the current National Ambient Air Quality Standard (NAAQS) for Maryland.



NITROGEN DIOXIDE (NO_2) ANNUAL ↓ 16% (FROM 2008)

NITROGEN DIOXIDE (NO_2) 1-HOUR ↓ 8% (FROM 2009)

OZONE (O_3) ↓ 21%

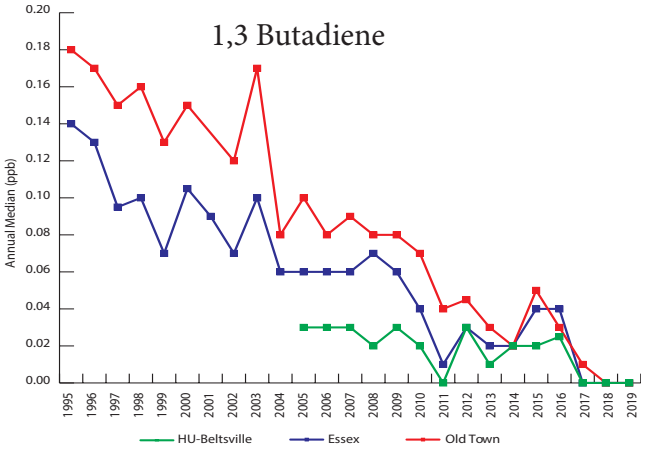
PARTICLES ($PM_{2.5}$) ANNUAL ↓ 53%

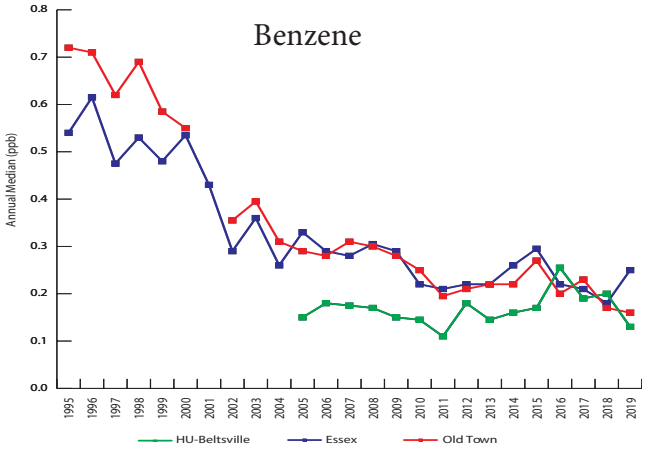
PARTICLES ($PM_{2.5}$) 24-HOUR ↓ 51%

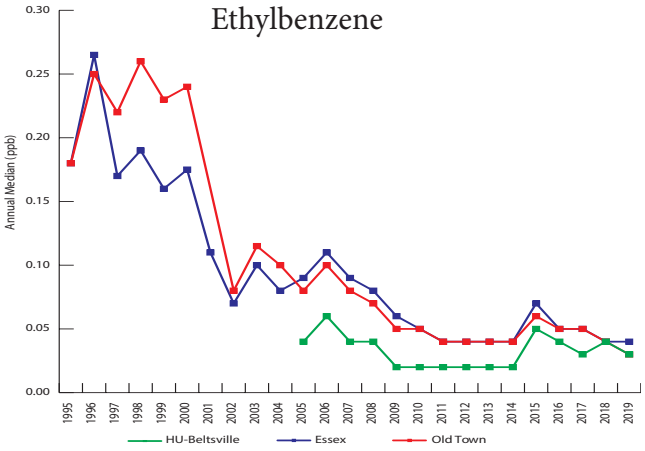
SULFUR DIOXIDE (SO_2) 1-HOUR ↓ 88%

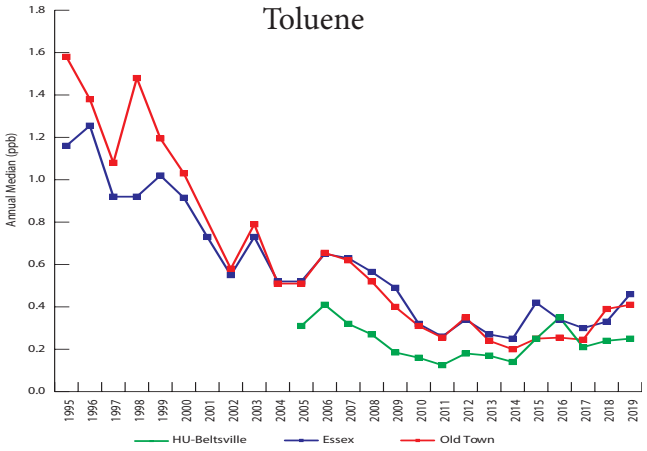
The Levels of Air Toxics Have Been Significantly Reduced

Hazardous air pollutants (sometimes called air toxics) are those known to cause cancer and other serious health impacts. Over the last 25 years, Maryland has generally cut concentrations of air toxics by 50%. Examples of the progress Maryland has seen are shown with the four toxic air pollutants below: 1,3 Butadiene, Benzene, Ethylbenzene, and Toluene. All four compounds show more than a 50% reduction in concentration. 1,3 Butadiene, a compound mostly associated with vehicle exhaust, has been essentially eliminated in recent years. While there is work to be done on other compounds, generally a downward trend continues and MDE is committed to further reducing toxic air pollution.







