Modification to the Phase II Attainment Plan for the Baltimore Region: Revising the Mobile Source Emission Budgets, Adding Tier 2 Standards

PROPOSED

November 6, 2000

Air and Radiation Management Administration
2500 Broening Highway
Baltimore, Maryland 21224

Executive Summary

Under the 1990 Clean Air Act Amendments, the Baltimore Region was classified as severe nonattainment area with respect to the National Ambient Air Quality Standard for ozone. The Clean Air Act requires that severe ozone nonattainment areas submit an attainment plan that includes a photochemical modeling demonstration that the area will comply with the federal ozone standard by 2005.

On April 28, 1998, Maryland submitted an attainment plan for the Baltimore Nonattainment Area and Cecil County entitled *Phase II Attainment Plan for the Baltimore Region and Cecil County* (Phase II Attainment Plan). This plan included local and regional modeling and weight of evidence demonstrations that these areas would be likely to achieve compliance with the federal ozone standard if pollution transported from areas outside these nonattainment areas was reduced.

The control measures contained in the Phase II Attainment Plan as modified through December 3, 1999 include: Enhanced Inspection/Maintenance Program, Tier 1 Vehicle Emission Standards, Reformulated Gasoline Phase I and II, National Low Emission Vehicle Program (NLEV), Stage II Vapor Recovery, Landfill Controls, Open Burning Ban, Surface Cleaning/Degreasing Controls, Reformulated Architectural Coatings, Reformulated Consumer Products, Auto Refinishing Controls, Nonroad Diesel Engine Standards, Nonroad Gasoline Engine Standards, Marine Engine Standards, Railroad Locomotive Standards, Expandable Polystyrene Reasonably Available Control Technology (RACT), Yeast Production RACT, Commercial Bakeries RACT, Screen Printing Controls, Federal Air Toxics Controls, Graphic Arts Controls, Enhanced Rule Compliance Program, State Air Toxics Controls, Heavy Duty Diesel Engine Rule, NOx RACT, and NOx Phase II and III.

EPA proposed approval of the Phase II Attainment Plan on December 16, 1999. The SIP will approved on the following conditions:

1. Maryland submits an adequate motor vehicle emissions budget with Tier 2 standards included by December 31, 2000.

2. Maryland reaffirms the intent of its existing enforceable commitment to adopt additional control measures as needed to attain the one-hour ozone national ambient air quality standard (NAAQS). The EPA has determined that the Baltimore Nonattainment Area will need additional emissions reductions to ensure attainment of the ozone NAAQS. The additional reduction requirements are equal to 3.1 of the 1990 baseline VOC emissions for the Baltimore Region.

3. Maryland adopts and submits a rule(s) for the regional NOx reductions consistent with the modeling demonstration, i.e. the NOx SIP Call.

4. Maryland commits to do the following:

a. By 10/31/01 submit measures that achieve the additional emission reductions as required, including a revised motor vehicle emissions budget if additional measures affect the motor vehicle emission inventory.
b. Revise the SIP and motor vehicle emissions budget using MOBILE6 within one (1) year after it is issued.
c. Perform a mid-course review by 12/31/03. The midcourse review will include an evaluation of trends in monitor data, local emissions, implementation of local emissions strategies, and comparison to the state implementation plans to determine progress the region is making towards attainment of the one-hour ozone standard.

This SIP revision fulfills condition number one (1) above which involves modifying the mobile emissions budget due to the adoption of Tier 2 standards. This document also provides a commitment that the MDE (as referenced in December 24, 1999 and April 28, 1998 SIP documents) will continue to adopt additional control measures to ensure that NAAQS standards will be adhered to by 2005. These additional measures will be adopted and submitted to the EPA no later than October 31, 2001. Maryland also commits to completing a mid-course review and submitting a revised SIP and motor vehicle emissions budget within one (1) year of the release of MOBILE6. Maryland commits to reduce emissions by an additional 0.5 tons/day of VOC and 6.4 tons/day of NOx to offset increases to the mobile source emissions budget made in December 1999.

The purpose of this modification to the Phase II Attainment Plan is to revise the motor vehicle emission budgets to include reductions from Tier 2 Vehicle Standards. Motor vehicle emissions budgets must be established for the attainment year and reflect all control programs used in the attainment demonstration. Motor vehicle emission budgets must be adequate for the purpose of determining whether transportation plans and improvement programs conform to the Phase II Attainment Plan.

On December 21, 1999, the EPA announced new regulations effecting emissions standards for the production of new vehicles beginning in 2004 and known as Tier 2 standards. The emissions reduction benefits of this Tier 2 program for the Maryland region will be significant. The new tailpipe standard will take into account all classes of passenger vehicles (including SUV’s and light trucks) beginning in 2004. In effect, the rule forces SUV’s (Sport Utility Vehicles) and light trucks to meet the same tailpipe emission standards as cars. Simultaneously, the EPA announced lower sulfur in gasoline standards, as part of the new tailpipe standard, which are necessary to enable passenger vehicles to meet Tier 2 emission standards.

This current SIP revision incorporates the new Tier 2 standards into the mobile source emission budgets for the Baltimore Nonattainment Area. Using the criteria established in the federal transportation conformity rule at 40 CFR 93.118(e)(4) and federal guidance regarding motor vehicle emission budgets in attainment plans, the 2005 motor vehicle emission budgets for the Baltimore Nonattainment Area is 45.5 tons/day VOC and 96.9 tons/day NOx.

TABLE OF CONTENTS

Modification to the Phase II Attainment Plan for the Baltimore Nonattainment Area: Revising the Mobile Source Emission Budgets Adding Tier 2 Standards

I. Background

Under the 1990 Clean Air Act Amendments, the Baltimore Nonattainment Area was classified as severe nonattainment areas with respect to the National Ambient Air Quality Standard for ozone. By November 1994, the Clean Air Act required that severe ozone nonattainment areas submit an attainment plan that included a photochemical modeling demonstration that the area would comply with the federal ozone standard by 2005. In a memorandum dated March 2, 1995, Mary Nichols, Assistant Administrator of the U. S. Environmental Protection Agency (EPA), provided an extended schedule for submitting attainment demonstrations in two phases for serious and severe ozone nonattainment areas. The extended schedule was contingent upon participation in the Ozone Transport Assessment Group and adoption of regional control measures such as the National Low Emission Vehicle (NLEV) Program and regional nitrogen oxides (NOx) reductions from utilities and other large NOx sources.

On April 28, 1998 Maryland submitted an attainment plan for the Baltimore Nonattainment Area and Cecil County entitled *Phase II Attainment Plan for the Baltimore Region and Cecil County.* This plan included local and regional modeling and weight of evidence demonstrations that these areas would be likely to achieve compliance with the federal ozone standard if pollution transported from areas outside these nonattainment areas was reduced. Maryland participated in the Ozone Transport Assessment Group (OTAG) process to identify a suite of regional strategies that would reduce transport across the eastern half of the United States. These regional measures, when combined with federal, state and local measures already included in the Phase II Attainment Plan were likely to result in achieving compliance with the ozone standard in 2005.

The control measures contained in the Phase II Attainment Plan submitted April 28, 1998 include: Enhanced Inspection/Maintenance (Enhanced I/M) Program, Tier 1 Vehicle Emission Standards, Reformulated Gasoline Phase I and II, Stage II Vapor Recovery, Landfill Emission Controls, Open Burning Ban, Surface Cleaning/Degreasing Controls, Reformulated Architectural Coatings, Reformulated Consumer Products, Auto Refinishing Controls, Nonroad Diesel Engine Standards, Nonroad Gasoline Engine Emission Standards, Marine Engine Emission Standards, Railroad Locomotive Emission Standards, Expandable Polystyrene Reasonably Available Control Technology (RACT), Yeast Production RACT, Commercial Bakeries RACT, Screen Printing Controls, Federal Air Toxics Controls, Graphic art Controls, Enhanced Rule Compliance Program, State

Air Toxics Controls, Heavy Duty Diesel Engine Emission Standards, The National Low Emission Vehicle Program, NOx RACT on major sources, and NOx Phase II and III Controls on Large NOx sources. On December 3, 1999 a modification to the Phase II Attainment Plan incorporating all the measures identified above that affect highway vehicle emissions into the mobile source emissions budget was submitted to the EPA.

Attainment Plan Approved

EPA proposed approval of the Phase II Attainment Plan on December 16, 1999. In March 2000, the EPA determined that the mobile source emissions budget for the Baltimore Region was adequate for use in the conformity process. The SIP will be approved based on the following conditions:

1. Maryland submits an adequate motor vehicle emissions budget with Tier 2 standards included by December 31, 2000.

2. Maryland reaffirms the intent of its existing enforceable commitment to adopt additional control measures as needed to attain the one-hour ozone national ambient air quality standard (NAAQS). The EPA has determined that the Baltimore Nonattainment Area will need additional emissions reductions to ensure attainment of the ozone NAAQS. The additional reduction requirements are equal to 3.1 of the 1990 baseline VOC emissions for the Baltimore Region.

3. Maryland adopts and submits a rule(s) for the regional NOx reductions consistent with the modeling demonstration, i.e. the NOx SIP Call.

4. Maryland commits to do the following:

    d. By 10/31/01 submit measures that achieve the additional emission reductions as required, including a revised motor vehicle emissions budget if additional measures affect the motor vehicle emission inventory.
    e. Revise the SIP and motor vehicle emissions budget using MOBILE6 within one (1) year after it is issued.
    f. Perform a mid-course review by 12/31/03. The midcourse review will include an evaluation of trends in monitor data, local emissions, implementation of local emissions strategies, and comparison to the state implementation plans to determine progress the region is making towards attainment of the one-hour ozone standard.

This SIP revision fulfills item number one (1) above, and makes commitments to fulfill the other conditions in the appropriate timeframe.

Tier 2 Standards:

On December 21, 1999, federal regulations were announced tightening tailpipe emission standards for the third time. In the early 1980's, the Federal Motor Vehicle Control Program began with Tier 0 tailpipe standards. These standards reduced emissions by over 90% from pre-control levels. Implementation of Tier 1 tailpipe standards began with the model year 1994. This round of standards made substantial reductions in carbon monoxide and nitrogen oxides.
As part of the EPA's program for cleaner vehicles, cleaner gasoline, and more protective tailpipe emission standards, the EPA announced lower sulfur in gasoline standards. A lower sulfur content in gasoline is needed to enable passenger vehicles to meet the Tier 2 standards

The benefits of this Tier 2 program for the Maryland region will be significant. The new tailpipe standard will take into account all classes of passenger vehicles (including SUV's and light trucks) beginning in 2004. New sulfur in gasoline standards require refiners to place caps on sulfur in fuel. These refiners have a great deal of flexibility under the new standard system that allows them to phase the standard in and even use credits from refiners who reduce emissions early.

II. Motor Vehicle Emission Budgets for the Phase II Attainment Plan

In the Baltimore Region, motor vehicle emission budgets established in the Phase II Attainment Plan are based on implicit motor vehicle emission budgets. An implicit motor vehicle emission budget is derived by projecting the level of onroad mobile source emissions for the appropriate milestone year or attainment year including the emission reductions from all mobile source control measures identified in the plan. The budgets in this modification were developed using this procedure and include the following control programs: the Federal Motor Vehicle Control Program, Tier 1, reformulated gasoline Phase I and II, enhanced inspection/maintenance program, NLEV program, and heavy duty diesel engine 2 g standard (HDDE2g).

The motor vehicle emission budgets for the Baltimore Region were prepared in conjunction with Transportation Steering Committee staff and the Maryland Department of Transportation. The emissions estimates were derived using travel data from the TP+ transportation model and average speed estimates supplied by the Transportation Steering Committee staff through a process described below. Emission factors were developed using MOBILE5b, the EPA approved mobile emissions model. The factors developed include the following controls: Federal Motor Vehicle Control
Program (FMVCP), reformulated gasoline Phase I and II, enhanced I/M, Tier 1 and 2, NLEV, and the HDDE2g rule and were based on 1999 vehicle fleet characteristics. Detailed analysis parameters for the MOBILE5b model runs can be found in Appendix A.

The Transportation Planning Division of the Baltimore Metropolitan Council (BMC), which serves as staff to the Transportation Steering Committee (TSC), applies a traditional four step travel model (trip generation, trip distribution, mode choice, and trip assignment) with feedback from trip assignment to trip distribution in redistributing Home-Based Work (HBW) trips. The model was developed in the TP+ software environment. The staff has made significant changes to the regional travel demand model during the past three years, which have provided a more reliable model for future year projections. The main enhancements to the model were an enhanced zonal structure and highway networks and new trip attraction rates. With these changes in the modeling equations and updates to the highway network characteristics, the model is better positioned to analyze and produce conformity results.

Motorized vehicle trips for 8 trip purposes (Home-Based Work, Home-Based Shop, Home-Based Other, Home-Based School, Work Based Other, Other Based Other, and Light and Heavy trucks) are generated at the production end using inputs of household size stratified by vehicle availability for 4 area types (City Center, Urban, Suburban, and Rural). Regression equations using inputs of employment and number of households are used to develop motorized attractions. Motorized vehicle trips are distributed using a standard gravity model using uncongested travel time for non-work purposes and am peak period congested skims for HBW. Home-based trips are split into auto drivers, auto passengers, and transit riders using inputs of travel time and cost for transit and highway, parking cost, and median household income. An additional logit model is executed in developing auto shares (SOV, HOV2, HOV3, HOV4+) for the HBW purpose. Assignment of the vehicle trip tables is completed for 5 time periods (2 peak and 3 off peak).

The travel demand model consisting of 1,326 Transportation Analysis Zones (TAZs) was developed for Baltimore City and the surrounding 5 jurisdictions in the Baltimore region and 4 neighboring jurisdictions from the Washington Region. The travel model was validated in 1999 against 1996 conditions as documented in *Baltimore Region Travel Demand Model 1996 Validation*. Trip generation and trip distribution have been calibrated against a 1993 Household Travel Survey and a 1996 Baltimore Regional Transit Study is being used to revise the mode choice model.

Since the application of Tier 2 only effects the 2005 budget, only this budget will be modified. The explicit motor vehicle emission budgets for the Baltimore Region for 2005 is 45.5 tons/day VOC and 96.9 tons/day NOx.

III. Consultation

The conformity rule requires air quality planning agencies to develop a consultation process with state departments of transportation and local officials. This process fosters understanding of the development process for air quality plans and transportation plans between the agencies. The Maryland Department of the Environment (MDE) adopted regulations, COMAR 26.11.26, governing consultation between the Maryland Departments of Transportation and the Environment and Baltimore Region Transportation Board (formally known as the Transportation Steering Committee) with respect to the development of air quality plans and transportation plans. This modification to the Phase II Attainment Plan and the motor vehicle emission budgets in it were developed in accordance with the consultation rule.

IV. Conclusions

The goal of this modification to the Phase II Attainment Plan is to establish new motor vehicle emission budgets for the Phase II Attainment Plan for the Baltimore Region. This document clarifies commitments by MDE (as referenced in December 24, 1999 and April 28, 1998 SIP documents) to adopt additional control measures to ensure that NAAQS standards will be adhered to by 2005. Additional measures equal to the emissions reduction shortfall identified in the attainment plan approval will be adopted and submitted to the EPA no later than October 31, 2001. Maryland also commits to revising the SIP and the mobile emissions budgets using Mobile 6 within one (1) year of the release of its release. Maryland commits to reduce emissions by an additional 0.5 tons/day VOC and 6.4 tons/day NOx to offset increases to the mobile source emissions budget made in December 1999.

V. Corrections to the Baltimore Region Rate of Progress Plan

The Phase II Attainment Plan for the Baltimore Region and Cecil County included a rate of progress (ROP) plan for the Baltimore Region. This plan shows how the Baltimore Region will make a 3% per year reduction in VOC emissions after 1996 through 2005. In 1999, Maryland increased the mobile source emission budgets for the Baltimore region. Maryland committed to demonstrate that the increases to the mobile budgets do not prevent Maryland from meeting the previously established ROP target levels for 2002 and 2005. The Rate-of-Progress calculation and other supporting documentation are included in Appendix C. These calculation demonstrate that the Baltimore Region has achieved the reductions needed to meet ROP requirements using the original 2002 and 2005 target levels.

APPENDIX A

MOBILE SOURCE DATA
FOR THE BALTIMORE REGION

Maryland Department of the Environment
Mobile Sources Control Program

Baltimore Area MOBILE Emission Modeling Analysis
Highway Network Data for SIP MOBILE Budget

Milestone Yr.	**2005**	
Scenario	**Build**	
Trans Model	**TP Pls**	
Year RegMix	**1999**	
Stabilized Exhaust VOC	24.5	
Cold Start Exhaust VOC	9.4	
Hot Start Exhaust VOC	2.2	
SubTot Exhaust VOC	36.1	
SubTot Evaporative VOC	13.6	
Total VOC	49.7	
Refueling VOC	2.6	
Non-Ref. VOC w/Tier2 Ben.	**45.5**	tons per day
Stab Exh NOx	98.9	
Cold Exh NOx	4.7	
Hot Exh NOx	1.7	
Tot. NOx with Tier2 Benefits	**96.9**	tons per day
Vehicle Miles Traveled	**71.04**	million miles
Fleet Average Speed	**45.50**	mph
Cold Starts	**4.2808**	millions
Hot Starts	**3.1903**	millions
Trip Ends	**7.4716**	millions

Note: **Emission modeling includes latest 1999 MD Vehicle Reg. Mixes.**

Emissions are expressed in tons per summer weekday.

The analysis includes all controls such as Stage II, Tier1, RFG, IM240, NLEV and the new HDE Rule. Benefits from Tier2 are also included.

Prepared by: Mobile Sources Control Program, Phone (410) 631-4841 **Oct. 23, 2000**

FOR THE BALTIMORE NONATTAINMENT AREA

MOBILE5b input and output files used in the development of the motor vehicle emission budget for the Baltimore Region are very extensive and have not been reproduced in hardcopy format for inclusion in this document. Hardcopy files of the input/output files can be viewed at the Maryland Department of the Environment. The input/output files can be obtained in electronic format by contacting:

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Appendix C
Modification to the Phase II Attainment Plan for the Baltimore Region: Revising the Mobile Source Emission Budgets, Adding Tier 2 Standards

Executive Summary

Appendix C demonstrates that the Baltimore Nonattainment Area meets the requirements of Section 182 (c)(2)(B)(i) of the Clean Air Act as applicable to Severe Areas, Section 182 (d), for the years 2002 and 2005. A severe area must make a reduction in VOC emissions equal to 3% of the 1990 baseline VOC emissions for each year beginning after 1996 through 2005. This plan demonstrates for the prescribed milestone years of 2002 and 2005 that all the required reductions were made for years beyond 1999. This revision of Appendix C supersedes all other plans designed to meet this requirement.

The Clean Air Act Amendments of 1990 (the Act) represent an unprecedented commitment to protecting public health and the environment. Title I of the Act classifies areas that exceed national health-based air quality standards based upon the severity of their pollution problem. In accordance with these classifications, the Act sets new deadlines for achieving the standard, and requires a minimum set of basic measures for each classification to ensure early progress toward this goal. Areas with more severe classifications must implement increasingly more stringent measures.

All areas of the country classified as a severe ozone nonattainment area must submit to the U.S. Environmental Protection Agency (EPA) a series of revisions to the State Implementation Plan (SIP) that show how the area will make a 42% reduction in VOC emissions by the attainment year 2005. The SIP revisions begin with a six-year plan to reduce emissions by 15% from the 1990 baseline, called the 15% Rate-of-Progress Plan, followed by a nine-year plan to reduce emissions by 3% per year beginning after 1996 until 2005, called the Post-1996 Rate of Progress Plan. These plans were due to EPA on November 15, 1993 and November 15, 1994 respectively. A demonstration using photochemical grid modeling that these plans would enable the nonattainment area to achieve the federal ozone standard was also due November 15, 1994. States in the Ozone Transport Region had difficulty meeting these deadlines because of overwhelming transport of pollution across state lines.

A March 2, 1995 memorandum, entitled "Ozone Attainment Demonstration" from EPA Assistant Administrator Mary D. Nichols to the EPA Regional Administrators sets forth guidance for an alternative approach to submitting these requirements to provide states flexibility in their planning efforts. The memorandum established a two-phased approach to development of the Post-1996 Rate-of-Progress Plan and the Attainment Demonstration. The SIP for the first phase was submitted to EPA on December 1997. This SIP revision fulfills Rate-of-Progress requirements for 2002 and 2005 under the second phase for the Baltimore Nonattainment Area.

Maryland participated in the Ozone Transport Assessment Group (OTAG) as required under the Phase I/Phase II process. Modeling analysis developed through this process and for the Baltimore Nonattainment Area's attainment demonstration showed that the Baltimore Nonattainment Area needs both VOC and NOx reductions to attain the ozone standard. Therefore, the 3% per year reduction requirement is met through a combination of VOC and NOx reductions using guidance from EPA regarding the

substitution of NOx emission reductions for required VOC emission reductions. The Baltimore Nonattainment Area must meet the 2002 and 2005 VOC and NOx target levels shown in Table 1.1 Summary of Emission Benefits for the Baltimore Nonattainment Area to meet the Post-1996 Rate-of-Progress requirements. This plan describes the reduction measures used to lower VOC and NOx emissions and offset growth in emissions to reach these target levels.

Table 1.1 - Summary of Emission Benefits for the Baltimore Nonattainment Area (Tons per Day)

	2002		2005	
Control Measure	**VOC**	**NOx**	**VOC**	**NOx**
Enhanced I/M				
Tier I				
Reform Gas				
LEV				
HDDE				
Total Mobile	51.20	56.70	57.40	69.50
Stage II/Refuel	9.00	0.00	10.00	0.00
Landfills	0.28	0.00	0.26	0.00
Open Burning	3.60	0.76	3.60	0.76
Surface Cleaning/ Degreasing	7.22	0.00	7.20	0.00
Architectural Coatings	5.52	0.00	5.55	0.00
Consumer Products	2.78	0.00	2.83	0.00
Auto Refinishing	5.84	0.00	6.05	0.00
Nonroad Small Gasoline Engines	9.69	-0.37	17.51	-0.45
Nonroad Diesel Engines	0.00	10.96	0.00	16.13
Marine Engine Standards	0.86	-0.01	1.79	-0.07
Railroads	0.00	2.40	0.00	4.20
Expandable Polystyrene	0.12	0.00	0.12	0.00
Yeast Production	0.81	0.00	0.87	0.00
Commercial Bakeries	0.85	0.00	0.86	0.00
Screen Printing	0.24	0.00	0.25	0.00
Federal Air Toxics	0.50	0.00	0.50	0.00
Graphic Arts – Lithography	2.61	0.00	2.66	0.00
Graphic Arts – Rotogravure & Flexographic	0.88	0.00	0.90	0.00
Enhanced Rule Compliance	4.90	0.00	5.10	0.00
State Air Toxics	1.10	0.00	1.20	0.00
NOx RACT - NOx Phase I/II/III	0.00	4.90	0.00	5.00
FMVCP/RVP				
Total	106.3	159.5	120.1	190.7
Projected Uncontrolled Emissions	340.57	518.85	348.26	532.94
Emission Level Obtained	232.32	353.51	223.60	329.37
Emission Level Required	235.80	375.30	224.00	351.50

Emission reductions beyond ROP requirements	3.22	21.79	0.40	22.13

The document is organized in the following manner. Section 2 provides a detailed background information about the Act, the region's air quality planning process, the role of the states, and the proposed plan. Section 3 presents the 1990 Base Year Inventory, which serves as the baseline against which emissions reductions are measured. Section 4 outlines how, utilizing EPA-approved growth factors, the 1990 base year emissions are projected for 1999, 2002, and 2005; these years are milestone years for severe nonattainment areas, as defined in the Act. This gives us a picture of how much emissions the area would have if no control measures were adopted. Section 5 presents the Department's calculations of how many tons per day of emissions must be reduced in order to meet the 3% per year requirement. Section 6 describes the various strategies that will be used to control emissions at each milestone. Section 7 includes the contingency plan. The Act requires states to outline a contingency plan of alternative measures. These measures are automatically implemented if the control measures described in Section 6 fail to provide the required emissions reductions.

2.0 INTRODUCTION AND BACKGROUND

Appendix C demonstrates that the Baltimore Nonattainment Area meets the requirements of Section 182 (c)(2)(B)(i) of the Clean Air Act as applicable to Severe Areas, Section 182 (d), for the years 2002 and 2005. A severe area must make a reduction in VOC emissions equal to 3% of the 1990 baseline VOC emissions for each year beginning after 1996 through 2005. This plan demonstrates for the prescribed milestone years of 2002 and 2005 that all the required reductions were made for years beyond 1999. This revision of Appendix E supersedes all other plans designed to meet this requirement.

2.1 CLEAN AIR ACT REQUIREMENTS

The original Air Pollution Control Act was passed in 1955 in response to public concerns raised by several air pollution episodes during which many fatalities occurred. The most famous episode was the four-day "killer fog" in London, England which claimed 4,000 lives. In 1948, a similar incident in Donora, Pennsylvania culminated in 20 fatalities and 7,000 illnesses. In response to public concerns, Congress adopted air pollution control laws.