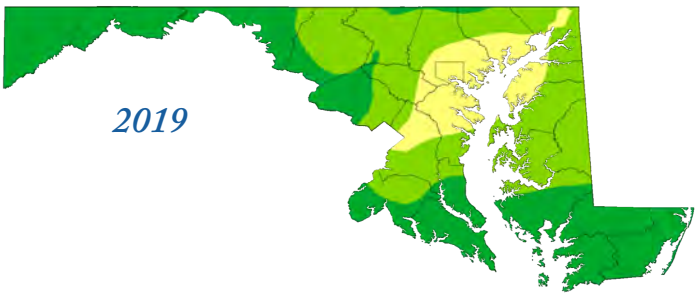


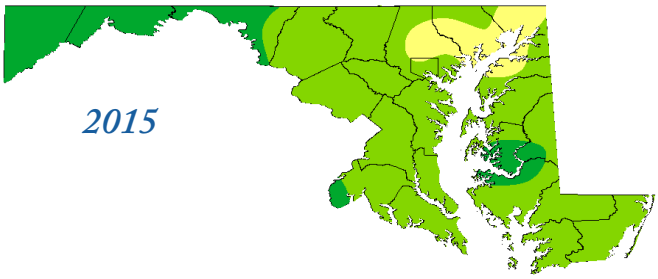
Severe, Multi-day Ozone Episodes Are Fewer, Sporadic and Briefer

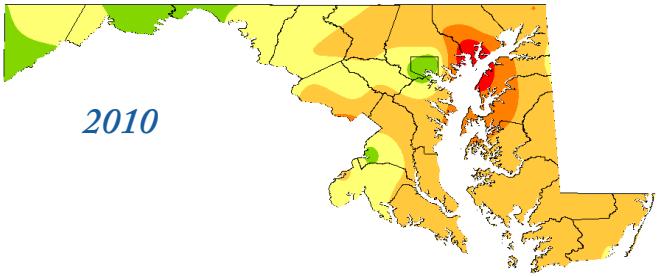
The 2019 ozone season continued the trend of cleaner air across the state. In 2019, Maryland air quality monitors recorded ozone concentrations greater than the NAAQS of 70 parts per billion (ppb) on just 14 days. The only year that experienced fewer ozone days than 2019 was 2014, when there were only 11 days with ozone concentrations above the NAAQS. Historically, on most days when high levels of ozone occurred, numerous air quality monitors throughout the state would record unhealthy ozone pollution. As air quality continues to improve, the concentration of pollution, geographic scope and duration of ozone episodes have been dramatically reduced. In 2019, half of the 14 days that ozone exceeded the NAAQS involved just one or two of the 20 ozone monitors located in Maryland. This indicates that those ozone exceedances were only occurring in a small area and that the majority of the state was observing ozone concentrations in the moderate or good range.

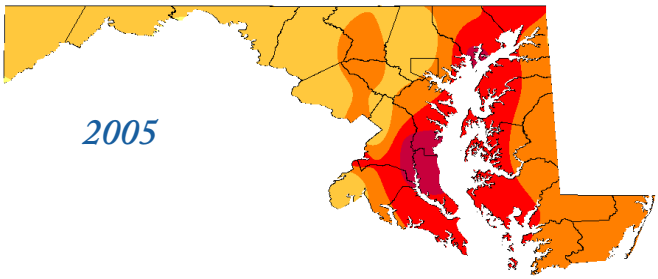
Variations in weather conditions play an important role in determining ozone concentrations. Precipitation across Maryland saw a unique split between the first half and second half of the 2019 ozone season. The first half of the season experienced above average rainfall with ozone transport patterns mostly unfavorable for high ozone concentrations. The first day where ozone in Maryland climbed above the NAAQS was not until June 26, setting a record as the latest initial ozone exceedance day by more than a month. High ozone patterns became more common during the second half of the season as weather conditions began to dry out. The total number of days during the ozone season when the maximum temperature reached or exceeded 90°F at Baltimore/Washington International Thurgood Marshall Airport was 59, nearly double the typical average. However, despite temperatures well above average across the state, a near-record low number of days above the ozone NAAQS occurred.

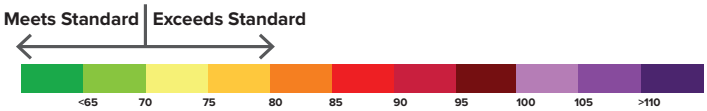
The maps to the right illustrate the improving ozone air quality over the past 19 years. In 2000, the dark reds and purples indicate pervasive high ozone concentrations throughout Maryland. Improvements occurred as federal and state policies were implemented to reduce ozone forming emissions. The areas in yellow and orange above the ozone NAAQS continue to shrink, illustrating the continued success of these programs. These maps also demonstrate a large reduction in the health risk from ozone as both ozone concentrations and spatial exposure have been greatly reduced.

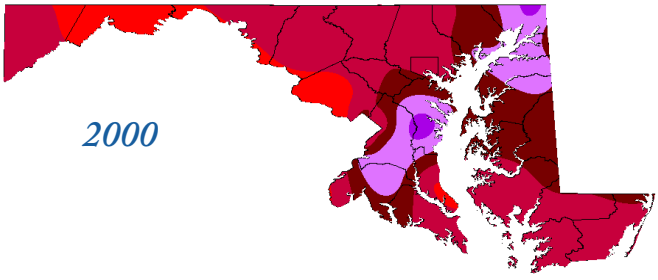












NO_x Reductions from Coal-Fired Power Plants

Coal-fired power plants have significantly reduced NO_x emissions over the past 20 years. Federal pollution trading programs and state driven NO_x reduction programs have resulted in reduced average NO_x emissions during the ozone season. Beginning in 2009, Maryland's Healthy Air Act imposed strict annual and ozone season NO_x, SO_2, and mercury emission limits on Maryland's largest power plants.

Maryland's 2015 NO_x regulation for coal-fired power plants built upon the Maryland Healthy Air Act by requiring power plants to minimize NO_x emissions every day of the ozone season by optimizing and operating existing pollution control equipment and by lowering emission rates to achieve increasingly stringent standards by 2020. During the 2020 ozone season, coal-fired power plants will need to be controlled by state-of-the-art Selective Catalytic Reduction (SCR) control technology, convert to cleaner natural gas or meet stringent system-wide NO_x emission limits equivalent to those achieved by SCR controls on all units.