With the passage of the original Air Pollution Control Act of 1955 and the Clean Air Act (the Act) of 1963 (amended in 1967, 1970, 1977, and 1990), Congress responded to the problem of air pollution by offering technical and financial assistance to the states. The Act of 1963 and subsequent amendments are intended to protect public health and the environment from hazards associated with airborne pollutants. The 1970 Amendments to the Act sharply increased federal authority and responsibility for addressing the air pollution problem; however Section 107(a) of the Act still provided that each state "shall have the primary responsibility for assuring air quality within the entire geographic area comprising the state". Despite the states' role in attaining and maintaining air quality standards within its borders, the challenges require an extensively cooperative state/federal partnership.

One of the most important components of the 1970 amendments to the Act was the creation of National Ambient Air Quality Standards (NAAQS**s**) for air pollutants which endanger public health and welfare. A system of primary NAAQS**s** was established for the protection of human health and a set of secondary standards was established for the protection of public welfare, property, crops, animals and natural ecosystems. A geographic area that meets or does better than the primary standard is called an attainment area; areas that do not meet the primary standard are called nonattainment areas. The six criteria pollutants for which NAAQS**s** have been established are: lead (Pb), carbon monoxide (CO), particulate matter (PM), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and ozone (O_3). The last three pollutants are serious respiratory irritants. They are highly reactive compounds that can oxidize or burn tissues of the mucous membranes and lungs. Prolonged exposure can cause permanent scarring of lung tissue and reduced lung capacity.

Despite the 1970 legislation, air quality in many areas of the country still did not meet the NAAQSs, especially for ozone. Congress amended the Act again in 1977, partly to address those areas that had not attained the NAAQS. SIP revisions submitted pursuant to the requirements of the 1977 amendments yielded progress in meeting the NAAQS**s**. However, many areas remained nonattainment.

In 1990**,** Congress once again enacted comprehensive amendments to the Act to revise State Implementation Plan (SIP) requirements for nonattainment areas. The requirements of the 1990

Amendments to the Act represent an unprecedented commitment to protecting public health and the environment. Title I of the Act classifies areas that exceed national health-based air quality standards based upon the severity of their pollution problem. In accordance with these classifications, the Act sets new deadlines for achieving the standard, and requires a minimum set of basic measures for each classification to ensure early progress toward this goal. Areas with more severe classifications must implement increasingly more stringent measures.

One major impact the Act had on the state of Maryland was to redefine and enlarge the ozone nonattainment areas. The Baltimore Nonattainment Area remained unchanged. Cecil County was added to the Philadelphia-Wilmington-Trenton nonattainment area in 1990. The Washington, D.C. Nonattainment Area expanded to include Calvert, Charles, and Frederick counties. Table 2.1 shows the current designations for the State of Maryland. This document deals only with the Baltimore Nonattainment Area.

Table 2.1 - Maryland Ozone Classifications

AREA	**CLASSIFICATION**	**ATTAINMENT DATE (NOVEMBER 15)**
BALTIMORE, MD Anne Arundel County, Baltimore City, Baltimore County, Carroll County, Harford County, Howard County	Severe Nonattainment	2005
WASHINGTON, D.C. Calvert County, Charles County, Frederick County, Montgomery County, Prince George's County	Serious Nonattainment	1999
PHILADELPHIA/WILMINGTON/TRENTON Cecil County	Severe Nonattainment	2005
KENT/QUEEN ANNE'S COUNTY Kent County Queen Anne's County	Marginal Nonattainment	1993
OTHER MARYLAND COUNTIES Allegheny, Caroline, Dorchester, Garrett, Somerset, St. Mary's, Talbot, Washington, Wicomico Worcester	Unclassifiable (Insufficient data to classify)[1]	N/A

[1] Areas which are unclassified are *not* nonattainment areas.

In addition to redefining and enlarging the nonattainment areas, the Act included specific emission reduction requirements depending on the severity of pollution in a nonattainment area. These emission reduction requirements insure that areas make continuous progress towards attainment of the NAAQS. Mandatory emission control programs, specific emission reduction requirements and deadlines for attainment of the NAAQS for ozone vary according to the classification of the nonattainment area. Areas with more serious nonattainment classifications must meet the mandates of the less severe classifications plus the more stringent requirements of their classification. The attainment date for the Baltimore nonattainment area is the year 2005.

Congress established Rate of Progress requirements: specific emission reduction requirements where the timing and quantity of the reductions depends on the nonattainment area classification. A severe nonattainment area must reduce emissions of VOCs by 15 percent between 1990 and 1996, and reduce emissions of VOCs and/or NOx by 3 percent per year between 1997 and 2005. In addition, state and local air pollution agencies must show through computer modeling that emissions reduction strategies chosen for the area will ultimately result in attainment of the ozone NAAQS.

Requirements for Baltimore nonattainment area include placing tighter controls on businesses and industries that discharge emissions, implementing an enhanced inspection and maintenance program for vehicles, and implementing Stage II Vapor recovery controls. For additional information on these new requirements see the Department's *Report to the General Assembly on the Clean Air Act Amendments of 1990*.

The ozone problem is regional in nature since ozone travels across county and state lines. So the Act created regions such as the OTR to facilitate coordination and consensus-building between states in areas with pollution transport problems. The Northeast OTR comprises Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, Rhode Island, New Jersey, Delaware, Maryland, Pennsylvania, Washington, DC, and Virginia. The coordinating body for the Northeast OTR is the Ozone Transport Commission (OTC). All Maryland counties are part of the Northeast Ozone Transport Region (OTR). The OTR is not a nonattainment classification, but does have certain requirements associated with it.

2.2 THE STATE IMPLEMENTATION PLAN (SIP) PROCESS

The Act requires states to develop and implement ozone reduction strategies in the form of a State Implementation Plan (SIP). The SIP is the state's "master plan" for attaining and maintaining the NAAQS. The SIP is revised as necessary to ensure that compliance with federal standards is achieved as expeditiously as possible.

EPA has identified four criteria to determine whether emission reductions from control strategies are creditable in the SIP. These four criteria are outlined in the General Preamble to Title I of the Clean Air Act Amendments of 1990 at *Federal Register* 13567. The four criteria are:

- emissions reductions ascribed to control measures must be quantifiable and measurable (*quantifiable*);
- control measures must be enforceable, in that the state must show that they have adopted legal means for ensuring that sources are in compliance with the control measure (*enforceable*);
- measures are replicable (*real*); and

- the control strategies be accountable in that the SIP must contain provisions to track emissions changes at sources and to provide for corrective actions if the emissions reductions are not achieved according to the Plan (*permanent*).

Once a SIP revision is approved by the Administrator of the EPA, it is enforceable as a state law and as federal law under Section 113 of the Act. If the SIP is found to be inadequate in the EPA's judgement, and if the state fails to make amendments to rectify the problem, under 110(c)(1), the EPA Administrator issues binding amendments to the SIP. These amendments are referred to as the federal implementation plan (FIP). EPA has releases guidance on how to take credit for voluntary measures in the SIP. Voluntary measures can be used to generate up to 3% of the required emission reductions if this guidance is followed.

EPA must impose sanctions if a state:

- Does not submit a SIP revision; or

- submits a SIP revision that the EPA does not approve; or

- fails to implement the SIP revision.

Possible sanctions include:

- Requiring new large industries, or those that want to expand, to offset emissions by 2:1, which could deter economic growth;

- withholding federal highway funds;

- withholding air quality planning grants;

- imposing a federal implementation plan (FIP).

The Act allows the EPA to exercise discretion in imposing sanctions under certain circumstances. In general, EPA can delay imposing sanctions for 18 months if a state is making a good faith effort to comply with the requirement. The EPA promulgated a rule regarding discretionary sanctions so that after 18 months mandatory sanctions would begin with 2:1 offsets for new Stationary Sources for the first six months followed by withholding federal transportation funds. Failure to submit or implement a SIP can have significant consequences for transportation plans under the transportation conformity requirements.

2.3 THE PHASE II RATE OF PROGRESS PLAN FOR 2002 AND 2005

A March 2, 1995 Memorandum, entitled "Ozone Attainment Demonstrations" from EPA Assistant Administrator Mary D. Nichols to the EPA Regional Administrators sets forth guidance for an alternative approach to submitting these requirements to provide States flexibility in their planning efforts. The memorandum established a two-phased approach to development of the Post-1996 Rate-of-Progress Plan and the Attainment Demonstration. The SIP for the first phase was submitted to EPA on December 1997. The SIP revision fulfills Rate-of-Progress requirements for 2002 and 2005 under the second phase for the

Baltimore Nonattainment Area.

Unlike the emissions reductions required in the *15 Percent Rate-of-Progress Plan*, Section 182 (c)(2) of the Act allows states to use NOx emission reductions to meet the 9 percent rate-of-progress requirement as well as VOC reductions. NOx emissions reductions can be substituted for VOC reductions provided they meet the criteria outlined in "EPA's NOx Substitution Guidance". Emission reductions of NOx may be substituted for required VOC reductions under the following criteria. The nonattainment area must show that NOx reductions are necessary to reach attainment. Emission reductions of NOx can be substituted for required VOC reductions at a ratio equal to the ration of NOx to VOC emissions in the baseline inventory. This plan uses a combination of VOC and NOx emission reductions to meet the 2002 and 2005 Rate-of-Progress reduction requirements.

3.0 1990 BASE YEAR INVENTORY

3.1 BACKGROUND AND REQUIREMENTS

The Act requires states to compile an emissions inventory to use as the foundation for planning strategies necessary to attain the NAAQS. The Act requires this base year inventory for all classes of nonattainment areas (42 U.S.C.A. Section 7511(a)(1)), and EPA requires a state-wide inventory for those states that are part of the Northeast OTR. The base year inventory is also the foundation for other required inventories that this chapter explains in greater detail:

- The adjusted base year inventory;
- the periodic inventory;
- the Reasonable Further Progress (RFP) inventory; and
- the projection inventory.

The 1990 base year inventory was required as part of the November 15, 1992 SIP submittals. The Department submitted a working draft of the inventory to the EPA on November 14, 1992. The EPA decided that the base year inventory should be subject to the public process, and allowed states until November 15, 1993 to hold public hearings on the inventory and formally submit it as a SIP revision to EPA. The complete inventory documentation is available for review and is entitled *1990 Base Year Inventory for Precursors of Ozone, Volatile Organic Compounds (VOC), Carbon Monoxide (CO), Nitrogen Oxides (NO_x) for the State of Maryland, Volumes 1-6, September 30, 1993* (MDE, 1993a).

This chapter summarizes the approach used to develop the inventory for ozone precursors during the ozone season, and presents inventory results for each pollutant. The base year inventory is an inventory of actual emissions for the calendar year 1990. It includes the ozone precursor pollutants: volatile organic compounds (VOC) and oxides of nitrogen (NO_x). Emissions estimates are for a typical peak ozone season weekday. The peak ozone season for the Baltimore Nonattainment Area is June, July and August.

3.2 SOURCE SECTORS

Emission sources are divided into five sectors:

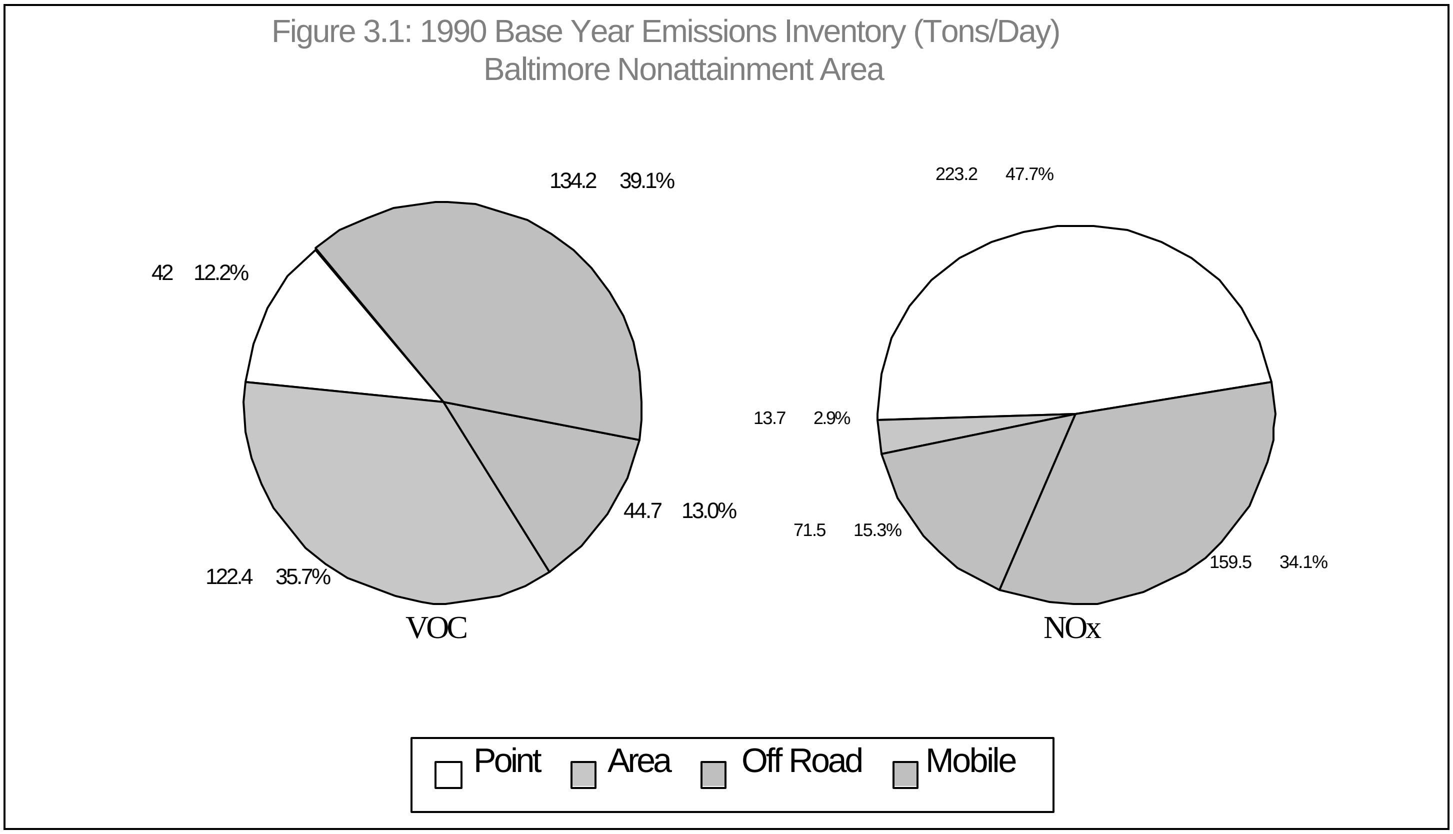
- Point sources: industrial and commercial sources with sufficient emissions to quantify on an individual basis;
- Area sources: smaller industrial, commercial, and business sources whose emissions are too low to quantify individually but collectively contribute a significant amount of emissions;
- Onroad mobile sources: traditional highway vehicles, such as cars and trucks;
- Nonroad mobile sources: sources powered by internal combustion engines that are not traditionally used for highway transportation, such as lawn mowers, airplanes, boats and construction equipment; and

❖ Biogenic sources: natural emissions sources of VOCs, such as trees, grasses, and crops.

Table 3.1 presents the inventory by source type. Figure 3.1 displays the information for VOC and NOx emissions in the Baltimore nonattainment area in graphs.

Table 3.1 - 1990 Base Year Ozone Precursor Emissions Inventory Emissions Summary By Source Type

Nonattainment Area	Tons Per Day	
Source Type	**VOC**	**NOx**
Baltimore Nonattainment Area		
Point Sources	**42.0**	**223.2**
Area Sources	**122.4**	**13.7**
Nonroad Sources	**44.7**	**71.5**
Mobile Sources	**134.2**	**159.5**
Subtotal:	**343.3**	**467.9**
Washington Nonattainment Area		
Point Sources	**14.6**	**334.8**
Area Sources	**191.2**	**47.3**
Nonroad Sources	**70.4**	**85.0**
Mobile Sources	**251.2**	**261.7**
Subtotal:	**527.2**	**728.8**
Washington NAA - MD Portion		
Point Sources	**5.5**	**267.4**
Area Sources	**94.2**	**15.8**
Nonroad Sources	**32.1**	**43.5**
Mobile Sources	**108.5**	**129.1**
Subtotal:	**240.3**	**455.8**
Cecil County - Phil-Wil-Tren NAA		
Point Sources	**0.6**	**0.0**
Area Sources	**8.7**	**1.8**
Nonroad Sources	**2.0**	**2.6**
Mobile Sources	**7.2**	**9.3**
Subtotal:	**18.5**	**13.7**
Kent/Queen Anne's Nonattainment Area		
Point Sources	**0.3**	**0.0**
Area Sources	**9.4**	**0.7**
Nonroad Sources	**3.4**	**1.8**
Mobile Sources	**6.6**	**7.3**
Subtotal:	**19.7**	**9.8**
Maryland Unclassified Counties		
Point Sources	**12.3**	**40.6**
Area Sources	**52.4**	**29.5**
Nonroad Sources	**25.3**	**23.7**
Mobile Sources	**47.3**	**50.9**
Subtotal:	**137.3**	**144.7**
State		
Point Sources	**60.7**	**531.2**
Area Sources	**287.1**	**61.5**
Nonroad Sources	**107.5**	**143.1**
Mobile Sources	**303.7**	**356.1**
Total:	**759.0**	**1091.9**



3.2.1 POINT SOURCES

A point source in the base year inventory for the Baltimore Nonattainment Area is defined as a stationary source of emissions that emits annually at least 10 tons of VOCs, 100 tons of CO or 25 tons of NOx.

Emissions for point sources are estimated using the following types of methodologies :

- EPA-supplied emission factors;
- material balance emissions calculations;
- source-based test data calculations; or
- agency- or company-generated emission factors

EPA guidance requires that the Department adjust the inventory to take into consideration equipment failures and the inability of control programs to achieve 100% effectiveness at all times. This analysis, referred to as rule effectiveness (RE), means that when Department staff conduct RE studies, they take into account various factors including non-compliance with existing rules, control equipment downtime, operating and maintenance problems, and process upsets due to human or other errors. RE may also indicate errors in the projection of emissions estimates as well as the actual emissions themselves. RE adjusts emissions to correct for these failures and uncertainties to provide a more reliable estimate for planning and modeling.

The Department used the 80% default factor in several RE applications, and concentrated on RE improvements for key sources. Although the Department recognizes that the EPA default RE factor of 80% inadequately represents the variation that exists in the effectiveness of different industry process unit/control device combinations, staff limitations have precluded the Department's extensive use of surveys or Stationary Source Compliance Division (SSCD) studies to develop alternatives.

The Department did not apply RE to several source categories. RE was not applied to uncontrolled sources, to sources which have undergone an irreversible process change, nor to sources whose emissions were calculated using direct determinations (material balance), unless a control device was employed. Additionally, the Department did not apply RE to sources where the operation of process equipment without an operational control device is mechanically or electronically prevented. This included some solvent vapor recovery processes and web printing equipment. Although the Department concedes that these electronic lock-outs can fail or be disabled, the former is rare and the latter is a criminal offense.

The Department has not collected extensive data on the temporal distribution of emissions. Typically, companies are required to quantify annual emissions by quarter. For purposes of modeling, however, the Department obtained daily NO_x emissions for specific ozone episodes. More specific information will be collected under the Certified Emissions Statement regulation, Code of Maryland Regulations 26.11.01.05-1 (COMAR, 1993).

The Department calculated peak ozone season emissions by the following method:

1) The Department converted annual emissions in pounds per year into pounds per day emissions by dividing annual emissions by operating days.

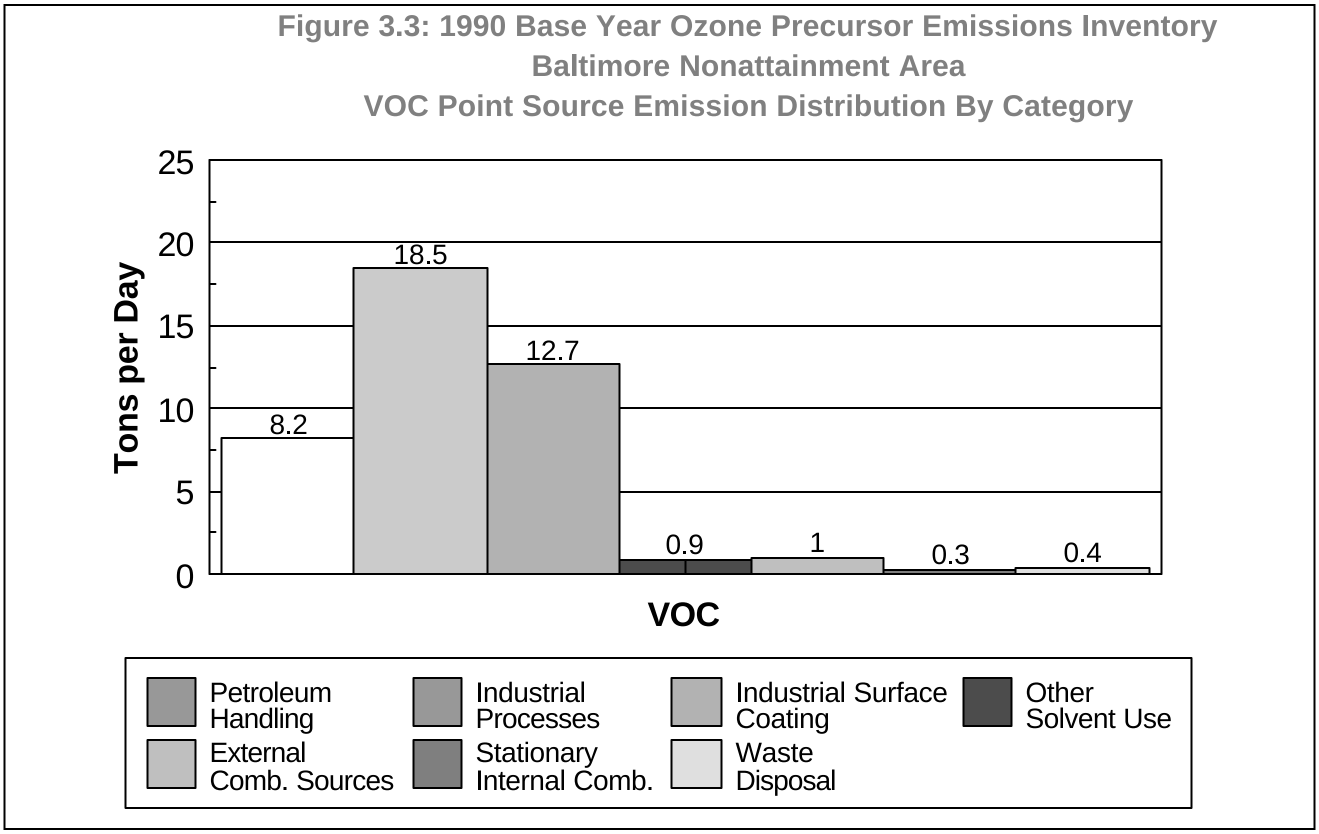
2) The pounds per day emissions were then multiplied by a seasonality factor. The seasonality factor was based on the quarterly percentage of operations (estimated by the company) for June, July, and August. The factor was calculated by multiplying the second quarter percentage by one third and the third quarter percentage by two thirds. The sum of the two results was divided by 25.

3) The ratio obtained was multiplied by the pounds per day emissions to get the seasonally adjusted emissions.

This methodology conforms with EPA-accepted practices. For a more detailed discussion of the methodology refer to *Volume 1, Section 2: Point Sources and Volumes 3-5: Documentation for Individual Point Sources* of the complete inventory documentation. Table 3.2 displays the VOC emissions for the Baltimore nonattainment area, a highly industrialized area of Maryland. Figures 3.3 and 3.4 illustrate, in the form of bar graphs, the comparative emissions levels from the various point sources present in the Baltimore ozone nonattainment area.

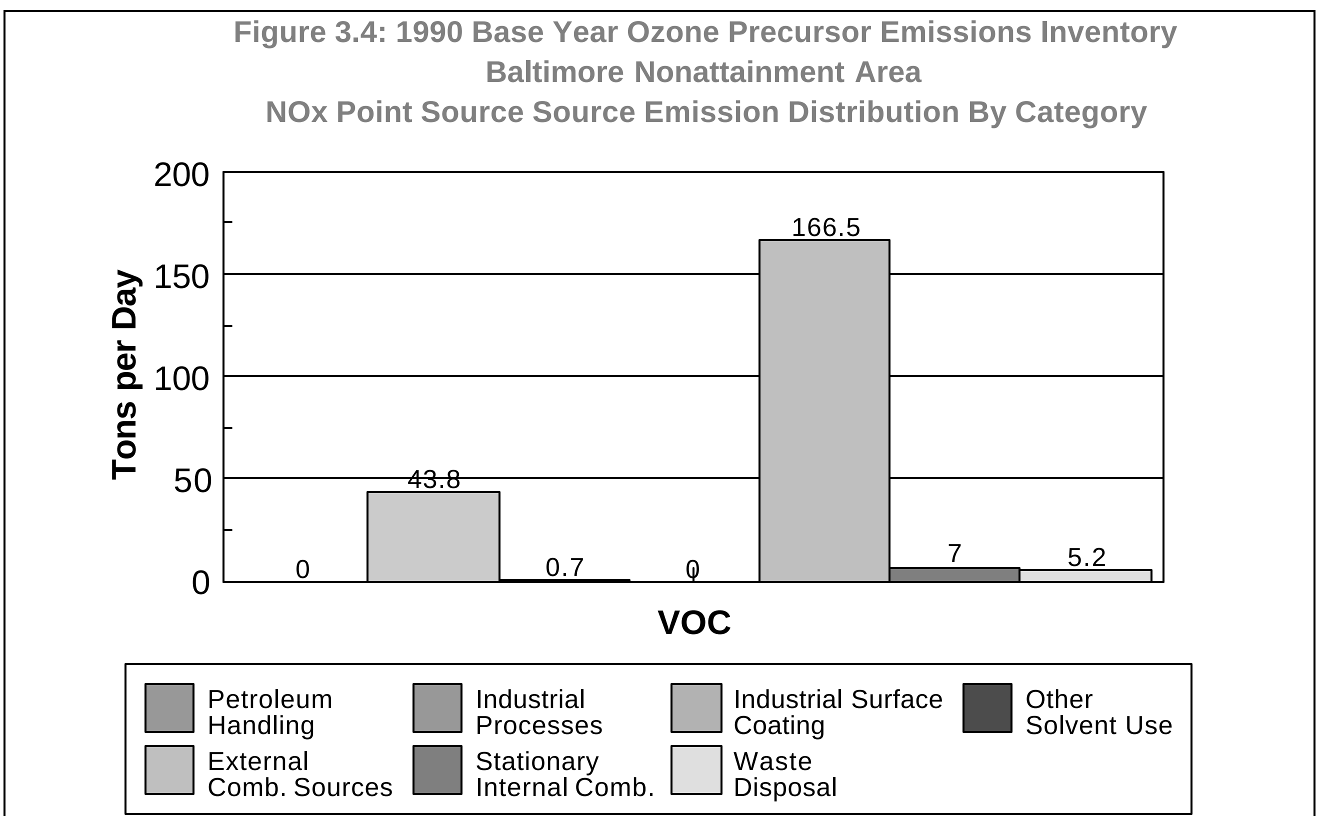
Table 3.2: 1990 Base Year Ozone Precursor Emissions Inventory
Point Source Emissions Totals By Category In The Baltimore Nonattainment Area

Baltimore Area	**VOC** tons/day	**NOx** tons/day
Petroleum Product Handling	8.2	0.0
Industrial Processes	18.5	43.8
Industrial Surface Coating	12.7	0.7
Other Solvent Use	0.9	0.0
External Combustion Sources	1.0	166.5
Stationary Internal Combustion	0.3	7.0
Waste Disposal	0.4	5.2
Total	42.0	223.2



3.2.2 AREA SOURCES

The area source component of the emissions inventory is an estimate of the emissions of sources too numerous to quantify them on an individual basis. The amount of emissions from each individual source is small, but collectively emissions from these sources represent a sizable portion of the



inventory. In some cases, an area source category may represent the emissions from a specific activity associated with source. For example, gasoline distribution is broken into tank breathing and refueling emissions. Both categories represent emissions from service stations. Gasoline distribution also includes emissions from tank trucks in transit, another area source category, and bulk terminals, which are included in the point source inventory. Figure 3.5 displays the VOC emissions for the Baltimore nonattainment area.

The Department developed area source emissions estimates by multiplying an EPA-published emission factor by the activity indicator for each source category. Since source activity can vary throughout the year (for example, pesticides are applied more during the summer) seasonal adjustment factors developed by the EPA are also used to compile the inventory. In addition, as per EPA guidance, a rule effectiveness factor of 80% is assumed where applicable.

Another important consideration in developing an area source inventory is variations in the level of activity throughout the week. For example, automobile refinishing establishments may typically operate only five days per week while vehicles are refueled seven days per week.

The Department used one of four emission factor-based estimation approaches to calculate area source emissions:

- ❖ Per-capita emission factors;
- ❖ commodity consumption-related emission factors;
- ❖ level-of-activity-based emission factors; and
- ❖ employment-related emission factors.

Most of the emission estimates are calculated using procedures described in the EPA guidance document entitled *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I: General Guidance for Stationary Sources*.

The Department obtained activity and commodity level data from publications containing census and economic data, and from letter communications with individual companies and government agencies. Emission factors are from *Procedures, May 1991 and Compilation of Air Pollutant Emission Factors, Fourth Edition, Volume I: Stationary Point and Area Sources, AP-42.*

For certain categories, the Department subtracted ozone precursor emissions included in the point source inventory from the area source totals to avoid double counting. These categories include auto refinishing, industrial coating operations, and printing.

For a further discussion of the methodology used to calculate the area source emission inventory refer to *Volume 1, Section 3: Area Sources, and Volume 6: Area Source Supporting Documentation* of the complete inventory documentation.

3.2.3 ONROAD MOBILE SOURCES

The highway mobile source component of the base year inventory is an estimate of VOC, NO_x, and CO tailpipe emissions and VOC evaporative emissions from vehicles operating on public roadways. Emissions are estimated for eight types of vehicles, including light-duty vehicles, light-duty trucks, heavy-duty trucks (both gasoline and diesel), and motorcycles, operating on thirteen categories of rural and urban public roadways.

The official 1990 ozone precursor inventory for highway vehicles in the Baltimore Nonattainment Area is the hourly, transportation model link-based inventory documented in Section 4.5 of *Volume 2*. The Mobile Sources Control Program at the Department considers the inventory produced using this methodology to be the most rigorous locality-specific inventory possible given current data resources.

Methodology for the Baltimore Nonattainment Area

In accordance with the standard methodology developing highway vehicle emissions inventories, the Department based all emissions estimates on emissions factors developed using the EPA's MOBILE 5 emissions factor model (December 4, 1992 release). Activity levels were developed using both Highway Performance Measuring System (HPMS) Vehicle Miles Traveled (VMT) data and locality-specific transportation model data as developed by the Baltimore Metropolitan Council (BMC).

In general, the better resolution of a link-based inventory makes it more accurate than a lower resolution inventory such as an HPMS-based inventory. Whereas, in an HPMS inventory, all travel along a particular roadway classification (e.g., urban interstate highways) is aggregated into a single county-level value, link-based inventories break the same travel into a series of discrete segments (i.e., links), each of which represents a discrete portion of the particular roadway classification over which traffic flow can be uniformly defined. Travel speed associated with a link-based inventory can vary within a roadway classification in accordance with actual traffic variations. Conversely, variations in speed within an individual roadway classification in an HPMS inventory are not considered travel aggregation process. As a direct result of the nonlinear relationship between vehicle speed and emissions, vehicle emissions are underestimated.

Since the Baltimore nonattainment area is classified as severe, the Mobile Source Control Program opted, in an effort to quantify emissions as accurately as possible, to develop an inventory of the area using hourly, link level data . While this type of inventory involves substantially more detailed input data than a daily inventory, the increased rigor is warranted given the scope of the controls likely to be considered for the Baltimore nonattainment area over the next decade. In addition, the inventory framework developed to support an hourly, link-based inventory can readily be used for promoting increased accuracy in the transportation conformity process for the Baltimore area.[2]

Just as a link-based inventory provides better speed resolution, it also allows for better spatial and temporal resolution of emissions. HPMS travel data is available at a county level-of-detail and therefore requires additional disaggregation algorithms to further resolve data. Typically these disaggregation algorithms are difficult to develop and subject to error far in excess of that associated with a properly designed and validated transportation model which allocates travel to discrete sections of roadway within a modeling network.

3.2.4 NONROAD MOBILE SOURCES

Nonroad mobile sources include those vehicles and equipment which are powered by internal combustion engines, but which are not normally operated on public highways. This includes mobile construction and industrial machinery and farm equipment, lawn and garden equipment and recreational boats. Emissions from aircraft and airports, railroads, and sea vessels are also included in this portion of the inventory.

Section 213(a) of the Act mandates that the EPA conduct a study of emissions from nonroad engines and vehicles in order to determine if these emissions cause or significantly contribute to air pollution. The EPA contracted with Energy and Environmental Analysts, Inc. (EEA) to conduct an emissions inventory for 33 severe and serious ozone nonattainment areas. The study covered nine nonroad equipment categories:

- lawn and garden equipment;
- agricultural or farm equipment;
- logging equipment;
- industrial equipment;
- construction equipment;
- light commercial equipment;
- airport service equipment;
- recreational land vehicles or equipment; and
- recreational marine equipment.

Data from the study entitled *Nonroad Engine and Vehicle Emission Study*, was provided to the nonattainment areas under study for use in developing the 1990 base year inventory.

The EEA inventory weighted use equally throughout the week. A Baltimore survey of boat owners found that use of personal boats was split 40/60 weekday to weekend use. Maryland adjusted the EEA inventory to account for this and for a 50/50 split of weekday/weekend use of lawnmowers.

The remaining six nonroad categories not covered in the EEA study are railroads, commercial aviation, air taxis, general aviation, military aviation and vessels. Calculations for these categories were performed by the

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[2] The transportation conformity process is defined in the consultation procedures and the memoranda of understanding developed between the Departments of Transportation and the Environment and metropolitan planning organizations in Washington, DC, Baltimore, and Delaware.

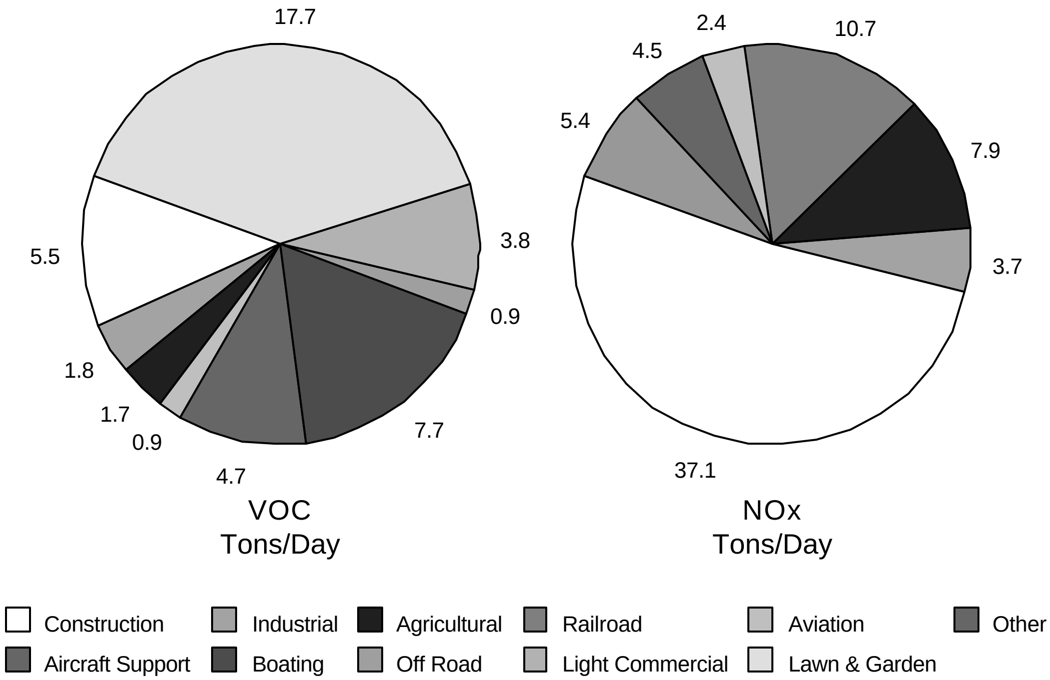
Department using methodologies in *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, Revised.*

Aircraft, marine vessel and railroad activities were considered constant throughout the year. The data necessary to estimate a seasonal variation in their emissions was not readily available, and their emissions represent a small fraction of both the total inventory and the nonroad inventory.

Table 3.6: Nonroad Source Emissions In Baltimore

Nonroad Source Category	Emissions (tons per day)
Lawn & Garden Equipment	17.7
Aircraft Services	0.9
Off-Road Vehicles	0.9
Recreational Boating	7.7
Construction	5.5
Industrial	1.8
Agricultural	1.7
Light Commercial	3.8
Logging	0.3
Other	4.4
Total	44.7

Figure 3.7: 1990 Base Year Ozone Precursor Emissions Inventory
Baltimore Nonattainment Area
Nonroad Source Emission Distribution By Category



3.2.5 BIOGENIC EMISSIONS

VOCs are emitted from biogenic sources (vegetation). The Department used the EPA *Personal Computer Version of the Biogenic Emissions Inventory System* (PC-BEIS), to calculate emissions from biogenic sources. PC-BEIS calculates VOC emissions in tons per day based on land use, leaf biomass factors (mass of dry leaf related to forest area), emission factors for different chemical species, and meteorological data.

The hourly meteorological data (wind speed, temperature, sky cover and relative humidity) were obtained from the National Weather Service at Baltimore Washington International Airport for July 6, 1988. The Introduction to *User's Guide to the Personal Computer Version of the Biogenic Emissions Inventory System* (PC-BEIS), recommends for a base year inventory to select a day based on the following steps:

- select top ten days with highest hourly ozone readings over most recent three years of monitoring
- obtain National Weather Service data for daily maximum temperature on each of the ten days
- rank temperature maxima from highest to lowest
- select fourth highest based upon maximum daily temperature
- use hourly meteorological data as above for this day as input to PC-BEIS

Using this criteria the Department selected July 6, 1988.

Land use data are from the Oak Ridge National Laboratory's GEOECOLOGY data base. It is aggregated into 25 land use types. The forest types are designated as primarily oak, other deciduous and mostly coniferous to match published emission factors in Lamb et al.

Table 3.6 summarizes the biogenic emissions for the state by county. Subtotals for the nonattainment areas are included.

TABLE 3.6 EMISSIONS FROM BIOGENIC SOURCES BY COUNTY

County	VOC (tpd)
Allegany	47.77
Anne Arundel	29.27
Baltimore	43.35
Calvert	22.01
Caroline	29.47
Carroll	38.91
Cecil	32.96
Charles	44.37
Dorchester	50.43
Frederick	57.95
Garrett	64.01
Harford	43.94
Howard	21.25
Kent	33.83
Montgomery	38.35
Prince George's	43.15
Queen Anne's	36.88
Saint Mary's	35.69
Somerset	23.83
Talbot	16.54
Washington	43.16
Wicomico	36.25
Worcester	43.94
Baltimore City	3.37
Baltimore Area	180.09
Washington Area (MD)	205.83
Kent/Queen Anne's	70.71
Unclassified Counties	391.09

[2] Lamb, B., A. Guenther, D. Gay, and H. Westburg (1987): A national inventory of biogenic hydrocarbon emissions. *Atmospheric Environment*, **21**, pp. 1695-1705.

4.0 THE PROJECTED EMISSIONS INVENTORIES

The Act requires all ozone nonattainment areas classified as moderate and above to achieve a 15 percent reduction in actual VOC emissions by 1996. Also, the Act requires that emissions be reduced by 3 percent every year until 2005. The reduction must be calculated from the anthropogenic VOC and NOx emission levels reported in the state's 1990 base year inventory after those levels have been adjusted for pre-1990 controls. The 1990 base year inventory is reported in Section 3. This section presents the projection year inventories, the state's estimation of the level of VOC and NOx emissions to be expected if no further action is taken to control VOC or NOx emissions.

The VOC and NOx projected year emissions inventories were derived by applying the appropriate growth factors to the 1990 base year emissions inventories. The EPA guidance describes four typical indicators of growth. In order of priority, these are:

- product output;
- value added;
- earnings and;
- employment

The population, households, and employment factors were based on Round 5 forecasts. For point and area, the Bureau of Economic Analysis (BEA) factors were used to project growth except for utilities and nonroad mobile sources. For these categories, the Economic Growth Analysis System (EGAS) was used as recommended by the EPA.

The results from using earnings data to project the point, area and nonroad sources using BEA and EGAS factors are presented. Mobile source growth is based on the computer modeling of 1996 mobile source patterns for the Baltimore nonattainment area. A brief discussion of the indicators and a detailed description of the BEA and EGAS methodology is provided in this section.

4.1 GROWTH FACTOR METHODOLOGY - BEA EARNINGS METHODOLOGY

4.1.1 DESCRIPTION OF DATA SOURCE

Growth rates for most point and area source categories in this study are derived from projection of industrial earnings made by the U.S. Department of Commerce, Bureau of Economic analysis (BEA, 1990). Using BEA industrial earnings to project emissions is consistent with EPA guidance on preparing emission projections. BEA projects State-specific industrial earnings for 57 industrial groups for the following years: 1995, 2000, 2005, 2010, and 2040. These 57 industrial groups can, for the most part, be matched with 2-digit Standard Industrial Classification (SIC) codes. Some new pseudo-SIC codes were assigned in the (99x) range for composite categories or categories not covered in the SIC system, such as population and VMT.

4.1.2 GROWTH PROJECTION METHODOLOGY

Growth rates for area source and VOC point sources came from the BEA earnings data. The methodology for developing NOx point source, and nonroad mobile source growth is presented separately in this section, along with justification for the distinct methodologies used. The methodology for calculating VMT growth rates is also presented separately, later in this section. BEA supplies historical data for 1973, 1979, 1983, and 1988 for each category for which it makes projections.

The first step in developing growth rates based on BEA factors is to estimate earnings in the base year (1990) and the projection years for which earnings data do not exist (1996, 1999, 2007). This is done by assuming straight-line growth between the two closest years for which data exists. For example, 1990 earnings were estimated using the following formula:

$$EARN_{90}=EARN_{88}+[2/7*(EARN_{95}-EARN_{88})]$$

where:

$EARN_{xx}$ = BEA earnings estimate in year xx

After using this process to estimate data for the base year and all projection years, average annual growth rates were calculated between the base year and each projection year:

$$AAGR_{BYPY}=\left[\left(\frac{EARN_{PY}}{EARN_{BY}}\right)^{\frac{1}{PY-BY}}-1\right]*100$$

where:

$AAGR_{BYPY}$ = average annual growth rate from the base year to the projection year (percent)
$EARN_{PY}$ = earnings in the projection year
$EARN_{BY}$ = earnings in the base year

4.1.3 OFFSET PROVISIONS

The Act requires that emission growth from major stationary sources in nonattainment areas be offset by reductions that would not otherwise be achieved by other mandated controls. The offset requirement applies to all new major stationary sources and existing major stationary sources that have undergone major modifications. Increases in emissions from existing sources resulting from increases in capacity utilization are not subject to the offset requirement. For the purposes of the offset requirement in severe ozone nonattainment areas such as the Baltimore nonattainment area, major stationary sources include all stationary sources exceeding 25 tons per year of VOC and NOx emissions, and 100 tons per year of CO emissions.

For extreme and severe areas, the Act also requires that mobile emission increases that result from increases in VMT be offset by transportation control measures. It is difficult at this time to determine if any offsets will be necessary under this provision because total reductions necessary for attainment and the reduction measures required to bring about these reductions have not been determined.

4.2 GROWTH FACTOR METHODOLOGY- EGAS GROWTH FACTORS

EGAS is composed of three tiers: a national economic tier, a regional economic tier, and a growth factor tier. Each of these tiers will be discussed briefly.

Tier 1: The National Economic Tier

The national economic tier includes a Regional Economic Modeling Institute (REMI) model of the United States which includes a baseline forecast calibrated to the one released by the Bureau of Labor Statistics (BLS). Although the BLS forecast is updated every two years, REMI updates the forecast using data released annually by BEA. In addition, the EGAS national economic tier contains the option to use economic forecasts from Wharton Economic Forecasting Association (WEFA). WEFA forecasts national economic activity under low growth, base case high growth, and cyclical growth scenarios.

The function of the national tier in EGAS is two-fold. First, the inclusion of a national forecasting capability allows EPA to forecast urban and regional economic growth using a common assumption about national economic growth. Second, it provides users with the ability to use the most current national economic forecasts and to simulate the effects of different levels of national growth on emission-producing activity in nonattainment areas.

Tier 2: The Regional Economic Tier

The regional economic tier includes separate economic models for each of the nonattainment areas and attainment portions of the States. The largest geographic area covered by an economic model is a State.

The regional economic models included in EGAS were built by REMI. The models simulate interaction between the 14 major sectors of an economy and produce estimates of employment and value added for 210 sectors. The 210-sector outputs are identified by BLS industrial codes. The BLS codes are closely related to three-digit SIC codes. Outputs from the regional models are used as input data for the growth factor tier.

The REMI models are designed to forecast future activity in an area and to simulate the effects of a policy change in an area. The models come with a capability for the user to simulate the effects of changes in almost 400 economic policy variables and over 70 demographic variables. The list of policy variables included with EGAS was reduced to 84 variables. Two criteria were used for choosing which policy would be included in the system: whether the policy variable relates to the implementation of the Act and whether the variable is one which local personnel using EGAS would be knowledgeable of , particularly changes of proposed changes. For example, industrial capital costs were included as a variable because that variable satisfies the first criterion. This variable will allow users to simulate the effects of control costs associated with the Act. Policy variables that satisfy the second criterion include local tax rates and State and local government spending. Policy variables which do not satisfy either criterion, and therefore are not in EGAS, include demographic variables such as birth and survival rates, and economic variables such as demand for goods not affected by the Act.

The REMI models and outputs contribute to the development of credible growth factors for future-year inventories in the following ways:

- Forecasts of activity from emission-producing sources were to be developed for both the attainment and nonattainment portions of States, allowing growth rates to differ between rural and urban portions of a State.

- Outputs form the models are used to produce area-level estimates of fuel consumption and and physical output.

- The effects of a nonattainment area policy on the surrounding areas can be assessed.

- Information on local policies can be entered directly into the REMI models. This ability allows users to include the effects of local policies when developing forecasts.

REMI outputs and the growth factor tier are linked in the following specific ways:

- REMI models provide income forecasts for estimating residential fuel consumption.

- REMI models provide population and personal income forecasts for estimating commercial energy consumption.

- REMI models provide the forecasts of the relative costs of capital, labor, and materials for estimating industrial fuel consumption.

- REMI models provide industry-specific employment and value added forecasts for estimating physical output.

Tier 3: The Growth Factor Tier

The third tier of EGAS is the largest portion of the system. Housed within the third tier are commercial, residential, industrial, and utility energy models; a physical output module; and a Crosswalk. Each of these modules will be discussed.

Utility Energy Models

The energy models in the system were developed by Argonne National Laboratories (ANL) and are currently being used for the National Acid Precipitation Assessment Program (NAPAP). The residential energy model, the Household Model of Energy (HOMES), was modified for use in the NAPAP model set in the mid-1980s. In 1989-1990, ANL updated HOMES to include the capability to model residential fuel consumption at the State, rather than Census, level. For use in EGAS, two changes were made to HOMES. First, the base year of the model projections was updated to 1990 using data from the State Energy Data Report (SEDS). Additionally, the capability to estimate growth in residential fuel consumption at the sub-State level was developed. REMI forecasts of population data for nonattainment areas and attainment portions of States are input with State-level fuel price forecasts to develop estimates for residential fuel consumption growth for seven fuels for each of the nonattainment areas and attainment portions of States in EGAS.

Commercial Energy Model

The Commercial Sector Energy Model (CSEMS), was also developed for use in the NAPAP model set in the mid-1980s and updated in 1989-1990 to estimate commercial fuel consumption at the State level. Like HOMES, the model was modified for use in EGAS to estimate commercial energy consumption growth for six fuels for nonattainment areas and surrounding attainment portions of States. The base year for the model projections was updated to 1990 using data form SEDS. Inputs to CSEMS include State-level fuel price forecasts and REMI forecasts of population and personal income at the sub-State level.

Industrial Energy Model

The Industrial Regional Activity and Energy Demand Model (INRAD), was developed to predict how energy use will be influenced by energy prices and the general level of economic activity. INRAD was developed to model energy consumption of fossil fuels and electricity for seven energy-intensive industries and an eighth "other" category with aggregates the non-energy-intensive industries. Two modifications to INRAD were made for use in EGAS. first, additional industrial categories were modeled. Second, INRAD was modified to estimate fossil fuel consumption by fuel type. With the modifications, INRAD can estimate coal, oil, gas, and electricity consumption for the following sectors: food, textiles, upstream paper products, down stream paper products, upstream chemicals, downstream chemicals, glass, glass products, and metals. Inputs to INRAD include State-level forecasts of fuel prices and REMI forecasts of the relative costs of capital, labor, and materials at the sub-State level.

Physical Output Module

The physical output module estimates physical output form value added data generated by the REMI models. Industrial VOC sources were ranked by their contributions to industrial VOC emissions and equations were developed for the largest VOC sources. These equations relate changes in physical output by three-digit SIC categories (as identified by BLS code) with changes in value added and a time trend to capture technological change. These equations provide better estimates of VOC-producing activity than value added alone because they estimate change in actual material output, which is related to the use of VOC producing materials, such as surface coatings and degreasers. For industrial VOC categories for which equations were not developed, activity levels are forecast using value added forecasts form the REMI models.