Since the 2015 rule was implemented, Maryland's coal-fired power plants have recorded their lowest NO_x emissions ever. As more electricity is generated by renewable energy sources or by using cleaner fuels like natural gas, dependence on coal-fired generation will decrease.

Municipal Waste Combustors

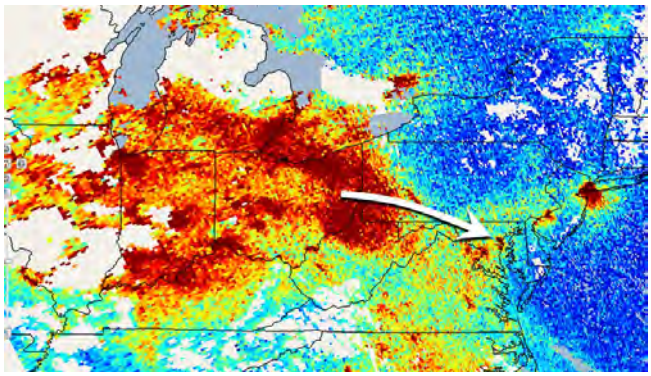
On December 6, 2018, MDE adopted updated regulations for municipal waste combustors. These new regulations require that Maryland's two large incinerators (Wheelabrator Baltimore, Inc. and Montgomery County Resource Recovery Facility) meet stringent NO_x emission rates, which will result in the reduction of approximately 200 tons of NO_x emissions each year. These regulations were developed to address federal Clean Air Act (CAA) statutes that require Maryland to update Reasonably Available Control Technology (RACT) regulations.

As part of the regulatory requirements, Wheelabrator was required to develop a feasibility analysis of new control technologies that could further reduce NO_x emissions. Wheelabrator submitted the analysis to MDE on December 27, 2019, for review and consideration of potential new NO_x emission limits for the facility.

Observing Air Quality with Satellites

A modern approach to studying air pollution is with the use of satellite imagery. Satellites are now used to track pollution moving across the country from one state to another. MDE has been collaborating with the scientific community for more than 20 years in an effort to address the state's air quality concerns. Most recently, MDE has been collaborating with the National Aeronautics and Space Administration (NASA) to determine how new satellites can be used to understand, track, and pinpoint air quality issues. The Tropospheric Ozone Monitoring Instrument (TROPOMI) has been the latest in a series of satellites that are revolutionizing the way regulatory agencies monitor air quality. TROPOMI gives the best satellite resolution to date of nitrogen dioxide, a key ozone precursor, allowing researchers to visualize air pollution in great detail, sometimes even identifying individual polluting facilities.

As an example of how satellites are currently assisting state agencies such as MDE, below is a snapshot of the eastern United States on July 1, 2019, the day before a widespread ozone event on July 2, 2019, in the Mid-Atlantic region. The satellite image clearly shows long range transport of NO_2 (red/warm colors in the image) from the Midwest towards the East Coast contributed to the high-ozone event.



One current limitation of these satellites is that only one picture of an area per day is taken, giving a "snapshot" in time. While informative, this snapshot misses daily pollutant and emissions variability. NASA is now preparing for the 2022 launch of the Tropospheric Emissions: Monitoring Pollution (TEMPO) satellite. TEMPO will provide unsurpassed, daylight coverage of pollution in the atmosphere. Current satellites such as TROPOMI are polar orbiting, meaning they track over the North Pole and South Pole 24 times a day while the earth rotates beneath them. By contrast, TEMPO will be a geostationary satellite that will remain stationary in relation to a fixed point on the surface, allowing pollution to be tracked hour by hour.

CLEAN AIR AND TRANSPORTATION

Cars today and the fuels that power them are significantly cleaner than they were just a decade ago. However, there are more vehicles on Maryland roads now, and those numbers will continue to increase. We are also now driving more miles commuting to work and for recreation than we have in the past. With the growth in the number of vehicles on the road and reductions from power plant emissions, pollution from mobile sources are now the largest contributing source category to Maryland's ozone and climate change problems. Despite these challenges, Maryland has been at the forefront in regulating ozone-forming and toxic pollutants from vehicles and fuels and will continue to drive down emissions from this category.

Changes to the vehicles we drive and the fuels that power them have had a significant impact on reducing ozone, GHGs and toxic emissions. In 2007, MDE adopted regulations implementing the California Clean Car emissions standards for new vehicles that dramatically lowered the amount of emissions coming from the tailpipe as the fleet turns over. Adopting the California program reduced tailpipe emissions from our cars more than the existing federal standards at that time. This program also was the first to reduce GHG emissions while improving fuel economy. Additionally, MDE worked with other state and regional stakeholders to get the federal government to adopt national fuel economy standards that mirrored California's, providing further reductions in harmful pollutants. The federal government has recently finalized a rule to rollback these new car emission standards. MDE will continue to fight to maintain these important health and environmental benefits.

The gasoline used in our vehicles has also changed and is providing significant air quality benefits. Reformulated gasoline (RFG) is used in much of Maryland. RFG is blended to burn more cleanly than conventional gasoline and to reduce smog-forming and toxic pollutants in the air we breathe. RFG also reduced the amount of benzene in gasoline. In 2017, the sulfur level in gasoline was also lowered. This sulfur reduction is important because it will make emissions control systems, like the catalytic converter, more effective and allow the development and use of more advanced emissions controls.