Electricity Generation Model

Electricity generation by electric utilities is forecast by the Neural Network Electric Utility Model (NUMOD). NUMOD is a behavioral model that uses three embedded neural networks to calculate annual generation activity indices and annual generation resulting from combustion of coal, oil, and natural gas in each of the 48 contiguous states. Although NUMOD forecasts state aggregate generation, it assumes that states are grouped into power pools. It also assumes that generation needed to meet demand in any state may be partially located in other states in the power pool. In contrast to traditional electric utility models, NUMOD used artificial intelligence to learn to relate the amount of electricity generated from data describing generation capacity, climate, peak loads, fuel prices, and power pool effects. The model operates by reading input records, each of which describes one state for one year. Each record is independent of every other record, allowing NUMOD to run any number of scenarios during a single model run.

The Crosswalk

The Crosswalk is the final component of the EGAS system. The Crosswalk translated growth factors from the energy and physical output modules into growth by SCC. The growth factors from the industrial energy and physical output modules are desegregated to the two-, three-, and sometimes four-digit SIC level, while growth factors from the electric utility model can be desegregated to the plant or county level by type of fuel consumption. The commercial and residential sector energy models desegregate consumption by fuel type only. The Crosswalk was developed by individually matching each of the approximately 7000 SCCs with the appropriate growth factor from the modules. This allows different growth factors to be applied to different emission sources form the same industrial category. For example, forecasts of fuel consumption in upstream chemical manufacturing are developed by INRAD, while forecasts of physical output of upstream chemical products are developed in the physical output module. This methodology takes into account that future emissions associated with a SIC code will vary by type of emission. This is consistent with the SCC system of clarification that differentiates according to not only industrial category, but also to processes within that category.

4.2.1 NOx POINT SOURCE GROWTH

EGAS will be used to project the AIRS point source inventories that are housed in the AIRS Facility Subsystem (AIRS/FS). These projected inventories will be used in photochemical grid modeling and RFP inventories. Because the AIRS/FS inventories will be projected on a source-specific basis, the user will be able to choose each growth factor. For example, if a user has information from permits or plant surveys about the expected growth of a point source, the user may use that information to predict future growth of that source within EGAS. The ability of the user to override default growth factors may be most important for electric utilities, which are permitted sources and are major emitters of oxides of nitrogen. EGAS produces default growth factors for commercial and industrial energy consumption, fuel consumption by electric utilities, and physical output by Bureau of Labor Statistics code, which represent groups of three- and four-digit SICs. These growth factors are then translated, via the EGAS CROSSWALK, into default growth factors by SCC. Because there is no direct linkage between EGAS and AIRS, users may alter the EGAS growth factor based on information that they have on specific emission sources.

EGAS uses the following information for projecting point source growth:

- Value added estimates for 210 non-farm industrial categories;
- Physical output estimates for 210 some major VOC-emitting sources; and
- Estimates of fuel consumption by type of fuel for the commercial, industrial, and electric utility sectors.

4.2.2 NONROAD GROWTH

Until the EPA develops it computer model for determining nonroad emissions, EGAS growth factors will also be used to determine future emissions from these sources.

The full text of the EPA guidance on projection of emissions from nonroad sources may be found in an EPA memo entitled "Guidance on Projection of Nonroad Inventories to Future Years", dated February 4, 1994. This guidance builds on a previously released report and subsequent development of nonroad inventories for use in 33 ozone and/or carbon monoxide nonattainment areas. These inventories were estimated as a product of equipment population, activity rates and emission factors.

EPA guidance recommends that states use one of the following five alternative methodologies to project nonroad inventories:

1. Project the original or state-modified (A+B)/2 inventory for 1990 to future years by projecting the indicator variables used to estimate the population and activity level of each engine-equipment type within the current A inventory.

2. Develop surrogates for the indicator variable(s) used to develop equipment population estimates for inventory A and use projections of the surrogate variables to project the indicator variables required under the first approach.

3. Project the 1990 inventory by multiplying 1990 emissions by the ratio of future to 1990 human population within the same nonattainment area.

4. Projecting emissions by multiplying 1990 emissions by the growth factors developed for EGAS

5. Project the 1990 inventory by using other projected data on equipment populations and activity levels specific to the nonattainment area in question in conjunction with EPA-provided in-use emission factors.

The Department has chosen option number four to project growth in emissions from nonroad sources.

Within EGAS, the surrogate indicators for nonroad sources are value added or population as identified in the table below.

Table 4.1: EGAS Surrogate Indicators for Projecting Growth in Nonroad Sources

Source Category	Relevant EGAS Growth Factors
Agricultural Equipment	Value Added: Farm
Aircraft	Value Added: Air Transportation
Airport Service Equipment	Value Added: Air Transportation
Commercial Marine	Value Added: Water Transportation
Construction Equipment	Value Added: Construction
Industrial Equipment	Value Added: Durable & Nondurable Mfg.
Lawn & Garden Equipment	Population
Light Commercial Equipment	Value Added: Retail, Wholesale, Services
Logging Equipment	Value Added: Logging
Military Vessels	Total Government

Railroads	Value Added: Railroad Transportation
Recreational Equipment	Population
Recreational Marine	Population

While these indicators appear to be the most appropriate considering the general application of EGAS, other area-specific factors may influence growth in these nonroad categories. For example, water surface area constraints may affect growth in marine vessel use, and population density and climatic conditions may affect emissions from lawn and garden equipment.

4.3 GROWTH FACTOR METHODOLOGY- MOBILE SOURCE GROWTH

Available data allows the on-road mobile source 1990 base year inventory to be projected to the attainment year of 2005 by transportation modeling techniques. The transportation model is run using vehicle fleet on the 2005 planned highway network. Appropriate population, household and employment growth are input through forecasting techniques. After projection of the emissions without controls, emission factors for each milestone's conditions are used in subsequent MOBILE5b runs to estimate sequentially the effect of each control measure on future emissions.

4.4 ASSUMPTIONS MADE IN CALCULATING GROWTH

The following section will summarize the basic assumptions applied in the construction of the projected emissions inventory. The issues involved include the use of actual versus allowable emissions in deriving the milestone emissions for each source category, and rule effectiveness and rule penetration assumptions.

4.4.1 USE OF BEA METHODOLOGY VS. USE OF EGAS METHODOLOGY

In projecting emission estimates the Department used the two methodologies described above, BEA and EGAS growth factors. The selection between these two methodologies was done based upon guidance from the EPA and through the analysis of both factors to each source category.

The EPA recommends the use of EGAS growth factors for the projection of nonroad emissions and NOx emissions from point sources. In addition, the Department analyzed these methodologies for NOx point sources. An analysis was developed for the projected estimates between EGAS and BEA growth factors. For example, EGAS uses a fossil fuel model which the Department feels projects realistically the use of fossil fuels for the Baltimore nonattainment area. This is important since fossil fuel-use by sources, such as utilities, are the major component of the point source emissions for NOx.

As recommended by the EPA, BEA growth factors were used for area sources and point source emissions of VOC. An analysis was also developed for these source categories using both methodologies. For the area source category, commercial and consumer products and new motor vehicle refinishing were projected by EGAS to decrease over the next ten years due to a population decrease in the Baltimore nonattainment area. This contradicts industry projections and the expectations of the Department.

In using the EGAS system, specific settings were chosen to run the model. The first setting was in the national tier, where the Department chose the BLS model over the WEFA model. Time constraints did not allow for a through comparison of the two models. In the regional tier, no policy changes were enacted, and the default settings for the Maryland Region were used. This was again due to time constraints and may be studied in the future.

4.4.2 ACTUAL VS. ALLOWABLE EMISSIONS IN THE CONSTRUCTION OF THE PROJECTED EMISSIONS INVENTORY

For the purposes of calculating projection emissions inventories, EPA guidance specifically outlines the circumstances under which emissions projections are to be based on actual or allowable emissions. For sources or source categories that are currently subject to a regulation and the state does not anticipate subjecting the source to additional regulation, emissions projections should be based on actual emissions levels. Actual emissions levels should also used to project for sources or source categories that are currently unregulated. For sources that are expected to be subject to additional regulation, projections should be based on new allowable emissions.

To simplify comparisons between the base year and the projected year, EPA guidance states that comparison should be made only between like emissions: actual to actual, or allowable to allowable, not actual to allowable. At this time, the Department does not have data to calculate allowable emissions for all sources that will be controlled in the future. Therefore, all base year and all projection year emissions estimates are based on actual emissions.

Formally, the distinction between "actual emissions" and "allowable emissions" is drawn under Title 26.11.01.01 of Maryland air quality regulations (COMAR, 1993). The term "actual emissions" means the average rate, in tons per year, at which a source discharged a pollutant during a 2-year period which preceded the date or other specified date, and which is representative of normal source operation. Actual emissions are calculated using the source's operating hours, production rates, and types of material processed, stored, or burned during the selected time period.

"Allowable emissions" are defined as "the maximum emissions a source or installation is capable of discharging after consideration of any physical, operations, or emissions limitations required by Maryland regulations or by federally enforceable conditions which restrict operations and which are included in an applicable air quality permit to construct or permit to operate, secretarial order, plan for compliance, consent agreement, court order, or applicable federal requirement".

4.4.3 EFFECT OF RULE EFFECTIVENESS

For the purposes of constructing the 1990 base year inventory, rule effectiveness was calculated using the EPA 80% default factor except for gasoline marketing where a Stationary Source Compliance Division study was done. Rule effectiveness was applied to the projected emissions reductions where appropriate using the 80% default factor. It was not applied in the case of product reformulations or total activity bans.

4.5 PROJECTION INVENTORY RESULTS

The VOC and NOx projection year emission inventory results with no control measures applied are summarized by component of the inventory in Table 4.2 for the Baltimore nonattainment area.

Table 4.2: Projection Year Emission Inventory Results for the Baltimore Nonattainment Area

	VOC Emissions (tpd)			NOx Emissions (tpd)		
Source	**1990**	**2002**	**2005**	**1990**	**2002**	**2005**
Mobile	134.2	105.30	106.10	159.5	169.60	173.80
Point	42.0	51.40	54.20	223.2	247.50	251.90
Area	122.4	130.50	132.20	13.7	15.10	15.40
Nonroad	44.7	53.37	55.76	71.5	86.65	91.84
Total	**343.3**	**340.57**	**348.26**	**467.9**	**518.85**	**532.94**

Area and Offroad Projections

Category	Indicator	VOC 1990	VOC 1996	VOC 1999	VOC 2002	VOC 2005	NOx 1990	NOx 1996	NOx 1999	NOx 2002	NOx 2005
Service Station Refueling	GAS	13.200	14.124	14.560	15.035	15.510	0.000	0.000	0.000	0.000	0.000
Tank Truck Unloading	GAS	0.800	0.856	0.882	0.911	0.940	0.000	0.000	0.000	0.000	0.000
Tank Breathing	GAS	1.050	1.124	1.158	1.196	1.234	0.000	0.000	0.000	0.000	0.000
Tank Trucks in Transit	GAS	0.180	0.193	0.199	0.205	0.212	0.000	0.000	0.000	0.000	0.000
Aircraft Refueling	EMP	0.410	0.516	0.561	0.597	0.627	0.000	0.000	0.000	0.000	0.000
Pet. Vessel Unloading	EMP	0.040	0.037	0.036	0.035	0.034	0.000	0.000	0.000	0.000	0.000
Cold Cleaning Degreasing	EMP	10.420	10.363	10.346	10.319	10.286	0.000	0.000	0.000	0.000	0.000
Architectural Surface Coatings	POP	19.230	20.363	20.828	21.263	21.684	0.000	0.000	0.000	0.000	0.000
Auto Refinishing	EMP	10.390	11.824	12.460	12.981	13.446	0.000	0.000	0.000	0.000	0.000
Graphic Arts	EMP	4.496	4.909	5.095	5.241	5.367	0.000	0.000	0.000	0.000	0.000
Pesticide Application	NONE	6.410	6.410	6.410	6.410	6.410	0.000	0.000	0.000	0.000	0.000
Commercial/Consumer Solvents	POP	20.260	21.454	21.943	22.402	22.845	0.000	0.000	0.000	0.000	0.000
Cutback Asphalt	POP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Emulsified Asphalt	POP	0.024	0.025	0.026	0.027	0.027	0.000	0.000	0.000	0.000	0.000
Traffic Marking	POP	0.610	0.646	0.661	0.674	0.688	0.000	0.000	0.000	0.000	0.000
Factory Finished Wood	EMP	0.320	0.322	0.328	0.330	0.328	0.000	0.000	0.000	0.000	0.000
Furntiure and Fixtures	EMP	3.450	3.471	3.534	3.555	3.555	0.000	0.000	0.000	0.000	0.000
Electrical Insulation	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Metal Cans	EMP	3.696	3.205	3.042	2.893	2.750	0.000	0.000	0.000	0.000	0.000
Misc. Finished Metals	EMP	0.710	0.710	0.710	0.704	0.696	0.000	0.000	0.000	0.000	0.000
Machinery and Equipment	EMP	1.152	1.152	1.152	1.150	1.146	0.000	0.000	0.000	0.000	0.000
Appliances	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
New Motor Vehicles	EMP	1.780	1.747	1.726	1.704	1.683	0.000	0.000	0.000	0.000	0.000
OtherTransportation Equipment	EMP	0.264	0.271	0.274	0.276	0.278	0.000	0.000	0.000	0.000	0.000
Marine Coatings	EMP	1.208	1.239	1.253	1.263	1.270	0.000	0.000	0.000	0.000	0.000
Misc. Manufacturing	EMP	2.715	2.715	2.715	2.715	2.715	0.000	0.000	0.000	0.000	0.000
Industrial Maintenance Ctgs.	EMP	3.617	3.137	2.977	2.831	2.691	0.000	0.000	0.000	0.000	0.000
Other Coatings	EMP	3.617	3.137	2.977	2.831	2.691	0.000	0.000	0.000	0.000	0.000
Municipal Landfills	POP	2.510	2.658	2.719	2.775	2.830	0.000	0.000	0.000	0.000	0.000
Incinerators	POP	0.036	0.038	0.039	0.040	0.041	0.260	0.275	0.282	0.287	0.293
POTWs	HHS	2.520	2.668	2.729	2.786	2.842	0.000	0.000	0.000	0.000	0.000
Structure Fires	POP	0.050	0.053	0.054	0.055	0.056	0.000	0.000	0.000	0.000	0.000
Slash/Prescribed Burning	NONE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Forest Fires	NONE	0.020	0.020	0.020	0.020	0.020	0.000	0.000	0.000	0.000	0.000
Open Burning	NONE	3.640	3.640	3.640	3.640	3.640	0.760	0.760	0.760	0.760	0.760
Leaking U.S.T.	NONE	3.360	3.360	3.360	3.360	3.360	0.000	0.000	0.000	0.000	0.000
R/C/I Fuel Use - Coal	POP	0.054	0.057	0.058	0.060	0.061	4.832	5.117	5.234	5.343	5.449
R/C/I Fuel Use - Fuel Oil	POP	0.074	0.078	0.080	0.081	0.083	4.415	4.675	4.782	4.882	4.978
R/C/I Fuel Use - Natural Gas	POP	0.114	0.121	0.123	0.126	0.129	3.199	3.387	3.465	3.537	3.607
R/C/I Fuel Use - LPG	POP	0.002	0.002	0.002	0.002	0.002	0.252	0.267	0.273	0.278	0.284
Bakeries	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breweries	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wineries	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oil Spills	POP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogenic*	NONE	180.090	180.090	180.090	180.090	180.090	0.000	0.000	0.000	0.000	0.000
Total		**122.428**	**126.643**	**128.677**	**130.492**	**132.175**	**13.718**	**14.481**	**14.795**	**15.088**	**15.371**

Category	Indicator	VOC 1990	VOC 1996	VOC 1999	VOC 2002	VOC 2005	NOx 1990	NOx 1996	NOx 1999	NOx 2002	NOx 2005
Recreational Equipment	EGAS	0.860	0.931	0.974	1.014	1.042	0.000	0.000	0.000	0.000	0.000
Construction Equipment	EGAS	5.480	6.175	6.598	7.062	7.561	37.040	41.740	44.596	47.711	51.115
Industrial Equipment	EGAS	1.770	1.883	2.100	2.260	2.426	3.680	3.916	4.368	4.687	5.045
Light Commercial Equipment	EGAS	3.800	4.261	4.621	5.015	5.449	0.510	0.572	0.616	0.674	0.731
Lawn & Garden Equipment	EGAS	17.680	19.236	20.028	20.756	21.423	0.290	0.316	0.329	0.340	0.351
Farm Equipment	NONE	1.720	1.720	1.720	1.720	1.720	7.870	9.887	7.870	7.870	7.870
Logging Equipment	EGAS	0.330	0.349	0.374	0.398	0.433	0.000	0.000	0.000	0.000	0.000
Aircraft Support	EGAS	0.880	1.001	1.124	1.251	1.408	5.380	6.119	6.847	7.650	8.574
Commercial Aviation	EGAS	0.490	0.581	0.624	0.728	0.781	1.440	1.638	1.836	2.054	2.295
General Aviation	EGAS	0.140	0.166	0.178	0.208	0.223	0.010	0.011	0.013	0.014	0.016
Air Taxis	EGAS	0.080	0.095	0.102	0.119	0.128	0.010	0.011	0.013	0.014	0.016
Military Aviation	NONE	2.810	2.810	2.810	2.810	2.810	0.980	0.980	0.980	0.980	0.980
Vessels	EGAS	0.410	0.449	0.479	0.510	0.544	2.780	3.045	3.250	3.460	3.689
Pleasure Boats	EGAS	7.710	8.391	8.734	9.048	9.342	0.920	1.001	1.050	1.080	1.120
Railroads	EGAS	0.490	0.475	0.475	0.470	0.469	10.580	10.263	10.189	10.113	10.040
Total		**44.650**	**48.524**	**50.941**	**53.370**	**55.759**	**71.490**	**79.499**	**81.956**	**86.648**	**91.844**

5.0 CALCULATING THE VOC EMISSION TARGET LEVELS FOR THE POST-1996 MILESTONE YEARS

To determine the amount of emissions reductions required after the year 1996, the Department must calculate the target level for VOC emissions at each milestone year for the Baltimore nonattainment area. The target level is the maximum amount of VOC emissions that can be emitted to comply with the Act's requirements. Table 5.1 demonstrates the target level of VOC emissions at each milestone year for the Baltimore nonattainment area. A discussion on how the target level is calculated is discussed in Section 5.2.

Table 5.1: Baltimore Area Emission Target Levels for Post-1996 Milestone Years

Milestone	VOC Emissions	NOx Emissions
2002	235.8	375.3
2005	224.0	351.5

5.1 NOx SUBSTITUTION

If a nonattainment area cannot meet the VOC emission target level, Section 182(c)(2)(C) of the Act allows for the substitution of actual NOx emission reductions which occur after 1990 to meet the VOC emission target level. This may be done provided that such reductions meet the criteria outlined in the EPA's December 15, 1993 NOx Substitution Guidance (Appendix G).

One of the conditions for meeting the VOC emission target level using NOx substitution is that the sum of all creditable VOC and NOx emission reductions must equal 3 percent per year averaged over each applicable milestone period. In other words, any combination of VOC and NOx emission reductions which totals 3% per year.

The following equation generally describes the method to calculate the total 3% per year emission reductions:

$R_V/VOC(Adj.) + R_N/NOx(Adj.) >= 0.03$

where; RV = typical summer day VOC reductions
RN = typical summer day NOx reductions
VOC(Adj.) = human-made 1990 adjusted VOC emissions inventory, and
NOx(Adj.) = human-made 1990 adjusted NOx emissions inventory.

The values of R_V and R_N include only the creditable emission reductions from the nonattainment area of concern. For instance, VOC and NOx reductions from automobile tailpipe and gasoline volatility standards adopted prior to the Act's amendments of 1990 are excluded from these values. The Act specifically excludes these as programs that may be not credited toward Rate-of Progress.

The values of VOC(Adj.) and NOx(Adj.) include the 1990 adjusted emissions inventories. These values are equal to the 1990 man-made base year inventory minus reductions from the pre-enactment automobile tailpipe and gasoline volatility standards.

The second condition for using NOx substitution requires the amount of NOx emission reductions used to meet the *Post-1996 RPP* be consistent with the amount of NOx emission reductions mandated by the urban airshed model. The amount of reductions necessary to bring an area into attainment with the ozone standard is determined by the urban airshed model. Therefore, the reductions required by the model must be met in addition to those required by the RPPs. However, do to the chemical reactions the maximum amount of NOx reductions required is that dictated by the model. NOx reductions have the potential of increasing ozone. In conclusion, when using NOx substitution to meet the RPP requirements the amount of NOx reductions is capped to the amount required by the model.

In order to use NOx substitution NOx emission reductions have to be factored in. The EPA developed an approach where a target level for VOC and NOx emissions is determined. Detailed calculations of the VOC target levels following the EPA's guidance is included in Appendix C. For simplicity, the Department has developed a process with the same results as the EPA method. The Department's approach involves converting NOx reductions into equivalent VOC reductions through a ratio of VOC to NOx adjusted emissions. See Appendix H for details.

5.2 CALCULATION OF THE VOC EMISSION TARGET LEVELS FOR THE POST-1996 TARGET LEVELS

The target level of emissions represents the maximum amount of emissions that a nonattainment area can emit for a given target year while complying with the three percent per year reduction requirements.

Two equations are presented in the General Preamble to describe the calculation of the target levels. These equations can be generalized into the following single equation:

Target level = (previous milestone's target level) - (reductions required to meet the rate-of-progress requirement) - (fleet turnover correction term).
or
TLx = TLy - BGx - FTx
where:

TLx = Target level of emissions for current milestone
TLy= Target level of emissions for previous milestone
BGx= Emission reduction requirement for current milestone
FTx = Fleet turnover correction term for current milestone

This equation can be used to calculate the target level of emissions for each post-1996 milestone year. The target level for each milestone year (TLx) is obtained by subtracting the 3 percent per year rate-of-progress emission reduction

(BGx) and the fleet turnover correction term (FTx) from the previous milestone year (TLy).
There are six major steps in calculating a post-1996 target level of emissions. The first four steps are needed to calculate the 3 percent per year rate-of-progress emission reductions. Steps 1 and 2,

developing the 1990 base year inventory and the 1990 rate-of-progress inventory, were required in the 15 percent rate-of-progress plan.

The 1996-2005 target levels have been revised from those included in the Phase I Plan submittal for the Baltimore area. The target levels are revised to take into account new estimates for mobile emissions.

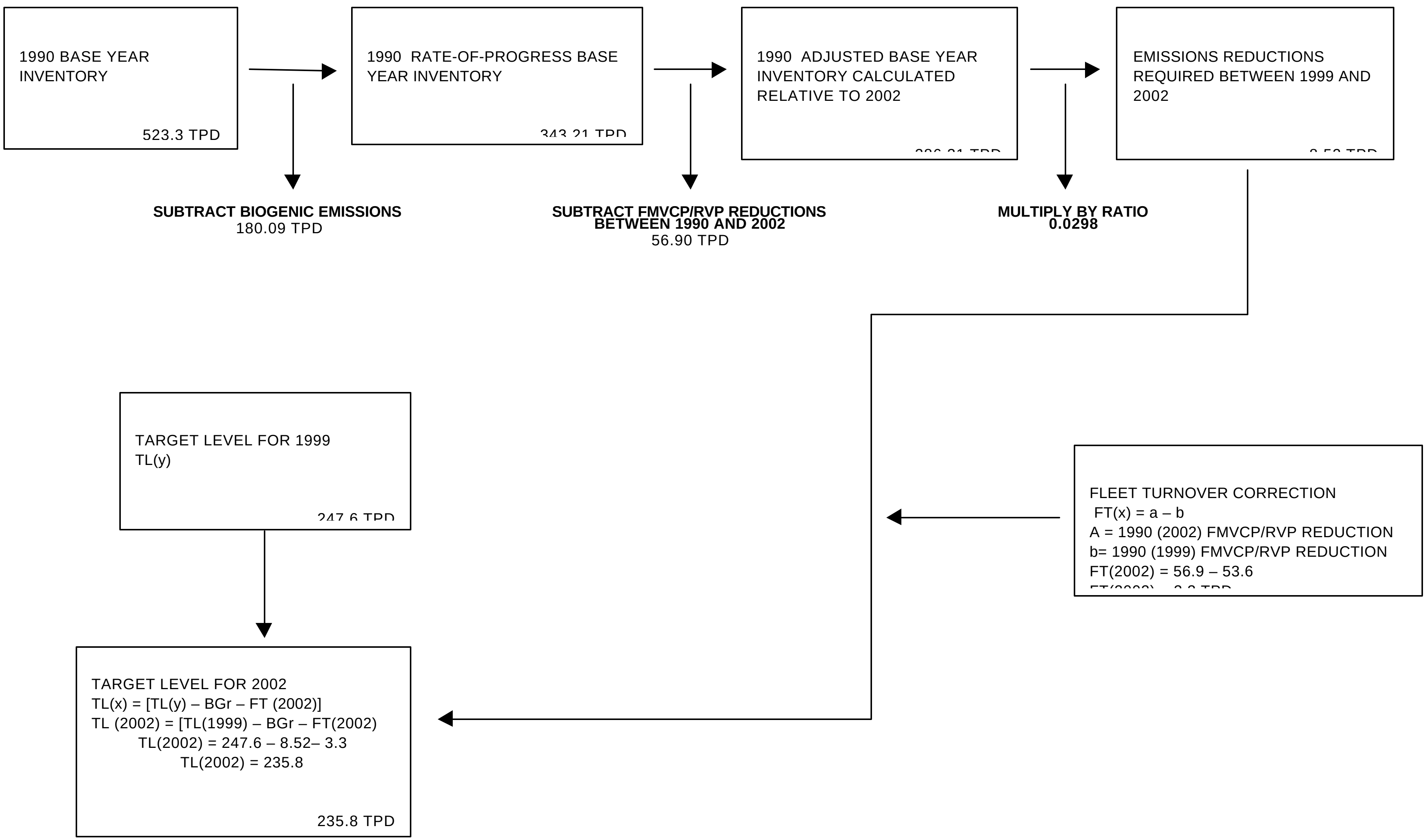
The new 1996 target levels are the following:

Baltimore Nonattainment Area

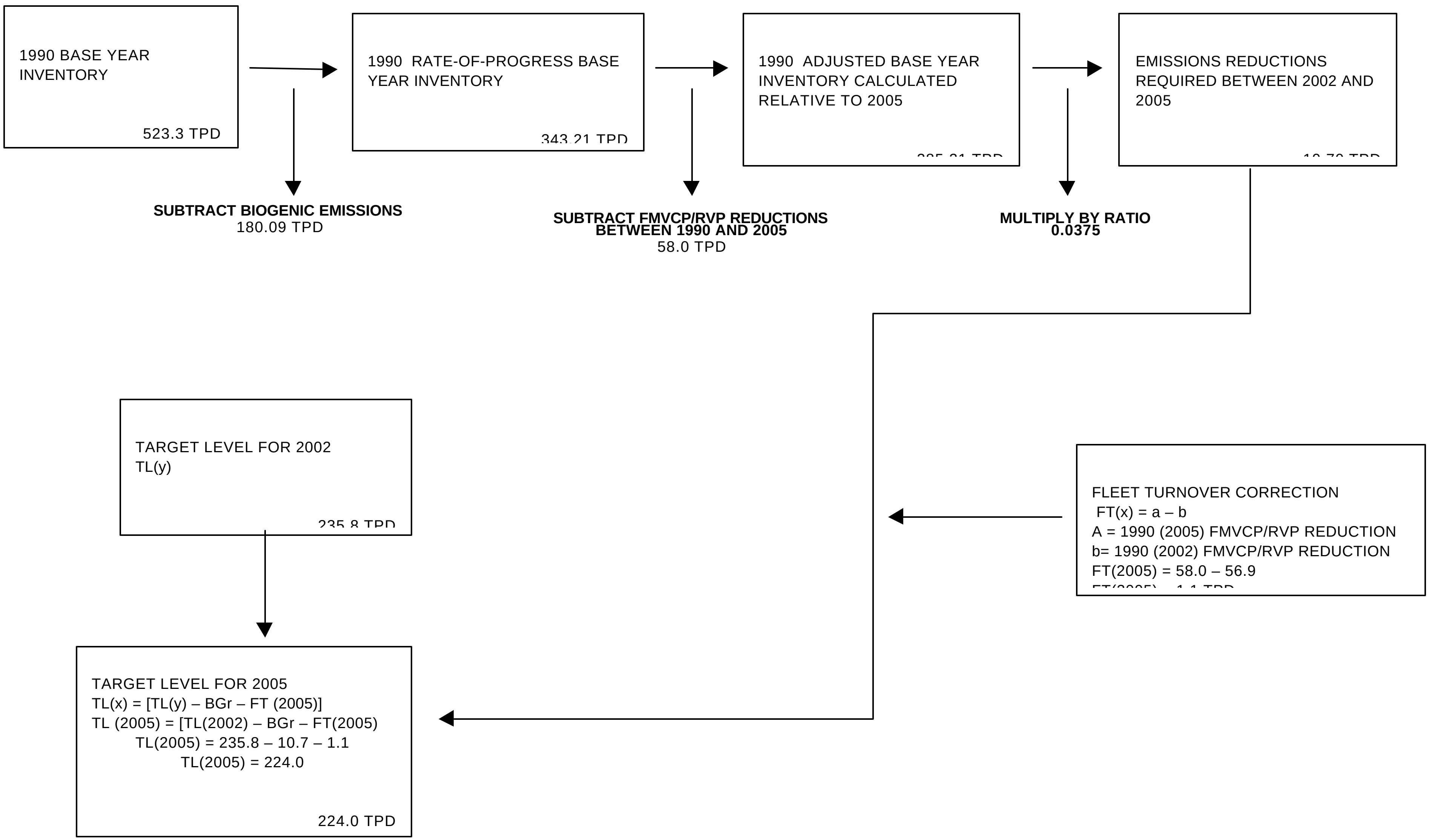
Baseyear Inventory	343.3
Noncreditable Reductions (1990-1996)	- 39.7
Adjusted Baseyear	303.6
Target Level (85% of Adj. BY)	258.1
Noncreditable Reductions (1990-1996)	- 4.8
Adjusted Target Level	253.3

The following figures contain the calculation for the 2002 and 2005 target levels.

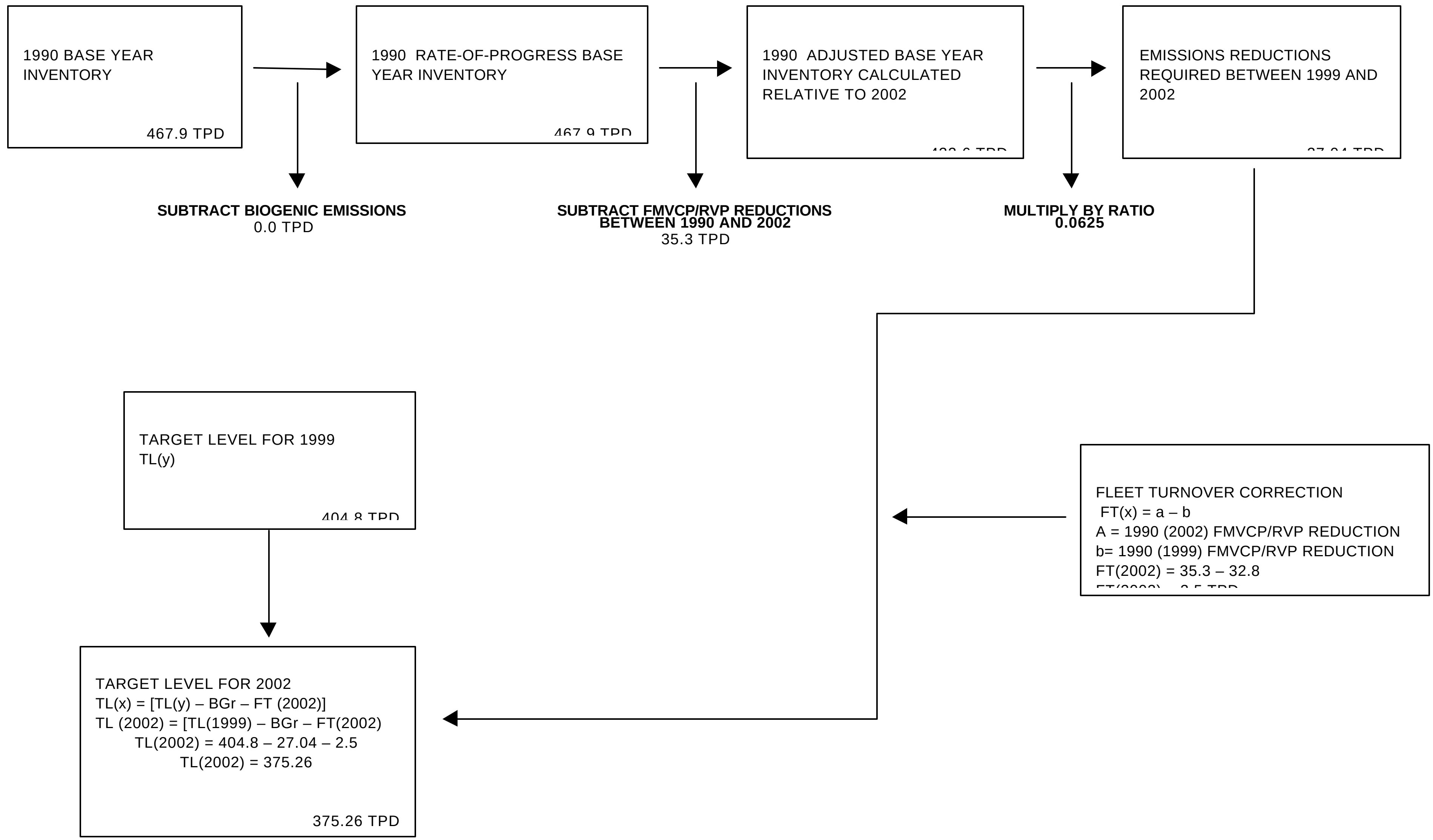
Flowchart for VOC Target Level for 2002 Milestone
Baltimore Nonattainment Area



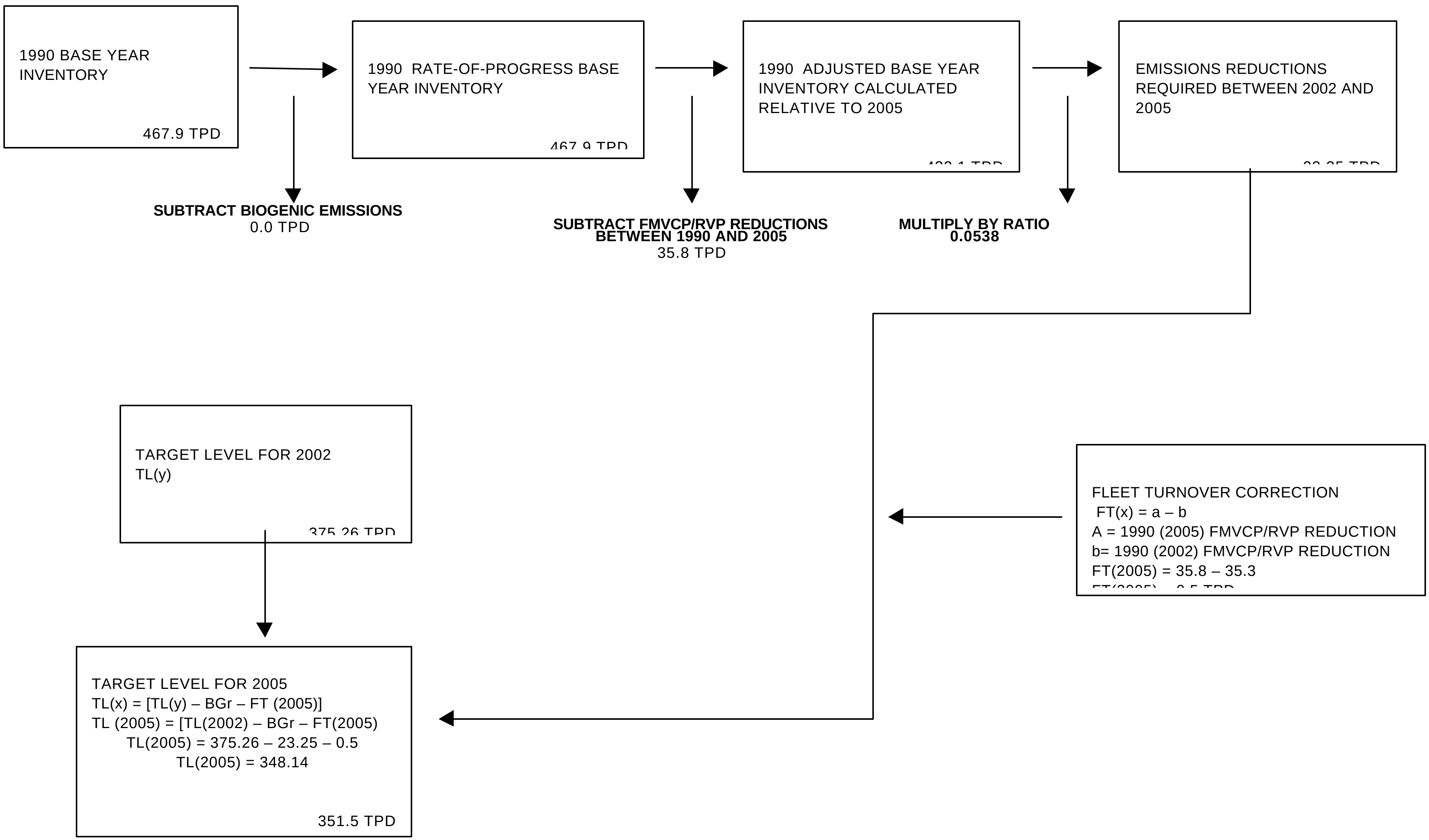
Flowchart for VOC Target Level for 2005 Milestone
Baltimore Nonattainment Area



Flowchart for NOx Target Level for 2002 Milestone
Baltimore Nonattainment Area



Flowchart for NOx Target Level for 2005 Milestone
Baltimore Nonattainment Area



6.0 CONTROL MEASURES TO MEET THE RATE OF PROGRESS REQUIREMENTS

This section briefly summarizes the control measures which account for the emission reductions required to meet the Rate-of-Progress requirements for the 2002 and 2005 milestones. Table 6.1 demonstrates the summary of emission reductions expected from considering the control measures used to meet the 2002 and 2005 milestones.

Table 6.1 - Summary of Emission Benefits For The Baltimore Area (Tons Per Day)

	2002		2005	
Control Measure	**VOC**	**NOx**	**VOC**	**NOx**
Enhanced I/M				
Tier I				
Reform Gas				
LEV				
HDDE				
Total Mobile	51.20	56.70	57.40	69.50
Stage II/Refuel	9.00	0.00	10.00	0.00
Landfills	0.28	0.00	0.26	0.00
Open Burning	3.60	0.76	3.60	0.76
Surface Cleaning/ Degreasing	7.22	0.00	7.20	0.00
Architectural Coatings	5.52	0.00	5.55	0.00
Consumer Products	2.78	0.00	2.83	0.00
Auto Refinishing	5.84	0.00	6.05	0.00
Nonroad Small Gasoline Engines	9.69	-0.37	17.51	-0.45
Nonroad Diesel Engines	0.00	10.96	0.00	16.13
Marine Engine Standards	0.86	-0.01	1.79	-0.07
Railroads	0.00	2.40	0.00	4.20
Expandable Polystyrene	0.12	0.00	0.12	0.00
Yeast Production	0.81	0.00	0.87	0.00
Commercial Bakeries	0.85	0.00	0.86	0.00
Screen Printing	0.24	0.00	0.25	0.00
Federal Air Toxics	0.50	0.00	0.50	0.00
Graphic Arts – Lithography	2.61	0.00	2.66	0.00
Graphic Arts – Rotogravure & Flexographic	0.88	0.00	0.90	0.00
Enhanced Rule Compliance	4.90	0.00	5.10	0.00
State Air Toxics	1.10	0.00	1.20	0.00
NOx RACT	0.00	4.90	0.00	5.00
NOx Phase II/III	0.00	90.00	0.00	133.035
FMVCP/RVP				
Total	107.99	165.34	124.66	228.10
Projected Uncontrolled Emissions	340.57	518.85	348.26	532.94
Emission Level Obtained	232.32	353.51	223.60	304.84

Emission Level Required	235.80	375.30	224.00	351.50
Surplus	3.22	21.79	0.40	46.66

Enhanced Vehicle Inspection and Maintenance (Enhanced I/M)

This measure involves implementing a vehicle emission inspection and maintenance program with stricter requirements than the "basic" program.

Description of Source Category

This measure affects light duty gasoline vehicles, light duty gasoline trucks and heavy-duty gasoline vehicles up to 26,000 pounds.

Control Strategy

The Act requires enhanced motor vehicle inspection and maintenance (I/M) programs in serious, severe, and extreme ozone nonattainment areas with urbanized populations of 200,000 or more. In Maryland, this required enhanced I/M program impacts the 8 jurisdictions currently operating a basic I/M program as well as 6 new jurisdictions, for a total of 14 of the 23 jurisdictions in the state.

Maryland obtained VOC emissions reductions by adopting regulations for an enhanced vehicle emissions I/M program that contains test procedures which will detect more emissions-related faults, cover a larger geographic area in the state, and allow fewer waivers from emissions standards. Tailpipe emissions will be measured over a transient driving cycle conducted on a dynamometer, which provides a much better indication of actual on-road vehicle performance than the existing idle test. Evaporative emissions control equipment will be checked for function and integrity, resulting in large emissions reductions not achieved with the current program. The geographic expansion will bring approximately 500,000 additional cars into the program. In addition, the projected waiver rate will decrease from approximately 15% of failed vehicles to 3%.

Estimated Emissions Reductions and Methodology

The EPA's mobile emissions model, MOBILE5b, with locality-specific inputs and appropriate design parameters for Maryland's enhanced I/M program, was used to estimate the VOC and NOx emissions reductions obtained from this control strategy. The specific methodologies and assumptions associated with modeling the enhanced I/M program can be found in the input stream for the model runs used to prepare the 2005 mobile source emissions budget (see Appendix B.) The expected reductions in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	25.7	24.9	26.5	26.1

Maryland Department of the Environment
Mobile Sources Control Program

2002 Balto Area Highway Vehicle Emission Analysis
Control By Control Emissions in Tons per Day

	1990 Activity Level		2002 Activity Level					
	1990 B/L	90 Adj B/L in 02	1	2	3	4	5	Scenario
Stab Exh VOC	54.6	34.5	51.6	48.7	41.2	28.0	27.6	
Cold Exh VOC	17.3	16.3	21.7	19.1	16.0	11.6	10.3	
Hot Exh VOC	4.4	3.3	5.3	4.9	4.0	2.7	2.6	
Sub Tot Exh VOC	76.3	54.1	78.6	72.7	61.2	42.3	40.5	
Sub Tot Evap VOC	71.0	36.3	39.0	31.4	29.1	22.3	16.9	
Total VOC	147.3	90.4	117.6	104.1	90.3	64.6	57.4	
Refueling VOC	13.1	11.2	12.3	9.1	8.7	8.7	3.3	
Tot NonRef VOC	134.2	79.2	105.3	95.0	81.6	55.9	54.1	
Stab Exh NOx	146.4	113.2	155.7	134.0	130.5	107.4	105.9	
Cold Exh NOx	9.4	8.2	9.9	7.3	6.7	5.4	5.1	
Hot Exh NOx	3.7	2.8	4.0	3.1	2.5	2.0	1.9	
Total Exh NOx	159.5	124.2	169.6	144.4	139.7	114.8	112.9	
								Total
NrefVOC Benefit		55.0		10.3	13.4	25.7	1.8	51.2
RefVOC Benefit		1.9		3.2	0.4	0.0	5.4	9.0
NOx Benefit		35.3		25.2	4.7	24.9	1.9	56.7
		Non-Creditables						Creditables
NRefVOC Growth	VMT + Trips		26.1					
RefVOC Growth			1.1					
NOx Growth			45.4					
Control Programs Accounted for:		FMVCP + RVP		Tier 1	RFG	IM240	NLEV+ HDE + Stage II	

Note:

1. 1990 Adjusted Baseline emissions in 2002; 2002 emission factors with no CAAA90 requirements- (i.e, no Tier I tailpipe standards or new evap test procedure), 7.0 RVP, and 1990 I/M Programs
2. Scenario 1 – Tier 0: same controls as above. Change is only in the activity levels (using 2002 levels).
3. Scenario 2 – Tier 1; 2002 emission factors with CAAA90 requirements in effect, 7.0 RVP and, 1990 I/M programs.
4. Scenario 3; Reformulated Gasoline (RFG) program added.
5. Scenario 4; IM240 program added.
6. Scenario 5; NLEV in 1999, Stage II in 1993, New HDE Rule in 2004.

Maryland Department of the Environment
Mobile Sources Control Program

2005 Balto Area Highway Vehicle Emission Analysis
Control By Control Emissions in Tons per Day

	1990 Activity Level		2005 Activity Level					
	1990 B/L	90 Adj B/L in 05	1	2	3	4	5	Scenario
Stab Exh VOC	54.6	33.8	51.7	47.6	40.1	26.4	25.4	
Cold Exh VOC	17.3	16.4	22.4	19.3	16.2	11.5	9.6	
Hot Exh VOC	4.4	3.3	5.4	4.8	3.9	2.6	2.3	
Sub Tot Exh VOC	76.3	53.5	79.5	71.7	60.2	40.5	37.3	
Sub Tot Evap VOC	71.0	35.8	39.2	26.6	24.6	17.8	14.0	
Total VOC	147.3	89.3	118.7	98.3	84.8	58.3	51.3	
Refueling VOC	13.1	11.2	12.6	6.6	6.4	6.4	2.6	
Tot NonRef VOC	134.2	78.1	106.1	91.7	78.4	51.9	48.7	
Stab Exh NOx	146.4	113.0	159.9	132.7	128.8	104.5	97.8	
Cold Exh NOx	9.4	8.0	10.0	7.1	6.6	5.3	4.8	
Hot Exh NOx	3.7	2.7	3.9	2.9	2.4	1.9	1.7	
Total Exh NOx	159.5	123.7	173.8	142.7	137.8	111.7	104.3	
								Total
NrefVOC Benefit		56.1		14.4	13.3	26.5	3.2	57.4
RefVOC Benefit		1.9		6.0	0.2	0.0	3.8	10.0
NOx Benefit		35.8		31.1	4.9	26.1	7.4	69.5
		Non-Creditables						Creditables
NRefVOC Growth	VMT + Trips		28.0					
RefVOC Growth			1.4					
NOx Growth			50.1					
Control Programs Accounted for:		FMVCP + RVP		Tier 1	RFG	IM240	NLEV+ HDE + Stage II	

Note:

1. 1990 Adjusted Baseline emissions in 2005; 2005 emission factors with no CAAA90 requirements- (i.e, no Tier I tailpipe standards or new evap test procedure), 7.0 RVP, and 1990 I/M Programs
2. Scenario 1 – Tier 0: same controls as above. Change is only in the activity levels (using 2005 levels).
3. Scenario 2 – Tier 1; 2005 emission factors with CAAA90 requirements in effect, 7.0 RVP and, 1990 I/M programs.
4. Scenario 3; Reformulated Gasoline (RFG) program added.
5. Scenario 4; IM240 program added.
6. Scenario 5; NLEV in 1999, Stage II in 1993, New HDE Rule in 2004.

Tier I Vehicle Emission Standards and New Federal Evaporative Test Procedures

The Act requires a new and cleaner set of federal motor vehicle emissions standards (Tier I standards) beginning with model year 1994. The Act also required a uniform level of evaporative emission controls, which are more stringent than most evaporative controls used in existing vehicles.

Description of Source Category

These federally implemented programs will affect light duty vehicles and trucks.

Control Strategy

The federal program requires more stringent exhaust emissions standards as well as a uniform level of evaporative emissions controls, demonstrated through new federal evaporative test procedures. The Tier I exhaust standards are to be phased in beginning with model year 1994.

Expected Emissions Reductions and Methodology

The MOBILE5b emissions factor model automatically applies these controls unless the input file has been modified to disable the Act's tailpipe standards and the evaporative test procedure. Using the emission reductions in the output to MOBILE5b, the expected reductions in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	10.3	25.2	14.4	31.1

Reformulated Gasoline

This federally mandated measure requires the use of lower polluting "reformulated" gasoline in the Baltimore Nonattainment Area.

Description of Source Category

All gasoline-powered vehicles are affected by this control measure. Vehicle refueling emissions at service stations are also reduced. In addition, emissions from gasoline powered nonroad vehicles and equipment will be reduced by this control strategy.

Control Strategy

The Act requires significant changes to conventional fuels for areas that exceed the health-based ozone standard. They require the EPA to establish specifications for reformulated gasoline that would achieve the greatest reduction of VOCs and toxic air pollutants achievable considering costs and technological feasibility.

At a minimum, reformulated gasoline must not cause an increase in NOx emissions, must have an oxygen content of at least 2.0% by weight, must have a benzene content no greater than 1.0% by volume and must not contain any heavy metals. Most importantly, the Act requires a reduction in VOC and toxic emissions of 15% over base year levels beginning in 1995 and 25% beginning in the year 2000.

Since January of 1995, only gasoline that the EPA has certified as reformulated may be sold to consumers in the nine worst ozone nonattainment areas with populations exceeding 250,000. Other ozone nonattainment areas are permitted to "opt-in" to the federal reformulated gasoline program.

Use of reformulated gasoline is required in the Baltimore nonattainment area.