Mobile Source Related Federal Rollbacks

Recent federal vehicle rules introduced by the EPA and the National Highway Traffic Safety Administration, known as the Safer Affordable Fuel-Efficient (SAFE) Vehicle Rule, will result in a weakening of existing auto emission standards adopted by previous administrations. Along with reducing the stringency of GHG emission standards for vehicles, EPA sought to remove California's, and the other states that have adopted California's Low Emission Vehicle (LEV) Program, authority to enforce GHG emission standards as well as the Zero Emission Vehicle (ZEV) standards. EPA's Final Rule intends to withdraw the waiver EPA granted to California and the other states that have opted into the California program to enforce provisions of California's LEV Program that relate to GHG emissions and the ZEV Program. Removing Maryland's ability to enforce these programs drastically impacts our efforts to transition to a cleaner, zero, or near-zero emission transportation sector. California, Maryland and other states have

challenged EPA over the rollback of previously adopted standards and its authority to revoke the California waiver. Numerous states have recently begun efforts to adopt California's Clean Car Standards, including adopting the ZEV standards. Once all of these states have adopted the rules, the total number of states with California's emission standards will rise to 16, as well as Washington D.C.

The Volkswagen Mitigation Plan

As a result of Volkswagen violating the CAA by installing software designed to defeat vehicle emissions standards, numerous legal settlements required the automaker to buy back or modify affected vehicles and mitigate pollution through investments that support ZEV technology. Under Maryland's portion of the settlement agreement, Maryland is eligible to authorize spending of $75.7 million for specifically defined mitigation projects to remediate the excess NO_x emissions. Maryland's mitigation plan places priority on electric vehicle charging infrastructure and the replacement of older, dirty diesel engines with new, cleaner technologies. Electric buses and heavy-duty equipment such as trucks, boats and locomotives are also potential projects that are eligible for funding. Maryland's first phase of the program funds electric and propane school buses. MDE hopes to have all mitigation effort awards announced by the end of summer 2020.

Port of Baltimore Inter-Agency Partnership

The Maryland Department of Transportation (MDOT), the Maryland Port Administration (MDOT-MPA) and MDE continue to work on efforts to reduce emissions and increase energy efficiency at and around the Port of Baltimore. MDOT-MPA received a $1.8 million EPA Diesel Emission Reduction Act (DERA) grant to continue with the replacement of dray trucks, cargo handling equipment, and cranes.

To date, more than $19 million has been invested into diesel emission reduction activities at the port. These projects will reduce thousands of tons of air pollutants including NO_x, fine particles, hydrocarbons and carbon monoxide. These projects result in significant reductions in GHG emissions, primarily carbon dioxide (CO_2) and black carbon. Part of the Volkswagen mitigation funding will be used for port projects.

The partnership continues to engage with community groups, give tours to community members, invite private port tenants to the workgroup's meetings, and participate in the Baltimore Port Alliance Environmental Committee's compliance assistance efforts.

Idle Free Maryland

Since 2018, MDE has run its Idle Free MD program, a partnership between the state, the private sector and Maryland schools. The program is designed to reduce unnecessary idling of vehicles. MDE is working with individual schools, many of which are Green Schools, to assist in implementing their own idle reduction strategies. Green Schools is a program administered by the Maryland Association for Environmental and Outdoor Education (MAEOE) that empowers youth, communities and schools to evaluate and improve their efforts in environmental sustainability. In addition to working with Maryland schools, MDE has been actively working with the Maryland Motor Truck Association (MMTA) through education and outreach to drivers in implementing idle reduction strategies.

Program resources are available to help spread the word about the health, economic and environmental benefits of reducing vehicle idling. The campaign includes a toolkit with a variety of products, including fact sheets, social media materials, pledge sheets, posters, policies and other material. For more information and the toolkit: https://mde.maryland.gov/programs/Air/MobileSources/idlefreeMD/Pages/index.aspx.

LEGAL EFFORTS TO ADDRESS TRANSPORTED AIR POLLUTION

For many years, Maryland has been actively engaged in numerous efforts to reduce the amount of air pollution crossing into our communities from neighboring states. Up to 70% of ozone and fine particle air pollution in Maryland originates in an upwind state. Cooperative efforts through regional planning organizations, support and participation in the development of national rules addressing transported pollution and leading by example have helped to reduce transported pollution, but more regional efforts are required for Maryland to meet our clean air goals. After exhausting cooperative means to achieve clean air, Maryland has engaged in several legal actions designed to reduce air pollution from other states and to strengthen federal policies that are critical to support our efforts.

One of the tools in the CAA for addressing transported pollution is Section 126. Section 126 gives a state the authority to ask EPA to set emissions limits for specific sources of air pollution in other states that significantly affect the air quality in the petitioning state. In 2016, Maryland submitted a 126 petition to EPA requesting that it require 19 power plants with 36 generation units in five upwind states to run their already installed pollution control technology. EPA denied Maryland's 126 petition, and on October 15, 2018, Maryland sued EPA in the United States Court of Appeals. Maryland's 126 petition clearly demonstrates that there are large, immediately available and cost-effective NO_x emissions reductions that can be achieved by requiring upwind power plant units to run their pollution controls effectively every day during the summer ozone season.

Maryland has also petitioned the Ozone Transport Commission (OTC) under Section 184(c) of the CAA in an attempt to further address regional transported air pollution. Under Section 184(c), any state within the Ozone Transport Region (OTR) may petition the OTC to develop recommendations for additional control measures to be applied within all or a part of the OTR. Section 184 of the CAA itself established a single transport region for ozone—the OTR— covering portions of the northeast and mid-Atlantic. Maryland completed an analysis of excess emissions from Pennsylvania coal-fired power plants in 2017 and 2018 and concluded that Pennsylvania air quality rules still allow excess NO_x emissions on a daily basis, up to an excess of 47 tons per day.

In 2016, EPA finalized an update to the Cross-State Air Pollution Rule (CSAPR) which is intended to reduce summertime NO_x emissions from power plants in 22 states in the eastern U.S. and reduce air quality impacts of ozone pollution that crosses state lines. Maryland joined with many other East Coast states and sued EPA over a related rule called the CSAPR Closeout. This case has already been heard by the courts. In general, the courts have ruled on two key issues: that the CSAPR rule did not fully address transport and that the CSAPR Closeout rule could not be used by upwind states as a complete transport remedy. EPA has been required to fix the issues identified by the courts as being illegal.