Expected Emissions Reductions and Methodology

The emissions factor used in calculating the reduction from this measure was determined using MOBILE5b. Activity levels were developed using both HPMS VMT data and locality specific transportation model data as developed by the Baltimore Metropolitan Council (BMC), which provides support staff and structure for the Transportation Steering Committee, the Metropolitan Planning Organization (MPO) for the Baltimore Metropolitan Area. Using the emission reductions in the output to MOBILE5b, the expected reductions in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	13.4	4.7	13.3	4.9

Stage II and New Vehicle On-Board Vapor Recovery Systems

These two separate measures require the installation of Stage II vapor recovery nozzles at gasoline pumps and the requirement of onboard refueling emissions controls for new passenger cars and light trucks beginning in the 1998 model year. Maryland adopted Stage II vapor recovery regulations for the Baltimore and Washington nonattainment areas and Cecil County in January of 1993.

Description of Source Category

When motor vehicle fuel tanks are refueled at a gasoline dispensing facility, gasoline vapors in the fuel tank are displaced by incoming gasoline. The vapors are discharged directly to the air.

Vehicle refueling emissions are the fuel vapors displaced from a vehicle tank when it is filled. These emissions account for a significant portion of the volatile organic compounds (VOCs) released into the air by motor vehicles and contribute to the formation of ozone and smog. In addition, gasoline vapors contain air toxics.

Control Strategy

The Stage II vapor recovery regulation requires that the dispensing system be equipped with nozzles that are designed to return the vapors through a vapor line into the gasoline storage tank. The vapors may be forced back to the storage tank by the pressure of the incoming liquid (vapor balance system) or by a vacuum pump or other mechanical device that creates a vacuum at the nozzle to more efficiently contain the vapors (vapor assist system). Maryland requires all systems used to be approved by the California Air Resources Board (CARB) which ensures a minimum control efficiency of 95 percent.

In addition, an EPA rule requires the use of onboard refueling vapor recovery (ORVR) systems for new passenger cars and light trucks beginning in model 1998. Light trucks include pickups, mini-vans, and most delivery and utility vehicles. Heavy duty vehicles and trucks over 8,500 pounds gross vehicle weight rating (GVWR) are exempt from the ORVR requirement. Upon full implementation, the ORVR rule will cover over ninety percent of all new gasoline-powered vehicles sold in Maryland.

Essentially, the ORVR system operates by storing the vapors displaced from the fuel tank during a refueling event and subsequently routing these VOC vapors to the engine, where the vapors are burned during vehicle operation. The EPA has allowed manufacturers to retain some flexibility in meeting the requirements. Although the EPA has not prescribed any particular technology, most past ORVR designs have been canister-based. In such a system, the displaced VOC vapors are stored in a canister by being adsorbed onto a bed of activated carbon contained within the canister. During vehicle operation, a manifold vacuum is used to pull ambient air over the carbon bed, stripping the VOCs from the canister. This VOC-rich purge gas is then routed to the engine and burned.

Emissions Reductions

Using MOBILE5b, the expected emissions reductions for these measures are listed below.

	2002 VOC	2002 NOx	2005 VOC	2005 NOx
Baltimore	9.0	0.0	10.0	0.0

National Low Emission Vehicle Program and Heavy Duty Engine Rule

National Low Emission Vehicle Program

On January 30, 1998, Maryland Governor Parris N. Glendening wrote to EPA agreeing to pursue a clean car program known as the National Low Emission Vehicle Program (NLEV). Maryland's participation in the voluntary program, however, was conditioned on the participation of all major motor vehicle manufacturers in the program and on their making NLEV vehicles available in Maryland beginning with the 1999 model year.

NLEV vehicles are 70% cleaner than vehicles now sold in Maryland. In making his decision, the Governor cited nationwide health and environmental benefits as a reason for pursuing the program. The program will provide emissions reductions that will help Maryland to meet the federal air quality standards for ozone. In addition, a national program will reduce vehicle emissions transported into Maryland from other states.

Heavy-Duty Engine Rule

On May 1, 1999, EPA proposed tighter tailpipe emissions standards for cars and light trucks weighing up to 8,500 pounds. Commonly referred to as Tier 2, these standards would take effect beginning in 2004 when manufacturers would start producing passenger cars that are 77 percent cleaner than those on the road today. Light-duty trucks, such as SUVs, which are subject to standards that are less protective than those for cars, would be as much as 95 percent cleaner under the new standards. EPA's heavy-duty engines proposal will address all vehicles weighing more than 8,500 pounds, and ensure that the heaviest passenger vans and SUVs will also meet Tier 2 standards.

Description of Source Category

These federally implemented programs will affect low emission vehicles and heavy duty vehicles.

Control Strategy

The heavy duty engine rule will require more stringent exhaust emissions standards, on-board diagnostics test procedures and compliance requirements.

The low emission vehicle program will require cleaner light duty vehicles to be produced.

Expected Emissions Reductions and Methodology

The MOBILE5b emissions factor model automatically applies these controls unless the input file has been modified to disable the Act's tailpipe standards and the evaporative test procedure. Using the emission reductions in the output to MOBILE5b, the expected reductions in tons per day are:

	2002 VOC	2002 NOx	2005 VOC	2005 NOx
Baltimore	1.8	1.9	3.2	7.4

Municipal Landfills

This measure requires municipal landfills to add new controls based on federal rules.

Description of Source Category

A municipal solid waste landfill is a disposal facility in a contiguous geographical space where household waste is placed and periodically covered with inert material. Landfill gases are produced from the aerobic and anaerobic decomposition and chemical reactions of the refuse in the landfill. Landfill gases consist primarily of methane and carbon dioxide, with volatile organic compounds making up less than one percent of the total emissions. Although the percentage for VOC emissions seems small, the total volume of gases is large.

Control Strategy for Source Category

The control strategy for this source category is based upon federal rules. On March 12, 1996, the U.S. EPA adopted final New Source Performance Standards for new or recently modified municipal solid waste (MSW) landfills (Subpart WWW) and Emission Guidelines for existing MSW landfills (Subpart CC). The Emission Guidelines (EG) affect the owner or operator of a MSW landfill that was constructed before May 30, 1991; received MSW on or after November 8, 1987; and did not receive a permit for reconstruction or modification between May 30, 1991, and March 12, 1996.

The Maryland Department of the Environment (MDE) adopted a State regulation (COMAR 26.11.19.29) to implement the EG. The State regulation, consistent with the EG, requires that any MSW landfill classified as an EG landfill report the MSW landfill design capacity by June 1, 1997. An affected MSW landfill with a design capacity above 2.75 million tons is also required to report annual non-methane organic compound (NMOC) emissions rates. An affected MSW landfill above 2.75 million tons in capacity and emitting at least 55 tons per year of NMOC is required to submit and implement a compliance plan for collecting and controlling the landfill gas.

In general, the control strategy for reducing landfill gas emissions requires a gas collection system with a control device system capable of reducing VOCs in the collected gas by at least 98 weight-percent by weight. Control devices typically used are flares. Energy recovery systems have also been demonstrated to achieve 98 percent emission control at landfills where their use is feasible. Energy recovery systems used to combust landfill emissions include internal combustion engines, gas turbines, and steam generation boilers. Power produced by these systems may be used for heating or to generate electricity.

The Department has estimated that controls achieve 98 percent destruction efficiency with a 70 percent capture efficiency. The expected emissions reductions are found below.

Expected Emissions Reductions, Methodology and Sample Calculation

The Landfill Gas Emission Model, version 2.0, was used to calculate NMOC emissions from this source category.

The model requires the following information to estimate emissions from a landfill:

- The design capacity of the landfill,
- The amount of refuse in place in the landfill, or the annual refuse acceptance rate for the landfill,
- The methane generation rate (k),
- The potential methane generation capacity (L),
- The concentration of total nonmethane organic compounds (NMOC) and speciated NMOC found in the landfill gas,
- The years the landfill has been in operation, and
- Whether the landfill has been used for disposal of hazardous waste (codisposal).

AP-42 default values were chosen as inputs for each regulated landfill. These default values are:

Lo : 100.00 m^3 / Mg	Methane Generation Potential
k : 0.0400 1/yr	Decay Rate/Rate of Decomposition
NMOC : 595.00 ppmv	Non-methane Concentration
Methane : 50.00 % volume	
Carbon Dioxide : 50.00 % volume	

The estimation method used by the model is a simple first-order decay equation.

Controls achieve a 98 percent destruction level and a 70 percent capture efficiency, the expected 2002 emissions reduction for Millersville landfill in Anne Arundel County are calculated as follows:

> 2002 Emissions (Tons per day from the Landfill Model) * Destruction Level (Percentage) * Capture Efficiency (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)
>
> 0.1838 Tons per day * 0.95 * 0.70 = 0.1222 Tons per day

Emission reductions from the remaining landfills were calculated in a similar fashion and then totaled for the year 2002.

The 2005 emission reductions were calculated in a similar fashion with their respective emission levels predicted by the landfill model.

Expected Emissions Reductions

The expected emission reductions in tons per day are:

	2002 VOC	2002 NOx	2005 VOC	2005 NOx
Baltimore	0.2767	0.0	0.2558	0.0

VOC EMISSIONS REDUCTIONS FROM LANDFILLS

Landgem Model Parameters AP-42 Default Values

Lo : 100.00 m^3 / Mg	Methane Generation Potential
k : 0.0400 1/yr	Decay Rate/Rate of Decomposition
NMOC : 595.00 ppmv	Non-methane Concentration
Methane : 50.00 % volume	
Carbon Dioxide : 50.00 % volume	

2002 Reduction Credit Calculation

County	Landfill Name	NMOC Emissions (Mg/yr) 2002	NMOC Emissions (tons/yr) 2002	Reduction (tons/day) 2002
Anne Arundel	Millersville	60.86	67.0867	0.1261
Baltimore County	Eastern	40.43	44.5664	0.0838
Howard	Alpha Ridge	32.17	35.4614	0.0666
			BNAA Total	**0.2765**

2005 Reduction Credit Calculation

County	Landfill Name	NMOC Emissions (Mg/yr) 2005	NMOC Emissions (tons/yr) 2005	Reduction (tons/day) 2005
Anne Arundel	Millersville	55.27	60.9247	0.1145
Baltimore County	Eastern	39.34	43.3649	0.0815
Howard	Alpha Ridge	28.85	31.8017	0.0598
			BNAA Total	**0.2558**

Assumptions:

Above reductions are calculated assuming that 70% of total gas is recovered and 98% of VOCs are destroyed.

Open Burning Ban

This control measure bans open burning during the peak ozone season.

Description of Source Category

Open burning refers to the method of burning that releases uncontrolled emissions. Open burning is primarily used for the disposal of brush, trees, and yard waste and as a method of land clearing by both developers and individual citizens alike. Emissions from open burning include oxides of nitrogen, hydrocarbons, carbon dioxide, carbon monoxide and other toxic compounds. Emissions levels from open burning are high due to the inefficient and uncontrolled manner in which the material is burned.

Control Strategy

The Department adopted a regulation that prohibits open burning during the peak ozone period (June to August). The seasonal prohibition affects only those counties that lie within the serious and severe nonattainment areas. Certain exemptions however must be in place so as not to adversely affect the agriculture industry or restrict fire training and recreational activities.

Estimated Emissions Reductions and Methodology

The 1990 base year emissions estimate for the Baltimore area using EPA approved emission factors for this category was 3.6 tons per day of VOC and 0.8 tons per day of NOx. No growth is assumed for the projected emissions.

The control measure for this category consists of an open burning ban, therefore, the emissions reductions expected would equal the emissions estimate.

The expected emission reductions by in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	3.640	0.76	3.640	0.76

Surface Cleaning/Degreasing

This control measure requires small degreasing operations like gasoline stations, autobody paint shops and machine shops to use less polluting degreasing solvents.

Description of Source Category

Cold degreasing is an operation that uses solvents and other materials to remove oils and grease from metal parts including automotive parts, machined products and fabricated metal components.

Control Strategies for Source Categories

The regulation, COMAR 26.11.19.09, requires the reformulation of cold degreasers to either aqueous solutions or low VOC formulations.

The reductions do not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

After a detailed review of all cost-effective approaches to reduce emissions from this source category, the Department adopted a final rule that will achieve greater reductions that originally projected. Maryland's regulation required that the vapor pressure of the degreasing solvent not exceed 1 mm Hg, which will produce a greater than 67 percent reduction in the vapor pressure of degreasing materials. As a result of this part of the regulation, the final rule will achieve emission reductions of 7.6 tons per day. This regulation became effective on June 5, 1995 and was submitted to the EPA on July 12, 1995.

Expected Emissions Reductions, Methodology and Sample Calculation

The regulation should result in a 70 percent reduction in VOC emissions.

The 2002 emission reductions for the Baltimore nonattainment area were calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reductions (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)

10.42 Tons per day * 0.99 * 0.70 = 7.22 Tons per day

The expected emission reductions in tons per day are the following:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	7.223	0.0	7.200	0.0

Architectural and Industrial Maintenance Coatings

This federal measure requires reformulation of architectural and industrial maintenance coatings.

Description of Source Category

Architectural and industrial maintenance coatings are field-applied coatings used by industry, contractors, and homeowners to coat houses, buildings, highway surfaces, and industrial equipment for decorative or protective purposes. The different types of coatings include flat, non-flat coatings, and numerous specialty coatings. VOC emissions result from the evaporation of solvents from the coatings during application and drying.

Control Strategy for Source Category

The users of these coatings are small and widespread, making the use of add-on control devices is technically and economically infeasible. Reductions in VOC emissions must therefore be obtained through product reformulation.

Product reformulation is the process of modifying the current formulation of the coating, in this case to obtain a lower VOC content. Product reformulation can involve one or several of the following approaches:

- replacing VOC solvents with non-VOC solvents;
- increasing the solids content of the coating;
- altering the chemistry of the resin so that less solvent is needed for the required viscosity;
- switching to a waterborne latex or water-soluble resin system.

The reductions do not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Estimated Emissions Reductions, Methodology and Sample Calculation

On March 22, 1995, the EPA issued a guidance memorandum on credit for reductions from the Architectural and Industrial Maintenance (AIM) Coating Rule. The memorandum stated that the federal AIM coating rule resulted in an overall reduction estimate of 20 percent.

> The AIM rule is applicable to the following source categories: Architectural Surface Coating, Traffic Marking, Industrial Maintenance Coatings, and Other Coatings. The 2002 emission reductions for the Baltimore nonattainment area were calculated as follows:
>
> {[1990 Emissions from the Architectural Surface Coating * Respective BEA Growth Factor] +

[1990 Emissions from the Traffic Paint Categories * Respective BEA Growth Factor] + [1990 Emissions from the Industrial Maintenance Coatings * Respective BEA Growth Factor] + [1990 Emissions from the Other Coatings Categories * Respective BEA Growth Factor]} * Expected Emissions Reductions (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)

{(19.23 * 1.106) + (0.610 * 1.106) + (3.617 * 0.783) + (3.617 * 0.783)} * 0.20 = 5.52 Tons per day

The 2005 emission reductions were calculated in a similar fashion with their respective growth factors.

	2002 VOC	2002 Nox	2005 VOC	2005 NOx
Baltimore	5.52	0.0	5.55	0.0

Commercial and Consumer Products

This measure requires the reformulation of certain consumer products to reduce their VOC content.

Description of Source Category

Consumer and commercial products are items sold to retail customers for household, personal or automotive use, along with the products marketed by wholesale distributors for use in institutional or commercial settings such as beauty shops, schools, and hospitals. VOC emissions result from the evaporation of solvent contents in the products or solvents used as propellants.

Control Strategy for Source Category

Control strategies to reduce emissions from consumer products include reformulation of the product, modified and alternative dispensing or delivery systems, and product substitution or elimination.

Product reformulation can be accomplished by substituting water, other non-VOC ingredients, or low-VOC solvents for VOCs in the product.

Alternative application techniques modify the product delivery system and include traditional as well as innovative ways to reduce VOC emissions. This option applies primarily to aerosol products, which produce the majority of the VOC emissions from this category. Methods include the substitution of a handpump in replacement of the traditional propellants to deliver the product or changing the delivery system from an aerosol to a liquid, solid or powder form.

Product substitution or elimination involves replacing high-VOC products with low or non-VOC emitting products.

The Department used VOC emissions reductions required through the implementation of federal regulations that would establish VOC content standards for various consumer product categories.

The reductions do not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology and Sample Calculation

The EPA issued a memorandum on June 22, 1995, which provided the regulatory schedule and guidance on the expected emission reduction for the federal consumer products rule.

According to the memorandum, the baseline emission factor from the regulated subset resulting from the federal rule is 3.9 pounds per person annually. The emissions reductions are 20% of this subset. The calculation is as follows:

1990 Emissions from regulated subset = (2,348,219 persons affected by rule) x (3.9 lbs/yr/ person) x (1

yr/365 days) x (1 ton/2000 lbs)
= 12.545 TPD

2002 Emissions from regulated subset = 1990 emissions x growth factor
= 12.545 TPD x 1.106 (1.128 in 2005)
= 13.875 TPD

2002 Emission reduction = 2002 Emissions from the regulated subset x 20%
= 13.875 x 0.20
= 2.775 TPD

The expected emission reductions in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 Nox**
Baltimore	2.775	0.0	2.830	0.0

Automobile Refinishing

This measure based on state regulation requires large and small autobody refinishing operations to use low VOC content materials in the refinishing process and cleanup and to use spray guns to control application.

Description of Source Type

Automobile refinishing is the repainting of worn or damaged automobiles, light trucks and other vehicles. The different types of coatings include primers, surfacers, sealers, topcoats and some specialty coatings. Volatile organic compound emissions result from the evaporation of solvents from the coatings during application, drying and clean up techniques.

Control Strategy for Source Type

The Department adopted regulations requiring the use of reformulated coatings that would reflect standards similar to those in EPA's draft, CTGs for Automobile Refinishing (1991c,e). In addition, the regulation requires the use of equipment with greater transfer efficiency in the application of the coatings, and regulates the use of solvents to clean application equipment.

The reductions do not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology and Sample Calculation

The regulation results in a 45 percent reduction in VOC emissions.

The 2002 emissions reductions for the Baltimore nonattainment area were calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reductions (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)

10.39 Tons per day * 1.249 (1.294 in 2005)* 0.45 = 5.84 Tons per day

The 2005 emissions reductions were calculated in a similar fashion with their respective growth factors.

The expected emission reductions in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	5.84	0.0	6.05	0.0

Nonroad Small Gasoline Engines

This measure requires small gasoline-powered engine equipment, such as lawn and garden equipment, manufactured after August 1, 1996 to meet federal emissions standards.

Description of Source Category

Small gasoline-powered engine equipment includes lawn mowers, trimmers, generators, compressors, etc. These measures apply to equipment with engines of less than 25 horsepower. VOC emissions result from combustion and evaporation of gasoline used to power this equipment.

Control Strategy

EPA promulgated regulations for this type of equipment in two phases. In the first phase, EPA developed regulations similar to California's regulation for 1995 and later utility and lawn and garden equipment engines through the normal regulatory process. The second phase of regulation used a consultative approach of negotiated rulemaking to develop consensus on important issues, such as useful life, in-use emissions, evaporative emissions, test procedures, and market based incentive programs.

Expected Emissions Reductions, Methodology and Sample Calculation

The regulation results in a 32 percent reduction in VOC emissions for Phase I. Phase II will produce an additional 4.38% for handheld spark ignition engines and 8.67% reduction for non-handheld spark ignition engines by 2002. Phase II with produce an additional 43.18% for handheld spark ignition engines and 23.88% reduction for non-handheld spark ignition engines by 2005.

The following is a sample calculation of 2002 emissions reductions for the Baltimore nonattainment for trimmers/edgers/brush cutters:

<u>Phase I Emission Reductions</u>:
1990 Emissions (Tons per day) * BEA Growth Factor * Expected Phase I Emissions Reduction (Percentage) = Expected Phase I Emissions Reduction in 2002 (Tons per day)

(2.143 Tons per day * 1.174 * 0.32) = 0.805082 Tons per day

<u>Phase II Emission Reductions</u>:
{[1990 Emissions (Tons per day) * BEA Growth Factor] – Phase I Emission Reductions} * Expected Additional Phase II Emissions Reductions (Percentage) = Expected Phase II Emissions Reduction in 2002 (Tons per day)

[(2.143 Tons per day * 1.174) – 0.805082] * 0.0438 = 0.074933 Tons per day

<u>Total Phase I and Phase II Emission Reductions</u>:
Phase I Emission Reductions + Phase II Emission Reductions = Total Emission Reductions

0.805082 + 0.074933 = 0.880015 Tons per day

The 2002 and 2005 emissions reductions for all involved categories were calculated in a similar fashion with their respective growth factors. A spreadsheet with calculations for this category follow this description.

The expected emission reductions by 2002 and 2005 in tons per day are:

	2002 VOC	2002 NOx	2005 VOC	2005 Nox
Baltimore	9.69	-0.37	16.69	-0.45

2002 VOC Emission Credits

Equipment Type	Equip Cat	Cat Type	Diesel VOC tpsd	4-Stroke VOC tpsd	2-Stroke VOC tpsd	Small Gas Engine Emission PH 1 Reduction	Emission After Ph 1	Small Gas Engine Emission PH 2 Reduction	Small Gas Engine Emission Total PH 1 & PH 2 Reduction
Trimmers/Edgers/Brush Cutters	1	1	0.0000	0.0000	2.5162	0.8052	1.7110	0.0749	0.8801
Lawn Mowers	1	2	0.0000	5.3376	3.5992	2.8598	6.0770	0.2662	3.1259
Leaf Blowers/Vacuums	1	3	0.0000	0.0000	0.8761	0.2804	0.5958	0.0261	0.3065
Rear Engine Riding Mowers	1	4	0.0000	0.1788	0.0000	0.0572	0.1216	0.0053	0.0626
Front Mowers	1	5	0.0000	0.0655	0.0000	0.0209	0.0445	0.0019	0.0229
Chainsaws <4HP	1	6	0.0000	0.0000	3.5453	1.1345	2.4108	0.1056	1.2401
Shredders <5HP	1	7	0.0000	0.0144	0.0036	0.0058	0.0122	0.0005	0.0063
Tillers <5HP	1	8	0.0000	0.4642	0.0108	0.1520	0.3230	0.0141	0.1662
Lawn & Garden Tractors	1	9	0.0108	1.6375	0.0000	0.5240	1.1135	0.0488	0.5728
Wood Splitters	1	10	0.0000	0.0909	0.0000	0.0291	0.0618	0.0027	0.0318
Snowblowers	1	11	0.0000	0.0455	0.0160	0.0197	0.0418	0.0018	0.0215
Chippers/Stump Grinders	1	12	0.0108	0.4565	0.0000	0.0000	0.4565	0.0000	0.0000
Commercial Turf Equip.	1	13	0.0000	1.8020	0.0000	0.5767	1.2254	0.0537	0.6303
Other Lawn & Garden Equip.	1	14	0.0000	0.0234	0.0360	0.0190	0.0404	0.0018	0.0208
Aircraft Support Equip.	2	1	0.0623	0.0514	0.0000	0.0000	0.0514	0.0000	0.0000
Terminal Tractors	2	2	0.7945	0.3327	0.0039	0.0000	0.3366	0.0000	0.0000
All Terrain Vehicles	3	1	0.0000	0.1863	0.1033	0.0000	0.2895	0.0000	0.0000
Minibikes	3	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road Motorcycles	3	3	0.0000	0.0053	0.1098	0.0000	0.1151	0.0000	0.0000
Golf Carts	3	4	0.0000	0.1773	0.2755	0.1449	0.3079	0.0267	0.1716
Snowmobiles	3	5	0.0000	0.0000	0.0307	0.0000	0.0307	0.0000	0.0000
Specialty Vehicle Carts	3	6	0.0000	0.0144	0.1151	0.0414	0.0881	0.0076	0.0491
Vessels w/Inboard Engines	4	1	0.0411	1.0470	0.0000	0.0000	1.0470	0.0000	0.0000
Vessels w/Outboard Engines	4	2	0.0000	0.0041	6.6542	0.8523	5.8060	0.0000	0.8523
Vessels w/Sternboard Engines	4	3	0.0000	1.2488	0.0000	0.0000	1.2488	0.0000	0.0000
Sailboat Auxiliary Inboard Engines	4	4	0.0123	0.0021	0.0000	0.0000	0.0021	0.0000	0.0000
Sailboat Auxiliary Outboard Engines	4	5	0.0000	0.0000	0.0246	0.0032	0.0215	0.0000	0.0032
Generator Sets <50 HP	5	1	0.0398	1.9872	1.7000	1.1799	2.5073	0.1098	1.2897
Pumps <50 HP	5	2	0.0108	0.4186	0.0361	0.1455	0.3092	0.0135	0.1591
Air Compressors <50 HP	5	3	0.0072	0.2564	0.0000	0.0820	0.1743	0.0076	0.0897
Gas Compressors <50 HP	5	4	0.0000	0.0000	0.0145	0.0000	0.0145	0.0000	0.0000
Welders <50 HP	5	5	0.0253	0.3802	0.0000	0.1217	0.2586	0.0113	0.1330
Pressure Washers <50 HP	5	6	0.0000	0.1380	0.0000	0.0441	0.0938	0.0041	0.0483
Aerial Lifts	6	1	0.0105	0.1500	0.0105	0.0000	0.1605	0.0000	0.0000
Forklifts	6	2	0.1434	0.9260	0.6190	0.0000	1.5451	0.0000	0.0000
Sweepers/Scrubbers	6	3	0.1119	0.0732	0.0216	0.0000	0.0949	0.0000	0.0000
Other Industrial Equip.	6	4	0.0280	0.0452	0.0945	0.0447	0.0950	0.0042	0.0489
Other Material Handling Equip.	6	5	0.0035	0.0035	0.0000	0.0000	0.0035	0.0000	0.0000
Asphalt Pavers	7	1	0.0107	0.0054	0.0000	0.0000	0.0054	0.0000	0.0000
Tampers/Rammers	7	2	0.0000	0.0000	0.1610	0.0515	0.1095	0.0048	0.0563
Plate Compactors	7	3	0.0000	0.0498	0.2616	0.0996	0.2117	0.0093	0.1089
Concrete Pavers	7	4	0.0107	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Rollers	7	5	0.0376	0.0791	0.0000	0.0253	0.0538	0.0047	0.0300
Scrapers	7	6	0.1664	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving Equipment	7	7	0.0644	0.1356	0.1610	0.0949	0.2017	0.0175	0.1124
Surfacing Equipment	7	8	0.0000	0.0456	0.0000	0.0146	0.0310	0.0027	0.0173
Signal Boards	7	9	0.0054	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Trenchers	7	10	0.0590	0.0577	0.0000	0.0000	0.0577	0.0000	0.0000
Bore/Drill Rigs	7	11	0.0376	0.0299	0.0107	0.0000	0.0406	0.0000	0.0000
Excavators	7	12	0.2200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Concrete/Industrial Saws	7	13	0.0000	0.1810	0.0000	0.0579	0.1231	0.0054	0.0633
Cement and Mortar Mixers	7	14	0.0000	0.0741	0.0000	0.0237	0.0504	0.0044	0.0281
Cranes	7	15	0.3918	0.0161	0.0000	0.0000	0.0161	0.0000	0.0000
Graders	7	16	0.2576	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Highway Trucks	7	17	0.4562	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Crushing/Proc. Equip.	7	18	0.0429	0.0054	0.0000	0.0000	0.0054	0.0000	0.0000
Rough Terrain Forklifts	7	19	0.1395	0.0149	0.0000	0.0000	0.0149	0.0000	0.0000
Rubber Tired Loaders	7	20	0.6601	0.0161	0.0000	0.0000	0.0161	0.0000	0.0000
Rubber Tired Dozers	7	21	0.0590	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tractors/Loaders/Backhoes	7	22	0.6601	0.0054	0.0000	0.0000	0.0054	0.0000	0.0000
Crawler Tractors	7	23	1.4744	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Skid Steer Loaders	7	24	0.2683	0.0418	0.0000	0.0000	0.0418	0.0000	0.0000
Off-Highway Tractors	7	25	0.6172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Dumpers/Tenders	7	26	0.0000	0.0054	0.0000	0.0017	0.0036	0.0003	0.0020
Other Construction Equip.	7	27	0.0429	0.0203	0.0000	0.0000	0.0203	0.0000	0.0000
2-Wheel Tractors	8	1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Agricultural Tractors	8	2	1.4904	0.0175	0.0000	0.0000	0.0175	0.0000	0.0000
Agricultural Mowers	8	3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Combines	8	4	0.0438	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sprayers	8	5	0.0000	0.0088	0.0000	0.0028	0.0060	0.0005	0.0033
Balers	8	6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tillers >5HP	8	7	0.0000	0.1161	0.0000	0.0372	0.0790	0.0068	0.0440
Swathers	8	8	0.0044	0.0283	0.0000	0.0000	0.0283	0.0000	0.0000