ADDRESSING CLIMATE CHANGE IN MARYLAND

Greenhouse Gas Reduction Efforts

Maryland is facing significant challenges in dealing with climate change. As a state, we are lowering our GHG emissions and working on building the capacity to adapt to the consequences that climate change has already caused. Maryland is proud to be a leader in the effort to tackle global climate change issues. Our state leadership has passed two laws that require aggressive action on stemming climate change. The most current law, passed in 2016, reauthorized the GGRA. Through this law, MDE is in the process of finalizing a detailed and comprehensive plan to reduce our GHG emissions by a minimum of 40% from 2006 levels by 2030 while positively impacting the state's economy and creating jobs. The draft plan also begins to establish a road map for the state to achieve much deeper reductions, or carbon neutrality, by the 2050 timeframe.

In 2019 and early 2020, MDE drafted and submitted a comprehensive, economy-wide plan to dramatically reduce emissions of GHGs that contribute to climate change. The plan will set Maryland on an ambitious path and serve as a model for how the nation can respond to climate change while also supporting economic growth. The draft plan incorporates a comprehensive set of more than 100 measures designed to reduce GHG emissions, including investments in energy efficiency and clean and renewable energy solutions, widespread adoption of electric vehicles, and improved management of farms and forests. The draft plan also supports new industries and technologies by encouraging investment in the energy and transportation sectors. MDE estimates that the plan will drive as much as $11.54 billion in increased economic output in the state by 2030, and the creation of more than 11,000 jobs as a result of these proposals.

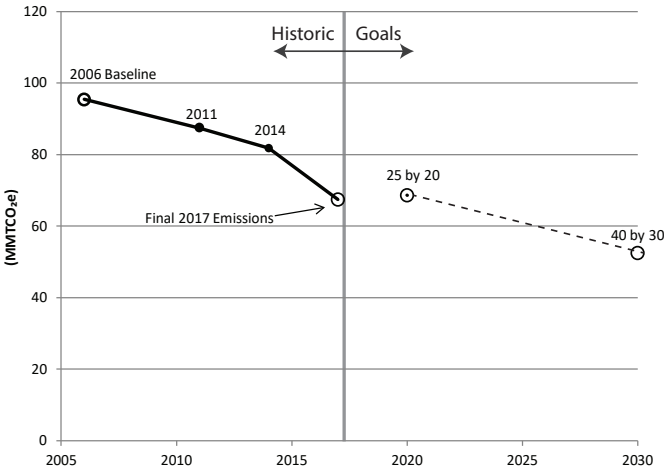
The draft 2020 GGRA Plan uses various strategies, programs, and initiatives that the state is developing and implementing to meet the emissions reduction and economic benefit goals. Some of these strategies are already being fully implemented, while others are in an earlier phase of the implementation process. The suite of programs covers multiple sectors, including electricity, transportation, agriculture, forestry, buildings, waste management, and additional non-specific sectors. The plan also includes many partnerships with key stakeholders like the private sector, underserved communities, state universities, and the Port of Baltimore.

The key programs included in the 2020 plan will build off of previous plans. Maryland's actual GHG emissions in 2017, which brought favorable weather (less demand for electricity to heat and cool buildings) indicate that we are meeting our GHG reduction goals. These results are encouraging but continued progress is necessary to ensure we maintain reductions to 2030.

The core programs in previous plans, along with recommended new programs, voluntary and nontraditional programs, outreach efforts to build public awareness and promote voluntary action, and new technologies, will all contribute to the state's goal of reducing GHG emissions by 40% by 2030. Programs of note include a Clean and Renewable Energy Standard which requires that an increasingly larger share of Maryland's electricity be generated by zero– and low–carbon resources, expanding the Regional Greenhouse

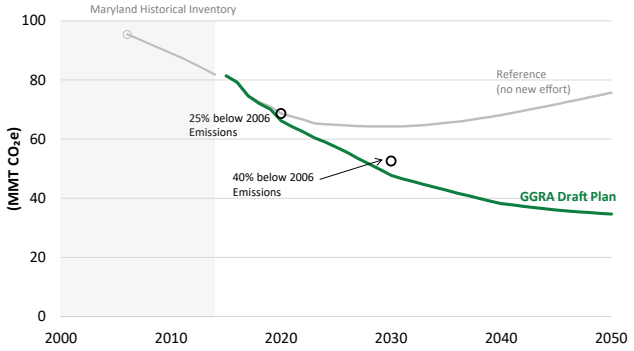
Gas Initiative (RGGI) cap and invest program, public transit expansion, promoting and incentivizing cleaner cars through the ZEV mandate. Also, continuing to support EmPOWER Maryland which reduces electricity consumption, passing regulations to phase out the most harmful hydrofluorocarbons (HFCs) in foam products and refrigeration equipment, as well as several important nature-based programs that remove carbon from the atmosphere and sequester it in trees and soil.

Maryland GHG Emissions, Accounting for Sequestration.
Note favorable weather drove additional reductions in 2017



MDE will submit a report in 2022 describing the state's progress toward achieving both the currently mandated GHG reductions, and the long-term goals as defined by the most up-to-date science regarding emissions reductions needed by 2050 to avoid the most dangerous impacts of climate change.

Maryland GHG Emissions, Accounting for Sequestration



Even as Maryland moves ahead with actions to reduce GHGs, some consequences of climate change are already under way and will get worse in the future. Maryland is simultaneously working to adapt to climate impacts through adaptation and resiliency programs.More detail on some of the key strategies included in the draft plan are described below.