Hydro Power Units	8	9	0.0000	0.0044	0.0000	0.0014	0.0030	0.0003	0.0017
Other Agricultural Equip.	8	10	0.0044	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Chainsaws >4HP	9	1	0.0000	0.0000	0.4039	0.1292	0.2746	0.0120	0.1413
Shredders >5HP	9	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Skidders	9	3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Fellers/Bunchers	9	4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
					Total	**9.68**		**0.8571**	**10.5409**
					Marine Vessels Reduction Total	**0.8554**			**0.8554**
					Total SI Engines minus Marine Vessels	**8.828**			**9.686**

Equipment Type	2005 VOC Emission Credits Equip Cat	Cat Type	Diesel VOC tpsd	4-Stroke VOC tpsd	2-Stroke VOC tpsd	Small Gas Engine Emission PH 1 Reduction	Emission After PH 1	Small Gas Engine Emission PH 2 Reduction	Small Gas Engine Emission Total PH 1 & PH 2 Reduction
Trimmers/Edgers/Brush Cutters	1	1	0.0000	0.0000	2.5971	0.8311	1.7660	0.7626	1.5936
Lawn Mowers	1	2	0.0000	5.5091	3.7148	2.9517	6.2723	2.7084	5.6600
Leaf Blowers/Vacuums	1	3	0.0000	0.0000	0.9043	0.2894	0.6149	0.2655	0.5549
Rear Engine Riding Mowers	1	4	0.0000	0.1846	0.0000	0.0591	0.1255	0.0542	0.1133
Front Mowers	1	5	0.0000	0.0676	0.0000	0.0216	0.0459	0.0198	0.0415
Chainsaws <4HP	1	6	0.0000	0.0000	3.6593	1.1710	2.4883	1.0745	2.2454
Shredders <5HP	1	7	0.0000	0.0149	0.0037	0.0059	0.0126	0.0055	0.0114
Tillers <5HP	1	8	0.0000	0.4791	0.0112	0.1569	0.3334	0.1440	0.3009
Lawn & Garden Tractors	1	9	0.0112	1.6902	0.0000	0.5408	1.1493	0.4963	1.0371
Wood Splitters	1	10	0.0000	0.0938	0.0000	0.0300	0.0638	0.0275	0.0576
Snowblowers	1	11	0.0000	0.0469	0.0166	0.0203	0.0432	0.0186	0.0390
Chippers/Stump Grinders	1	12	0.0112	0.4711	0.0000	0.0000	0.4711	0.0000	0.0000
Commercial Turf Equip.	1	13	0.0000	1.8599	0.0000	0.5952	1.2648	0.5461	1.1413
Other Lawn & Garden Equip.	1	14	0.0000	0.0241	0.0372	0.0196	0.0417	0.0180	0.0376
Aircraft Support Equip.	2	1	0.0701	0.0578	0.0000	0.0000	0.0578	0.0000	0.0000
Terminal Tractors	2	2	0.8942	0.3745	0.0044	0.0000	0.3789	0.0000	0.0000
All Terrain Vehicles	3	1	0.0000	0.1914	0.1061	0.0000	0.2975	0.0000	0.0000
Minibikes	3	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road Motorcycles	3	3	0.0000	0.0054	0.1128	0.0000	0.1183	0.0000	0.0000
Golf Carts	3	4	0.0000	0.1822	0.2831	0.1489	0.3164	0.0756	0.2245
Snowmobiles	3	5	0.0000	0.0000	0.0315	0.0000	0.0315	0.0000	0.0000
Specialty Vehicle Carts	3	6	0.0000	0.0148	0.1183	0.0426	0.0905	0.0216	0.0642
Vessels w/Inboard Engines	4	1	0.0424	1.0810	0.0000	0.0000	1.0810	0.0000	0.0000
Vessels w/Outboard Engines	4	2	0.0000	0.0042	6.8704	1.7874	5.0872	0.0000	1.7874
Vessels w/Sternboard Engines	4	3	0.0000	1.2893	0.0000	0.0000	1.2893	0.0000	0.0000
Sailboat Auxiliary Inboard Engines	4	4	0.0127	0.0022	0.0000	0.0000	0.0022	0.0000	0.0000
Sailboat Auxiliary Outboard Engines	4	5	0.0000	0.0000	0.0254	0.0066	0.0188	0.0000	0.0066
Generator Sets <50 HP	5	1	0.0432	2.1592	1.8471	1.2820	2.7243	1.1764	2.4584
Pumps <50 HP	5	2	0.0118	0.4548	0.0392	0.1581	0.3360	0.1451	0.3032
Air Compressors <50 HP	5	3	0.0079	0.2786	0.0000	0.0891	0.1894	0.0818	0.1709
Gas Compressors <50 HP	5	4	0.0000	0.0000	0.0157	0.0000	0.0157	0.0000	0.0000
Welders <50 HP	5	5	0.0275	0.4131	0.0000	0.1322	0.2809	0.1213	0.2535
Pressure Washers <50 HP	5	6	0.0000	0.1499	0.0000	0.0480	0.1019	0.0440	0.0920
Aerial Lifts	6	1	0.0113	0.1610	0.0113	0.0000	0.1722	0.0000	0.0000
Forklifts	6	2	0.1540	0.9940	0.6645	0.0000	1.6585	0.0000	0.0000
Sweepers/Scrubbers	6	3	0.1202	0.0786	0.0232	0.0000	0.1018	0.0000	0.0000
Other Industrial Equip.	6	4	0.0300	0.0486	0.1014	0.0480	0.1020	0.0440	0.0920
Other Material Handling Equip.	6	5	0.0038	0.0038	0.0000	0.0000	0.0038	0.0000	0.0000
Asphalt Pavers	7	1	0.0115	0.0057	0.0000	0.0000	0.0057	0.0000	0.0000
Tampers/Rammers	7	2	0.0000	0.0000	0.1724	0.0552	0.1172	0.0506	0.1058
Plate Compactors	7	3	0.0000	0.0533	0.2801	0.1067	0.2267	0.0979	0.2046
Concrete Pavers	7	4	0.0115	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Rollers	7	5	0.0402	0.0847	0.0000	0.0271	0.0576	0.0138	0.0409
Scrapers	7	6	0.1781	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving Equipment	7	7	0.0689	0.1451	0.1724	0.1016	0.2159	0.0516	0.1532
Surfacing Equipment	7	8	0.0000	0.0488	0.0000	0.0156	0.0332	0.0079	0.0235
Signal Boards	7	9	0.0057	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Trenchers	7	10	0.0632	0.0617	0.0000	0.0000	0.0617	0.0000	0.0000
Bore/Drill Rigs	7	11	0.0402	0.0320	0.0115	0.0000	0.0435	0.0000	0.0000
Excavators	7	12	0.2356	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Concrete/Industrial Saws	7	13	0.0000	0.1938	0.0000	0.0620	0.1318	0.0569	0.1189
Cement and Mortar Mixers	7	14	0.0000	0.0793	0.0000	0.0254	0.0539	0.0129	0.0383
Cranes	7	15	0.4194	0.0172	0.0000	0.0000	0.0172	0.0000	0.0000
Graders	7	16	0.2758	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Highway Trucks	7	17	0.4884	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Crushing/Proc. Equip.	7	18	0.0460	0.0057	0.0000	0.0000	0.0057	0.0000	0.0000
Rough Terrain Forklifts	7	19	0.1494	0.0160	0.0000	0.0000	0.0160	0.0000	0.0000
Rubber Tired Loaders	7	20	0.7067	0.0172	0.0000	0.0000	0.0172	0.0000	0.0000
Rubber Tired Dozers	7	21	0.0632	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tractors/Loaders/Backhoes	7	22	0.7067	0.0057	0.0000	0.0000	0.0057	0.0000	0.0000
Crawler Tractors	7	23	1.5786	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Skid Steer Loaders	7	24	0.2873	0.0447	0.0000	0.0000	0.0447	0.0000	0.0000
Off-Highway Tractors	7	25	0.6608	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Dumpers/Tenders	7	26	0.0000	0.0057	0.0000	0.0018	0.0039	0.0009	0.0028
Other Construction Equip.	7	27	0.0460	0.0217	0.0000	0.0000	0.0217	0.0000	0.0000
2-Wheel Tractors	8	1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Agricultural Tractors	8	2	1.4904	0.0175	0.0000	0.0000	0.0175	0.0000	0.0000
Agricultural Mowers	8	3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Combines	8	4	0.0438	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sprayers	8	5	0.0000	0.0088	0.0000	0.0028	0.0060	0.0014	0.0042
Balers	8	6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tillers >5HP	8	7	0.0000	0.1161	0.0000	0.0372	0.0790	0.0189	0.0560
Swathers	8	8	0.0044	0.0283	0.0000	0.0000	0.0283	0.0000	0.0000
Hydro Power Units	8	9	0.0000	0.0044	0.0000	0.0014	0.0030	0.0007	0.0021

Other Agricultural Equip.	8	10	0.0044	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Chainsaws >4HP	9	1	0.0000	0.0000	0.4394	0.1406	0.2988	0.1290	0.2696
Shredders >5HP	9	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Skidders	9	3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Fellers/Bunchers	9	4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
					Total	**11.013**		**8.293**	**19.306**
					Marine Vessels Reduction Total	**1.794**			**1.794**
					Total SI Engines minus Marine Vessels	**9.219**			**17.512**

Non-Road Diesel Engines

This measure requires heavy-duty farm, construction equipment, and other equipment manufactured after 1996 to meet federal emission standards.

Description of Source Category

Heavy-duty farm and construction equipment includes asphalt pavers, rollers, scrapers, rubber-tired dozers, agricultural tractors, combines, balers, and harvesters. This measure applies to all compression-ignition engines at or above 37 KW (50 horsepower) except engines used in aircraft, marine vessels, locomotives and underground mining activity. NOx emissions result from combustion of diesel fuel used to power this equipment.

Control Strategy

EPA has the authority to require emission standards for nonroad mobile sources under section 213(a)(3) of the Act. EPA has promulgated regulations for NOx emissions and smoke standards for new heavy duty farm and construction equipment with gross maximum power output measured at or above 37 KW (50 horsepower). The NOx emissions standard is 9.2 grams per kilowatt-hour (6.9 grams per brake horsepower hour). NOx standards will be phased in depending upon the horsepower of the engine, beginning with the 1996 model year. The first standards to take effect will be for engines at or above 175 hp and at or below 750 hp.

Projected reductions are technically achievable within a short time period because the emissions control technologies necessary to meet the proposed standards are known to be effective on similar on-highway engines.

Expected Emissions Reductions, Methodology and Sample Calculation

The regulation results in NOx emissions reductions of 16.2% by 2002 and 23.5% by 2005.

The following is a sample calculation of 2002 emissions reductions for the Baltimore nonattainment for agricultural tractors:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)

7.364 Tons per day * 1.0 * 0.162 = 1.19 Tons per day

The 2002 and 2005 emissions reductions were calculated in a similar fashion with their respective growth factors. A spreadsheet with calculations for this category follow this description.

The expected emission reductions by 2002 and 2005 in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 Nox**
Baltimore	0.0	10.96	0.0	16.13

2002 NOx Emission HD Diesel Reductions and Small Enginge Increases

Equipment Type	Equip Cat	Cat Type	Diesel NOx tpsd	4-Stroke NOx tpsd	2-Stroke NOx tpsd	HD Diesel NOx Reductions	Small Engine Emission Increases
Trimmers/Edgers/Brush Cutters	1	1	0.0000	0.0000	0.0036	0.0000	-0.0034
Lawn Mowers	1	2	0.0000	0.0465	0.0036	0.0000	-0.0473
Leaf Blowers/Vacuums	1	3	0.0000	0.0000	0.0036	0.0000	-0.0034
Rear Engine Riding Mowers	1	4	0.0000	0.0036	0.0000	0.0000	-0.0034
Front Mowers	1	5	0.0000	0.0000	0.0000	0.0000	0.0000
Chainsaws <4HP	1	6	0.0000	0.0000	0.0045	0.0000	-0.0042
Shredders <5HP	1	7	0.0000	0.0000	0.0000	0.0000	0.0000
Tillers <5HP	1	8	0.0000	0.0036	0.0000	0.0000	-0.0034
Lawn & Garden Tractors	1	9	0.0680	0.0501	0.0000	0.0000	-0.0473
Wood Splitters	1	10	0.0000	0.0000	0.0000	0.0000	0.0000
Snowblowers	1	11	0.0000	0.0000	0.0000	0.0000	0.0000
Chippers/Stump Grinders	1	12	0.0751	0.0143	0.0000	0.0122	0.0000
Commercial Turf Equip.	1	13	0.0000	0.0680	0.0000	0.0000	-0.0642
Other Lawn & Garden Equip.	1	14	0.0000	0.0000	0.0000	0.0000	0.0000
Aircraft Support Equip.	2	1	0.5468	0.0193	0.0000	0.0886	0.0000
Terminal Tractors	2	2	6.8537	0.1348	0.0077	1.1103	0.0000
All Terrain Vehicles	3	1	0.0000	0.0000	0.0000	0.0000	0.0000
Minibikes	3	2	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road Motorcycles	3	3	0.0000	0.0000	0.0000	0.0000	0.0000
Golf Carts	3	4	0.0000	0.0000	0.0000	0.0000	0.0000
Snowmobiles	3	5	0.0000	0.0000	0.0000	0.0000	0.0000
Specialty Vehicle Carts	3	6	0.0000	0.0000	0.0000	0.0000	0.0000
Vessels w/Inboard Engines	4	1	0.2981	0.2768	0.0000	0.0000	0.0000
Vessels w/Outboard Engines	4	2	0.0000	0.0043	0.0681	0.0000	-0.0102
Vessels w/Sternboard Engines	4	3	0.0000	0.4514	0.0000	0.0000	0.0000
Sailboat Auxiliary Inboard Engines	4	4	0.0170	0.0000	0.0000	0.0000	0.0000
Sailboat Auxiliary Outboard Engines	4	5	0.0000	0.0000	0.0000	0.0000	0.0000
Generator Sets <50 HP	5	1	0.2945	0.0668	0.0000	0.0000	-0.0631
Pumps <50 HP	5	2	0.0903	0.0118	0.0079	0.0000	-0.0186
Air Compressors <50 HP	5	3	0.0432	0.0079	0.0000	0.0000	-0.0074
Gas Compressors <50 HP	5	4	0.0000	0.0000	0.0118	0.0000	0.0000
Welders <50 HP	5	5	0.1846	0.0118	0.0000	0.0000	-0.0111
Pressure Washers <50 HP	5	6	0.0000	0.0039	0.0000	0.0000	-0.0037
Aerial Lifts	6	1	0.0977	0.0639	0.0300	0.0000	0.0000
Forklifts	6	2	1.3446	0.3869	1.6714	0.2178	0.0000
Sweepers/Scrubbers	6	3	1.0254	0.0300	0.0563	0.1661	0.0000
Other Industrial Equip.	6	4	0.2704	0.0188	0.0000	0.0438	-0.0177
Other Material Handling Equip.	6	5	0.0488	0.0038	0.0000	0.0079	0.0000
Asphalt Pavers	7	1	0.1954	0.0000	0.0000	0.0317	0.0000
Tampers/Rammers	7	2	0.0000	0.0000	0.0000	0.0000	0.0000
Plate Compactors	7	3	0.0000	0.0057	0.0000	0.0000	-0.0054
Concrete Pavers	7	4	0.1092	0.0000	0.0000	0.0177	0.0000
Rollers	7	5	0.4770	0.0057	0.0000	0.0773	-0.0054
Scrapers	7	6	2.1148	0.0000	0.0000	0.3426	0.0000
Paving Equipment	7	7	0.7241	0.0115	0.0000	0.1173	-0.0109
Surfacing Equipment	7	8	0.0000	0.0057	0.0000	0.0000	-0.0054
Signal Boards	7	9	0.0345	0.0000	0.0000	0.0000	0.0000
Trenchers	7	10	0.4080	0.0230	0.0000	0.0661	0.0000
Bore/Drill Rigs	7	11	0.2988	0.0115	0.0000	0.0484	0.0000
Excavators	7	12	3.5286	0.0000	0.0000	0.5716	0.0000
Concrete/Industrial Saws	7	13	0.0000	0.0230	0.0000	0.0000	-0.0217
Cement and Mortar Mixers	7	14	0.0057	0.0057	0.0000	0.0000	-0.0054
Cranes	7	15	3.3561	0.0057	0.0000	0.5437	0.0000
Graders	7	16	1.6723	0.0000	0.0000	0.2709	0.0000
Off-Highway Trucks	7	17	5.4308	0.0000	0.0000	0.8798	0.0000
Crushing/Proc. Equip.	7	18	0.3735	0.0057	0.0000	0.0605	0.0000
Rough Terrain Forklifts	7	19	0.7011	0.0057	0.0000	0.1136	0.0000
Rubber Tired Loaders	7	20	8.4363	0.0115	0.0000	1.3667	0.0000
Rubber Tired Dozers	7	21	0.7298	0.0000	0.0000	0.1182	0.0000
Tractors/Loaders/Backhoes	7	22	4.9768	0.0057	0.0000	0.8062	0.0000
Crawler Tractors	7	23	12.6085	0.0000	0.0000	2.0426	0.0000
Skid Steer Loaders	7	24	1.2873	0.0172	0.0000	0.0000	0.0000
Off-Highway Tractors	7	25	3.1378	0.0000	0.0000	0.5083	0.0000
Dumpers/Tenders	7	26	0.0000	0.0000	0.0000	0.0000	0.0000
Other Construction Equip.	7	27	0.3678	0.0057	0.0000	0.0596	0.0000
2-Wheel Tractors	8	1	0.0000	0.0000	0.0000	0.0000	0.0000
Agricultural Tractors	8	2	7.3644	0.0088	0.0000	1.1930	0.0000
Agricultural Mowers	8	3	0.0000	0.0000	0.0000	0.0000	0.0000
Combines	8	4	0.3989	0.0000	0.0000	0.0646	0.0000
Sprayers	8	5	0.0044	0.0044	0.0000	0.0007	-0.0041
Balers	8	6	0.0044	0.0000	0.0000	0.0007	0.0000
Tillers >5HP	8	7	0.0000	0.0000	0.0000	0.0000	0.0000
Swathers	8	8	0.0614	0.0044	0.0000	0.0099	0.0000

Hydro Power Units	8	9	0.0000	0.0000	0.0000	0.0000	0.0000
Other Agricultural Equip.	8	10	0.0175	0.0000	0.0000	0.0028	0.0000
Chainsaws >4HP	9	1	0.0000	0.0000	0.0000	0.0000	0.0000
Shredders >5HP	9	2	0.0000	0.0000	0.0000	0.0000	0.0000
Skidders	9	3	0.0000	0.0000	0.0000	0.0000	0.0000
Fellers/Bunchers	9	4	0.0000	0.0000	0.0000	0.0000	0.0000
Total						10.96	-0.37