Energy: Maryland passed the Clean Energy Jobs Act (CEJA) in May 2019, which sets a 50% renewable portfolio standard (RPS) by 2030. CEJA carves out 14.5% of this target for solar development and mandates 1.2 GW of offshore wind solicitations. Governor Hogan is looking to propose legislation next year to put Maryland on a path of 100% clean electricity by 2040 through the Clean and Renewable Energy Standard. This initiative would require that an increasingly large share of Maryland's electricity be generated by zero – and low-carbon resources. Maryland is a member of RGGI, where emissions from the energy sector are reduced over time and auction proceeds fund various state and local programs which promote energy efficiency, renewable energy, bill assistance, or other consumer benefits.

Energy Efficiency: Maryland's EmPOWER Energy Efficiency Program charges utility customers a monthly fee that is used to fund programs like lighting and appliance rebates for homeowners, energy efficiency services for industrial facilities, home energy assessments, among other incentives. Maryland's Weatherization Assistance Program helps eligible low-income households with the installation of energy conservation materials. Maryland's energy efficiency resource standard targets 2.9% average incremental electric savings per year through 2018. Maryland's GGRA draft plan proposes to incentivize increased deployment of efficient electric heat pumps to heat homes in Maryland. In June 2019, Governor Hogan signed an executive order directing two agencies to develop an initiative to reduce energy consumption in state buildings by 10% by 2029.

Transportation: Maryland is a member of the Transportation Climate Initiative (TCI), a regional effort of 11 Northeast and Mid-Atlantic states and Washington, D.C. working to reduce GHG emissions from the region's transportation sector. Maryland continues to cooperate with the other TCI states to develop a regional cap-and-invest program for transportation fuels building from the successful cap-and-invest program for energy already being implemented through RGGI. Maryland is also a member of the multi-state ZEV Task Force that has a goal of having 60,000 ZEVs on the road by 2020 and 300,000 ZEVs on the road by 2025. To help develop the market for ZEV/electric vehicles, Maryland offers the Maryland Excise Tax Credit of up to $3,000 and a rebate of up to 40% for electric vehicle infrastructure through the Maryland Electric Vehicle Supply Equipment Rebate. The Maryland Clean Cars Program, discussed above, also achieves significant GHG emission reductions.

Resilience: The CoastSmart Communities Program assists Maryland's coastal communities to address short- and long-term coastal hazards, such as sea level rise, by providing technical assistance and training opportunities, along with financial assistance through the Community Resilience Grant Program. In 2018, Maryland launched the Climate Leadership Academy to provide climate training and support to state and local government officials, citizens, the private sector, and nonprofits.

Climate Finance: The Maryland Energy Administration's Energy Finance Initiative is a collection of programs, financing tools, and other resources that help fill the funding needs of clean energy projects. For example, the Solar Canopy Grant Program combines Maryland's RPS goal for solar with the state's ongoing support of electric vehicle infrastructure. This program aims to capture the unrealized potential of existing parking facilities by installing solar photovoltaics while still allowing parking services to be offered.

Natural and Working Lands: Maryland established the Maryland Healthy Soils Program to increase biological activity and carbon sequestration

in the state's soils by promoting practices based on emerging soil science, through incentives, research, education, technical assistance, and financial assistance for farmers. Maryland is using sustainable forestry management practices to capture carbon in public and private Maryland forests. These programs aim to improve sustainable forest management on about 30,000 acres of private land annually and on all state-owned resource lands and to ensure all state forest lands will be third-party certified as sustainably managed.

Just Transition: MDE and the Regional Economic Studies Institute of Towson University evaluated the economic dislocations resulting from potential carbon mitigation strategies in the state, including direct impacts to fossil-fuel-reliant workers, fiscal impacts resulting from industry changes at the local level, and other related disparities associated with the state's efforts to reduce GHG emissions. To meet objectives set in the state's 40 by 30 plan, MDE requested strategies for transitioning impacted fossil-fuel-reliant workers and mitigating other economic dislocations associated with GHG reduction efforts.

Short-Lived Climate Pollutants: The increased use of natural gas in homes and businesses, as well as the increased demand for air conditioning and refrigeration globally, has been linked to rising emissions of highly potent GHGs. As a result, Maryland has initiated regulatory efforts to reduce leaking methane emissions from the natural gas industry, the distribution sector and landfills, and to ban certain highly potent HFCs. Working in collaboration with the United States Climate Alliance, the business community, and environmental advocates, Maryland may adopt regulations to curb methane and HFC emissions by the end of the year. When the new rules are in place, MDE estimates a potential reduction of up to 40% of the currently reported methane emissions in the natural gas transmission and storage segment and up to a 25% reduction of HFC emissions. Furthermore, Maryland has begun discussions with stakeholders and utility companies and municipal solid waste landfill operators to begin the process to adopt GHG mitigation strategies for leaking pipes and landfill gas.

ONGOING AIR QUALITY & CLIMATE CHANGE RESEARCH

For more than 30 years, MDE and the University of Maryland College Park (UMCP) have worked in partnership to conduct policy-relevant research on air quality and climate change. This partnership has often involved collaboration with other partners like NASA, the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and other universities like Howard University and the University of Maryland Baltimore County. This collaborative research effort has led to some of Maryland's and the nation's most successful efforts to reduce air pollution and protect public health.

During the summer of 2018, the Ozone Water-Land Environmental Transition Study (OWLETS-2) measurement campaign took place. This was an intensive collaborative effort to study air quality in and around the northern Chesapeake Bay. MDE and scientists from NASA, NOAA, and several local universities took air quality measurements from various locations in and around the bay. These measurements provided a much needed three-dimensional view of air pollution over and surrounding the bay and has helped scientists better understand how pollutant levels are affected by the land-water interface.

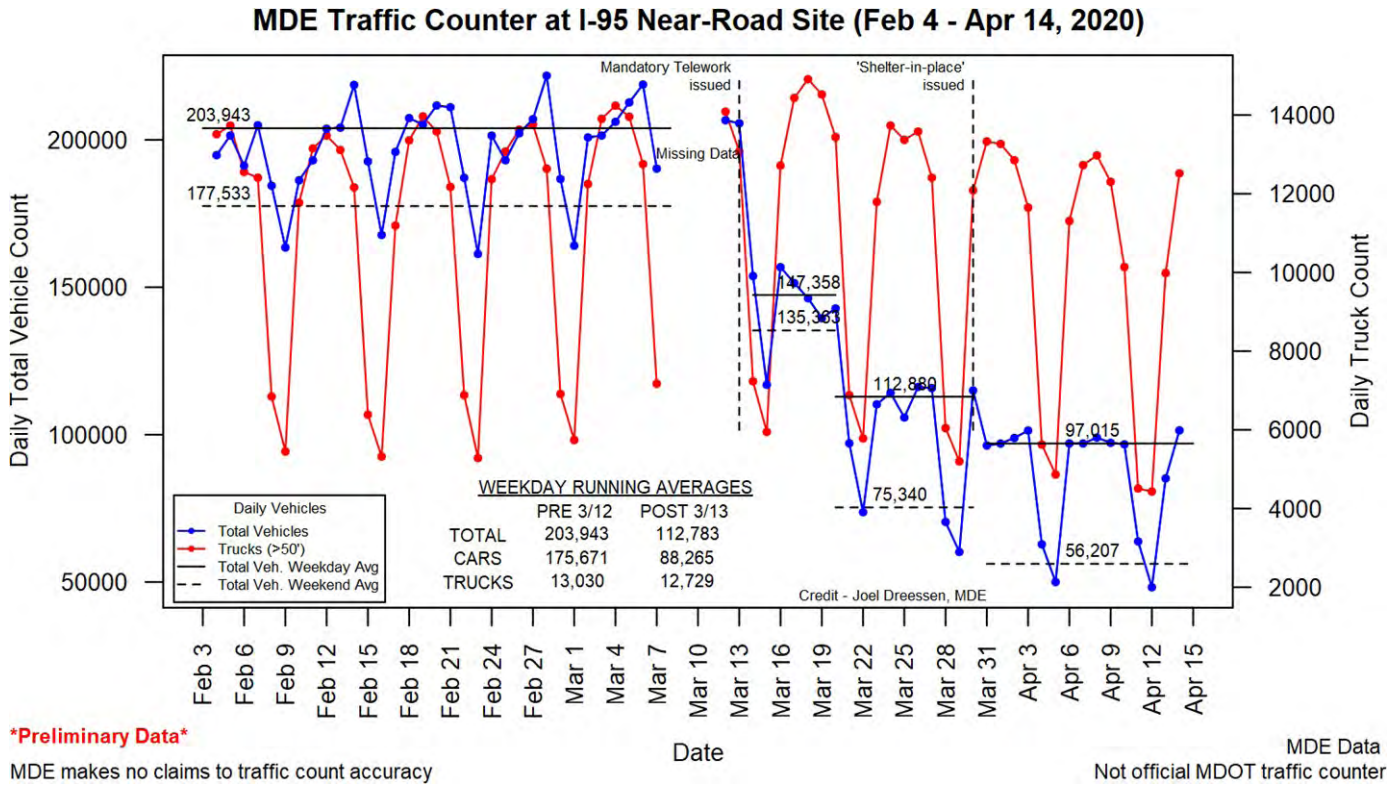
Most recently, in March and April of 2020, MDE has been collaborating with UMCP, NASA, NIST, and NOAA with support from MDOT and the Maryland Department of Natural Resources to learn how reduced traffic and other changes linked to social distancing during the COVID-19 pandemic are affecting pollutants that contribute to poor air quality and climate change. The goal of the research is to help inform policy makers working on efforts to further improve air quality and to reduce GHGs. The analyses are still in a very early stage of development and it is not possible to draw definitive conclusions at this time, but the data is extremely interesting.

Through April 14th, the following observation could be made: traffic is way down. In particular, car traffic is dramatically down with only about half as many light-duty vehicles on I-95. Numbers of semi-truck and large diesel vehicle traffic has persisted, with a slower delayed drop compared to light-duty vehicles. Satellite data collected by NASA indicates that air pollution levels are likely lower than normal. Traffic data and other measurement data suggest that GHG emissions are also lower than normal. Overall electricity usage in the U.S. is down by only about 7% from seasonally adjusted expected rates (New York Times, page B3, 10 April 2020).

The initial and primary analyses of traffic data uses MDE's roadside monitoring station located at the I-95 rest stop between Baltimore and Washington, D.C. The unofficial traffic counts are obtained through a remote sensing instrument and are generally consistent with MDOT data. Official statewide analysis from MDOT is under development.

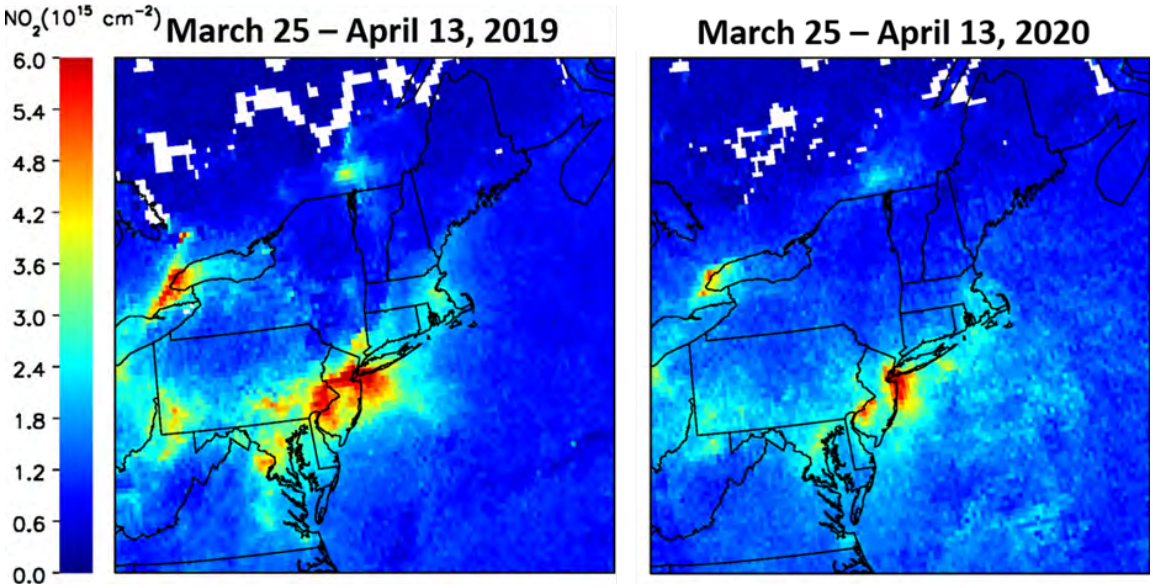
As shown in the figure below, light duty gasoline vehicle traffic (cars and passenger trucks) has dropped dramatically, by at least 50%. Traffic counts show two clear phases associated with Maryland policies on mandatory telework and shelter-in-place. Over that same time period, truck traffic had an initial, minor increase for a week. Truck numbers have been dropping

since then, but by only a smaller percentage. The data also provides a clear opportunity to measure the influence of both gasoline and diesel vehicles on air quality and climate change at the I-95 site.



The satellite data is also extremely interesting and is a powerful tool to analyze air quality and climate change. NASA works closely with UMCP and MDE on satellite data analysis. UMCP has been using the OMI (the Ozone Monitoring Instrument) and TROPOMI satellites to look at changes in column nitrogen dioxide (NO_2). These data are directly related to ozone air pollution and are also a good indicator for changes in emissions of combustion sources (power plants and vehicles). The preliminary data shown below, shows maps of NO_2 acquired before and after the COVID-19 pandemic.

Average Tropospheric Column NO_2 for March 25 – April 13, 2019 (left) and 2020 (right) as Observed by TROPOMI
Data Are Only Used When Cloud Cover is Less Than 30%

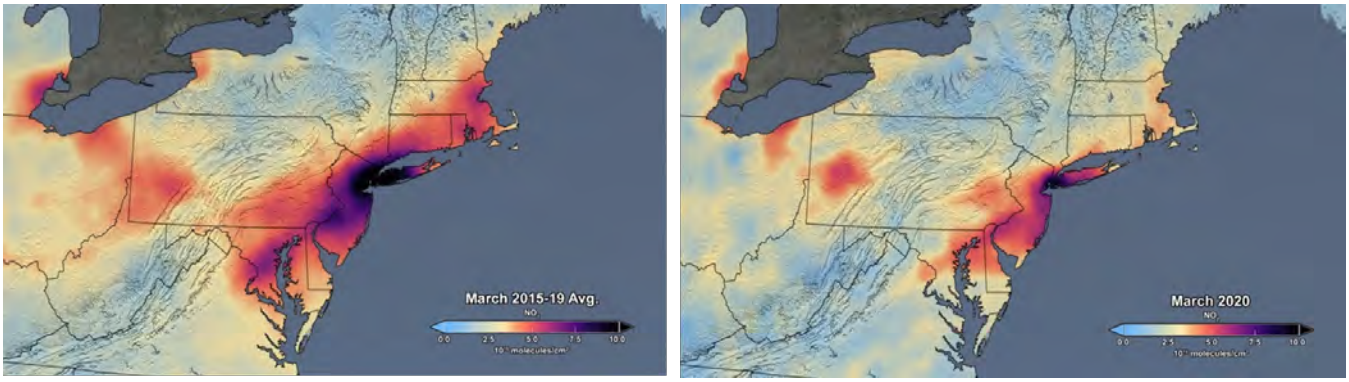


Credit – Tim Canty, UMCP

In addition, NASA, one of our federal partners is also analyzing satellite data. The figures below compare measurements of tropospheric NO_2 obtained by the NASA OMI tool in the Mid-Atlantic during March of 2015 to 2019 and in March 2020. Further information about these two figures is available at https://svs.gsfc.nasa.gov/4810.

The maps below were recently released by NASA and indicate the dramatic reduction in pollution related to fossil fuel combustion. To determine the exact amount of the reduction related to reduced activity due to the pandemic will require numerical simulations, but these preliminary results provide a suggestion of what the air quality and climate change benefit could be expected if half the light-duty vehicle fleet were replaced by electric cars.

NASA Observations of NO_2 Showing Major Decreases in March 2020



NIST operates a network of high precision GHG monitors on towers in the Baltimore Maryland/Washington, DC area. MDE is working with NIST to use the observations and numerical models to quantify the reduction in emissions due to reduced consumption of fossil fuels driven by the response to the pandemic.

MDE plans to continue collaborating with its partners to learn as much as it can from this unintended experiment. Future efforts include the analysis of additional pollutants (NO_2, black carbon, ozone, etc.) and GHG trends by MDE and UMCP utilizing MDE's I-95 roadside site. In coordination with MDOT additional traffic count data will be analyzed and UMCP measurements of CO_2 and methane from the I-95 rest stop site will be made. In addition, UMCP will also begin flying its research aircraft to measure changes in air pollution and GHGs before and after the pandemic. UMCP is also measuring GHGs, including short-lived pollutants, at its on-campus site. MDE and UMCP will also continue to collaborate with NASA and NIST. NASA is focused on collection and analysis of satellite data and NIST scientists are operating an array of GHG instruments on towers throughout Maryland and the District of Columbia to quantify the change in emissions of CO_2 and methane.