2005 NOx Emission HD Diesel Reductions and Small Enginge Increases							
Equipment Type	Equip Cat	Cat Type	Diesel NOx tpsd	4-Stroke NOx tpsd	2-Stroke NOx tpsd	HD Diesel NOx Reductions	Small Engine Emission Increases
Trimmers/Edgers/Brush Cutters	1	1	0.0000	0.0000	0.0037	0.0000	-0.0036
Lawn Mowers	1	2	0.0000	0.0479	0.0037	0.0000	-0.0505
Leaf Blowers/Vacuums	1	3	0.0000	0.0000	0.0037	0.0000	-0.0036
Rear Engine Riding Mowers	1	4	0.0000	0.0037	0.0000	0.0000	-0.0036
Front Mowers	1	5	0.0000	0.0000	0.0000	0.0000	0.0000
Chainsaws <4HP	1	6	0.0000	0.0000	0.0046	0.0000	-0.0045
Shredders <5HP	1	7	0.0000	0.0000	0.0000	0.0000	0.0000
Tillers <5HP	1	8	0.0000	0.0037	0.0000	0.0000	-0.0036
Lawn & Garden Tractors	1	9	0.0700	0.0516	0.0000	0.0000	-0.0505
Wood Splitters	1	10	0.0000	0.0000	0.0000	0.0000	0.0000
Snowblowers	1	11	0.0000	0.0000	0.0000	0.0000	0.0000
Chippers/Stump Grinders	1	12	0.0773	0.0147	0.0000	0.0182	0.0000
Commercial Turf Equip.	1	13	0.0000	0.0700	0.0000	0.0000	-0.0685
Other Lawn & Garden Equip.	1	14	0.0000	0.0000	0.0000	0.0000	0.0000
Aircraft Support Equip.	2	1	0.6200	0.0218	0.0000	0.1457	0.0000
Terminal Tractors	2	2	7.7719	0.1528	0.0087	1.8264	0.0000
All Terrain Vehicles	3	1	0.0000	0.0000	0.0000	0.0000	0.0000
Minibikes	3	2	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road Motorcycles	3	3	0.0000	0.0000	0.0000	0.0000	0.0000
Golf Carts	3	4	0.0000	0.0000	0.0000	0.0000	0.0000
Snowmobiles	3	5	0.0000	0.0000	0.0000	0.0000	0.0000
Specialty Vehicle Carts	3	6	0.0000	0.0000	0.0000	0.0000	0.0000
Vessels w/Inboard Engines	4	1	0.2981	0.2768	0.0000	0.0000	0.0000
Vessels w/Outboard Engines	4	2	0.0000	0.0043	0.0681	0.0000	-0.0709
Vessels w/Sternboard Engines	4	3	0.0000	0.4514	0.0000	0.0000	0.0000
Sailboat Auxiliary Inboard Engines	4	4	0.0170	0.0000	0.0000	0.0000	0.0000
Sailboat Auxiliary Outboard Engines	4	5	0.0000	0.0000	0.0000	0.0000	0.0000
Generator Sets <50 HP	5	1	0.2945	0.0668	0.0000	0.0000	-0.0654
Pumps <50 HP	5	2	0.0903	0.0118	0.0079	0.0000	-0.0192
Air Compressors <50 HP	5	3	0.0432	0.0079	0.0000	0.0000	-0.0077
Gas Compressors <50 HP	5	4	0.0000	0.0000	0.0118	0.0000	0.0000
Welders <50 HP	5	5	0.1846	0.0118	0.0000	0.0000	-0.0115
Pressure Washers <50 HP	5	6	0.0000	0.0039	0.0000	0.0000	-0.0038
Aerial Lifts	6	1	0.0977	0.0639	0.0300	0.0000	0.0000
Forklifts	6	2	1.3446	0.3869	1.6714	0.3160	0.0000
Sweepers/Scrubbers	6	3	1.0254	0.0300	0.0563	0.2410	0.0000
Other Industrial Equip.	6	4	0.2704	0.0188	0.0000	0.0636	-0.0184
Other Material Handling Equip.	6	5	0.0488	0.0038	0.0000	0.0115	0.0000
Asphalt Pavers	7	1	0.1954	0.0000	0.0000	0.0459	0.0000
Tampers/Rammers	7	2	0.0000	0.0000	0.0000	0.0000	0.0000
Plate Compactors	7	3	0.0000	0.0057	0.0000	0.0000	-0.0056
Concrete Pavers	7	4	0.1092	0.0000	0.0000	0.0257	0.0000
Rollers	7	5	0.4770	0.0057	0.0000	0.1121	-0.0056
Scrapers	7	6	2.1148	0.0000	0.0000	0.4970	0.0000
Paving Equipment	7	7	0.7241	0.0115	0.0000	0.1702	-0.0113
Surfacing Equipment	7	8	0.0000	0.0057	0.0000	0.0000	-0.0056
Signal Boards	7	9	0.0345	0.0000	0.0000	0.0000	0.0000
Trenchers	7	10	0.4080	0.0230	0.0000	0.0959	0.0000
Bore/Drill Rigs	7	11	0.2988	0.0115	0.0000	0.0702	0.0000
Excavators	7	12	3.5286	0.0000	0.0000	0.8292	0.0000
Concrete/Industrial Saws	7	13	0.0000	0.0230	0.0000	0.0000	-0.0225
Cement and Mortar Mixers	7	14	0.0057	0.0057	0.0000	0.0000	-0.0056
Cranes	7	15	3.3561	0.0057	0.0000	0.7887	0.0000
Graders	7	16	1.6723	0.0000	0.0000	0.3930	0.0000
Off-Highway Trucks	7	17	5.4308	0.0000	0.0000	1.2762	0.0000
Crushing/Proc. Equip.	7	18	0.3735	0.0057	0.0000	0.0878	0.0000
Rough Terrain Forklifts	7	19	0.7011	0.0057	0.0000	0.1648	0.0000
Rubber Tired Loaders	7	20	8.4363	0.0115	0.0000	1.9825	0.0000
Rubber Tired Dozers	7	21	0.7298	0.0000	0.0000	0.1715	0.0000
Tractors/Loaders/Backhoes	7	22	4.9768	0.0057	0.0000	1.1695	0.0000
Crawler Tractors	7	23	12.6085	0.0000	0.0000	2.9630	0.0000
Skid Steer Loaders	7	24	1.2873	0.0172	0.0000	0.0000	0.0000
Off-Highway Tractors	7	25	3.1378	0.0000	0.0000	0.7374	0.0000
Dumpers/Tenders	7	26	0.0000	0.0000	0.0000	0.0000	0.0000
Other Construction Equip.	7	27	0.3678	0.0057	0.0000	0.0864	0.0000
2-Wheel Tractors	8	1	0.0000	0.0000	0.0000	0.0000	0.0000
Agricultural Tractors	8	2	7.3644	0.0088	0.0000	1.7306	0.0000
Agricultural Mowers	8	3	0.0000	0.0000	0.0000	0.0000	0.0000
Combines	8	4	0.3989	0.0000	0.0000	0.0937	0.0000
Sprayers	8	5	0.0044	0.0044	0.0000	0.0010	-0.0043
Balers	8	6	0.0044	0.0000	0.0000	0.0010	0.0000
Tillers >5HP	8	7	0.0000	0.0000	0.0000	0.0000	0.0000
Swathers	8	8	0.0614	0.0044	0.0000	0.0144	0.0000

Hydro Power Units	8	9	0.0000	0.0000	0.0000	0.0000	0.0000
Other Agricultural Equip.	8	10	0.0175	0.0000	0.0000	0.0041	0.0000
Chainsaws >4HP	9	1	0.0000	0.0000	0.0000	0.0000	0.0000
Shredders >5HP	9	2	0.0000	0.0000	0.0000	0.0000	0.0000
Skidders	9	3	0.0000	0.0000	0.0000	0.0000	0.0000
Fellers/Bunchers	9	4	0.0000	0.0000	0.0000	0.0000	0.0000
Total						16.13	-0.45

Marine Engine Standards

This measure controls exhaust emissions from new spark-ignition (SI) gasoline marine engines, including outboard engines, personal watercraft engines, and jet boat engines. Of nonroad sources studied by EPA, gasoline marine engines were found to be one of the largest contributors of hydrocarbon (HC) emissions (30% of the nationwide nonroad total).

Control Strategy for Source Type

Once the program is fully implemented, manufacturers of these engines must demonstrate to EPA that hydrocarbon emissions are reduced by 75 percent from present levels, by testing engines representative of the product line before sale and after use. EPA is imposing emission standards for 2 – stroke technology, outboard and personal watercraft engines. This will involve increasingly stringent HC control over the course of a nine-year phase-in period beginning in model year 1998. By the end of the phase-in, each manufacturer must meet an HC and NOx emission standard that represents a 75% reduction in HC compared to unregulated levels.

Each manufacturer is allowed to decide the type of control technologies to be applied to each engine type. However, there will be a pre-production certification program that requires all gasoline marine engine families to be certified by EPA as meeting applicable emissions standards before they are introduced into commerce. Manufacturers will comply by testing engines as they leave the production line, at appropriate sampling rates. Manufacturers will also have to test a portion of their fleet each year to determine if their engines are meeting emission standards while in use. These standards do not apply to any currently owned engines or boats.

Expected Emissions Reductions

The Code of Federal Register (40 CFR Parts 89, 90 and 91) rule entitled Control of Air Pollution; Final Rule for New Gasoline Spark-Ignition Marine Engines; Exemptions for New Nonroad Compression-Ignition Engines at or Above 37 Kilowatts and New Nonroad Spark-Ignition Engines at or Below 19 Kilowatts lists the projected inventory reductions for outboard/personal watercraft (OB/PWC) engines. These reduction percentages are listed in Table 3 of the document and are reproduced below.

TABLE 3. – PROJECTED INVENTORY REDUCTIONS

Year	Percent reduction in OB/PWC HC inventory
2000	4
2005	26
2010	52
2015	68
2020	73
2030	75

Linearly extrapolating the data between 2000 and 2005 yields a 2002 percent reduction in HC inventory of 12.8 percent. The expected emissions reductions by 2005 in tons per day are as follows:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**

Baltimore	0.8554	-0.0102	1.794	-0.0709

Railroad Engine Standards

This measure establishes emission standards for oxides of nitrogen (NOx), hydrocarbons (HC), carbon monoxide (CO), particulate matter (PM) and smoke for newly manufactured and remanufactured diesel-powered locomotives and locomotive engines, which have previously been unregulated.

Control Strategy for Source Type

This regulation will take effect in 2000 and will affect railroad manufacturers and locomotive remanufacturers. It involves adoption of three separate sets of emission standards with applicability dependent on the date a locomotive is first manufactured. The first set of standards (Tier 0) applies to locomotives originally manufactured from 1973 through 2000. The second set of standards (Tier 1) applies to locomotives and locomotive engines manufactured from 2002 through 2004. The final set of standards (Tier 2) apply tolocomotives and locomotive engines origninally manufactured in 2005 and later. Locomotives and locomotive engines will be required to meet the Tier 1 standards at original manufacture and at each subsequent remanufacture.

EPA has adopted a production line testing (PLT) program that requires manufacturers, and in some cases, remanufacturers of locomotives to perform production line testing of newly manufactured and remanufactured locomotives as they leave the point where the manufacture or remanufacture is completed. EPA is also planning to adopt an in-use-testing program to ensure that locomotives continue to meet emission standards during actual operation. EPA has also adopted averaging, banking and trading (ABT) provisions to allow manufacturers and remanufacturers the flexibility to meet overall emissions goals at the lowest cost, while allowing EPA to set emissions standards at levels more stringent than they would be if each and every engine family had to comply with the standards.

Expected Emissions Reductions, Methodology and Sample Calculation

According to the EPA, the regulation should result in NOx emissions reductions of 23.9 % by 2002 and 41.8 % by 2005.

> The following is a sample calculation of 2002 emissions reductions for the Baltimore nonattainment area for agricultural tractors:
>
> 1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reductions (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)
>
> 10.58 Tons per day * 0.956 * 0.239 = 2.425 Tons per day

The 2005 emissions reductions were calculated in a similar fashion with their respective growth factors. A spreadsheet with calculations for this category follow this description.

The expected emissions reductions by 2002 and 2005 in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 Nox**
Baltimore	0.0	2.42	0.0	4.20

Expandable Polystyrene Products

This measure requires RACT to be installed at operations that manufacture foam cups, foam insulation and other foam products.

Description of Source Type

These sources use expandable polystyrene beads that contain pentane, a VOC, to manufacture foam products such as foam cups, board insulation, and custom shapes.

There are three different stages of operation during which VOC emissions typically occur: storage and pre-expansion of the beads, manufacturing the product, and aging emissions that occur because of the slow diffusion of the blowing agent (pentane) from the foam before shipping.

Control Strategy for Source Type

COMAR 26.11.19.19 requiresVOC emissions reductions that has the following general requirements:

- A person who owns or operates an expandable polystyrene operation (EPO) subject to this regulation may not cause or permit the discharge of VOC into the atmosphere unless one of the following control measures is implemented:
  - A VOC collection and destruction system to control emissions from the preexpander by 85 percent or more overall; or
  - A VOC collection system that ducts emissions from the preexpander into the fire box of fuel burning equipment.
- As an alternative to meeting the above requirements in of this regulation, the following manufacturing requirements may be implemented:
  - Manufacturers of block products using reduced VOC content beads that have a bead VOC content greater than 6.5 percent shall use 10 percent or more recycled expanded polystyrene;
  - Manufacturers of block products that cannot use recycled expanded polystyrene shall use beads with a VOC content of 6.5 percent or less;
  - Manufacturers of shape molded products, including cups, shall use beads with a VOC content of 6 percent or less; and
  - Manufacturers of specialty products shall use reduced VOC content beads.
- Compliance with the bead VOC content for each product in §C(2) of this regulation shall be determined as a daily average.

This regulation became effective on July 3, 1995 and was submitted to the EPA on July 12, 1995.

Expected Emissions Reductions, Methodology and Sample Calculation

The sources subject to this measure are located in the Baltimore nonattainment area. The 1990 base year emissions estimate using EPA published emission factors for this category was 0.34 tons per day (MDE, 1993). This figure is the total of the estimates for the polystyrene blowing operations in the Baltimore nonattainment area. The proposed measure results in a 30 percent reduction in VOC emissions.

The 2002 emissions reductions were calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)

0.34 Tons per day * 1.15 * 0.30 = 0.1173 Tons per day

The 2005 emissions reductions were calculated in a similar fashion except that the 2005 BEA projection factor of 1.205 was used.

The reductions do not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).
The expected emissions reductions by 2002 and 2005 in tons per day are:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 Nox**
Baltimore	0.1173	0.0	0.1229	0.0

Yeast Manufacturing

This measure requires RACT to be installed at two yeast-manufacturing operations in the Baltimore nonattainment area.

Description of Source Type

Yeast is produced using an aerated fermentation process under controlled conditions. The fermentation process generates significant quantities of ethanol and other VOC's. The yeast is used in baking and wine processes.

Control Strategy for Source Type

COMAR 26.11.19.17 requires the use of improved process control techniques to obtainVOC emission reductions. This regulation became effective on June 5, 1995, was submitted to the EPA on July 12, 1995, and is now part of Maryland's SIP. The regulation obtains an overall emission reduction of approximately 60 to 70 percent from the 1990 baseline by requiring affected sources to meet specific VOC emission standards.

The 15% RPP did not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology, and Sample Calculations

The 1990 base year emissions estimate using EPA published emission factors for this category was 0.976 tons per day. This represents 0.778 tons per day of VOC emitted by Red Star Yeast and 0.198 tons per day emitted by American Yeast.

The 2002 emission reductions were calculated as follows:

1990 Emissions (Tons Per Day) * BEA Growth Factor * Expected Control Efficiency (Percent) = Expected Emission Reductions in 2002 (Tons Per Day)

0.976 Tons Per Day * 1.263 * 0.66 = 0.8136 Tons Per Day

The calculation for the 2005 reductions is similar except for a growth factor of 1.349.
The expected emissions reductions by 2002 and 2005 in tons per day are as follows:

	2002 VOC	2002 Nox	2005 VOC	2005 NOx
Baltimore	0.814	0.0	0.869	0.0

Commercial Bakery Ovens

This measure requires commercial bakeries using yeast to leaven bread and bread products to install RACT.

Description of Source Type

Commercial bakeries generate VOC emissions from the fermentation and baking processes used to produce yeast-raised baked goods. These emissions are primarily ethanol. VOC resulting from the fermentation and baking are currently discharged directly into the air.

Control Strategy for Source Type

The regulation requires control equipment dependent upon thresholds that are based on cost effectiveness criteria. The finalized regulation requires 80% control efficiency, with a rule effectiveness of 80%.

This regulation, COMAR 26.11.19.21, became effective on July 3, 1995 and was submitted to the EPA on July 12, 1995.

Expected Emissions Reductions, Methodology, and Sample Calculations

In the Baltimore Area, the 1990 base year emissions estimate using stack test data and EPA approved emission factors for this category was 0.72 tons per day (MDE 1993). The 1996 projected emissions were 0.74 tons per day.

Five point sources were identified within the Baltimore Nonattainment Area as bakeries. These are H&S Bakery, Hauswald Bakery, Crispy Bagel, Automatic Rolls, and Schmidt Bakery. Of these five sources the proposed Bakery RACT applies to Schmidt Bakery and Automatic Rolls. Schmidt Bakery has installed a Humidification/Conditioner innovative control technology device and Automatic Rolls has installed a Catalytic Afterburner control device.

For the 66 year old Hauswald's bakery oven, a detailed cost analysis was conducted to determine the economic impact. Control costs in terms of capital investment at this facility exceed the value of the existing production equipment. The cost effectiveness is $4,198 per ton of VOC reduced. Since the age of the equipment and condition is such that the high capital expenditure of $853,528 along with high operating costs cannot be justified, the oven has been exempted from control requirements until it is replaced.

Voluntary actions taken by Maryland baking companies within the Baltimore Non-Attainment Area will produce other VOC reductions. Crispy Bagel (formerly A & P Bakery) has scaled-back production at the facility with an expected emission reduction of 34.99 Tons per Year. This voluntary reduction is documented within emission certification reports over this time period as shown below:

Year	Reported Facility Emissions Tons per Year
1991	37.61
1992	38.45
1993	1.72

1994	1.04
1995	0.98
1996	3.51
1997	4.5
1998	6.32

Year	Reported Facility Emissions Tons per Year	Growth Factors from 1992	Grown Emissions (1992 Emissions * GF) Tons per Year	Emission Reduction Grown Emissions – Reported Emissions Tons per Year
1991	37.61			
1992	38.45			
1993	1.72	Facility sold to Crispy Bagel – Not operating at capacity		
1994	1.04	Facility sold to Crispy Bagel – Not operating at capacity		
1995	0.98	Facility sold to Crispy Bagel – Not operating at capacity		
1996	3.51	1.0187	39.169	35.659
1997	4.5	1.0341	39.7611	35.2611
1998	6.32	1.0496	40.3571	34.0371
1999		1.0651	40.9531	

As shown in the table above the Crispy Bagels facility is reducing emissions levels by 34.99 Tons per Year computed as the average annual reductions for 1996-1998. According to MDE certified emission files, A&P Bakery operated two oven lines for 249 days in 1992. The 34.99 Tons per Year reduction in expected emissions then translates into 0.1405 Tons per Day.

The 2002 emission reductions were calculated as follows:

Expected total emission reductions for 2002 = Schmidt Bakery Reduction + Automatic Rolls Reduction + Crispy Bagel Reduction

1990 Emissions (Tons per Day) * BEA Growth Factor * Control Efficiency (Percent) * Rule Effectiveness (Percent) = Expected Emission Reductions in 2002 (Tons per Day)

Schmidt Bakery
0.876 Tons per Day * 1.064 * 0.8 * 0.8 = 0.5965 Tons per Day

Automatic Rolls
0.160 Tons per Day * 1.064 * 0.8 *0.8 = 0.10895 Tons per Day

Expected total emission reductions for 2002 = 0.5965 + 0.10895 + 0.1405
Expected total emission reductions for 2002 = 0.8460

The expected emission reductions for 2005 is calculated similarly except for the change in BEA growth factor to 1.089.

	2002 VOC	2002 Nox	2005 VOC	2005 Nox
Baltimore	0.8460	0.0	0.8626	0.0

Screen Printing

This measure requires certain small printing operations to install RACT.

Description of Source Category

A screen printing process is used to apply printing or an image to virtually any substrate. In the screen printing operation, ink is distributed through a porous screen mesh to which a stencil may have been applied to define an image to be printed on a substrate. The printed substrate is then placed on a drying rack or in a drying unit. After the screen is used, it is transferred to a screen reclamation process to be cleaned for reuse. During this process the ink residue is removed with solvents. Sometimes stencil material and hardened ink appears as a "ghost image" from previous stencil applications. Separate solvent material is used to remove this image.

VOC emissions result from the evaporation of ink solvents and from the use of solvents for cleaning. The major source of VOC emissions is the printing process.

Control Strategy for Source Category

Because the users of these coatings are relatively small, requiring the use of add-on control devices is technically and economically infeasible. Reductions in VOC emissions will be obtained through the use of ink reformulation, process printing modification, and material substitution for cleaning operations.

Ink reformulation is the process of modifying the current formulation of the ink to a lower VOC content. Ink reformulation can involve one or several of the following approaches:

Replacing the VOC solvents with non-VOC solvents;

Increasing the solids content of the coating;

Altering the chemistry of the resin;

In a printing process modification, a typical VOC solvent based printing operation may be replaced with an ultraviolet (UV) ink operation. The UV inks are cured by exposing the printed substrate to an ultraviolet light source. Ultraviolet inks do not contain VOC nor is VOC added to the inks during the operation. For a high production facility, a cost saving can be attributed to using an ultraviolet system over a conventional ink system. For the screen cleaning process there are a number of cleaning systems which contain lower amounts of VOC.

The Department promulgated a regulation with ink standards that would be dependent upon the printed substrate. The cleaning solvents were required to have a lower VOC content. The regulation reflects standards similar to the South Coast Air Quality Management District's (SCAQMD) regulation for screen printing.

The 15% RPP did not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

This regulation became effective on June 5, 1995 and submitted to the EPA on July 12, 1995.

Expected Emissions Reductions, Methodology and Sample Calculation

The Department expects four sources in the Baltimore area's point source inventory with expected total emissions of 0.44 tons per day to be subject to this measure. In addition, approximately 3 to 5 percent (or 0.135 tons per day) of the graphic arts area source inventory can be attributed to screen printing sources. Therefore, the total expected emissions for this category is 0.575 tons per day.

Based upon the SCAQMD rule reductions, the Department expects to obtain a 35% emission reduction from the implementation of this rule (SCAQMD, 1991b). Using this emissions reduction percentage, the expected emissions reductions for this category is 0.5 tons per day by 2005. The 2002 emissions reductions were calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) = Expected Emissions Reduction (Tons per day)

0.575 Tons per day * 1.19 (1.24 in 2005) * 0.35 = 0.24 Tons per day

The expected emission reductions by 2002 and 2005 in tons per day are as follows:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	0.24	0.0	0.25	0.0

Federal Air Toxics

This measure covers sources that are required to comply with Federal air toxics requirements that have or will achieve VOC reduction between 1990 and 1996.

Control Strategy

The Department has delegation to implement Federal air toxics rules that will achieve VOC emissions reductions creditable towards the RPP and adopts rules as EPA promulgates them. Federal rules that may achieve such reductions include Federal NESHAPs for vinyl chloride production plants and benzene emissions from equipment leaks, benzene storage vessels, coke by-product recovery plants, benzene transfer operations and waste operations.

In addition this measure could include reductions from Maximum Achievable Control Technology (MACT) standards scheduled for completion in November of 1992 and 1994 with full implementation required in November of 1995 and 1997 respectively. Source categories covered by the 1992 MACT standards include the Hazardous Organic NESHAP (HON), coke ovens, dry cleaners, and chromium electroplating.

Federal Air Toxics Requirements

The Department has delegation to implement Federal air toxics rules that will achieve VOC emissions reductions creditable towards the Rate of Progress Plan and has adopted by reference the following rules as EPA has promulgated them.

NESHAP for Coke Oven Batteries

Benzene NESHAP

The Final Rule for the NESHAP is for organic hazardous air pollutants from the synthetic organic chemical manufacturing industry (SOCMI). As of September 1, 1993, the one premise in Maryland that was covered by this regulation ceased from using benzene in its processes.

The expected emission reductions by 1999, 2002, and 2005 in tons per day are the following:

	2002 VOC	2002 NOx	2005 VOC	2005 NOx
Baltimore	0.5	0.0	0.5	0.0

Graphic Arts – Lithographic Printing

This measure requires smaller printers to use control devices and/or low VOC materials to reduce VOC emissions.

Description of Source Type

This source category consists of numerous small sheet-fed printers that perform non-continuous printing and web printers that print on a continuous web or roll. Heat-set web printers use drying ovens to force dry the printed matter. Web printing sources perform high volume printing on paper or paperboard.

VOC emissions to the air are caused by evaporation of the ink solvents, alcohol in the fountain or dampening solution, and equipment wash solvents. Emissions from sheet fed presses are minimal because most of the VOC from the inks are absorbed in the printed matter. About one third of the VOC from web printing ink is absorbed in the printed matter. Higher VOC emissions are caused by heat-set inks because of the elevated temperatures. These VOC discharges may also cause visible emissions and nuisance odors.

Historically, lithographic web printers have used up to 35 percent isopropyl alcohol (IPA) in the fountain solutions. The volatile alcohol evaporated relatively quickly causing significant VOC emissions. The industry eventually found non-volatile substitutes for the isopropyl alcohol. Web printers are able to utilize 100 percent substitution, however, sheet fed printers with older design printing presses may require a limited amount of alcohol to achieve the required dampening.

Control Strategy for Source Type

Although several control devices were evaluated over the years for web printers, a catalytic oxidizer has proven to be most successful. For heat-set web printers, the dryer emissions are ducted directly into the oxidizer yielding a 100 percent capture of emissions. A typical oxidizer yields 96-98 percent destruction of VOC.

The measure requires that:

- Web printers use no alcohol in the fountain solutions;
- Heat-set web printers install an afterburner on the oven exhaust if plant wide emissions exceed 20 pounds per day; and
- Sheet fed printers use no more than 8.5 percent isopropyl alcohol in the fountain solution and the solution must be refrigerated to 55^{o}F or less.

The EPA Control Techniques Guideline (CTG) included the following controls:

Emission Source	**CTG Recommended Control**
Inks	90% control (condenser filters) for heatset plants
Fountain Solution	1.6% isopropyl alcohol (IPA) for heatset plants (90% reduction)
	alcohol substitution for non-heatset (99% reduction)
	5% IPA for sheet-fed (50% reduction)

Cleaning Solutions	30% VOC content limit (70% reduction)

The emission reductions described in the 15% RPP for this control measure takes into consideration only one type of printer, lithographic printing. The Department adopted a regulation (COMAR 26.11.19.11 C & D) that limits the amount of isopropyl alcohol in the fountain solutions. Web printers are prohibited from using IPA (100 percent control) while sheet-fed printers are limited to no more than 8.5 percent IPA in the fountain solution. Previously, fountain solutions typically contained 16 percent IPA in the fountain solution (46.88 percent reduction). The IPA requirements in these regulations became effective on January 1, 1992.

The 15% RPP did not include rule effectiveness in the calculation for point sources because this measure constitutes an irreversible process change for the web printers. EPA guidance on rule effectiveness states that it is not required for sources for which an irreversible process change has been applied (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology, and Sample Calculations

Based on the CTG (based on employment), it was assumed that offset lithographic printing accounts for 64% of total graphic arts emissions. This percentage contribution was applied to total graphic arts area source emissions to estimate total emissions from offset lithography.

The CTG estimated overall reduction for four model plants: heatset web, non-heatset web, non-heatset sheet-fed, and newspaper non-heated web. Since the CTG did not classify the population of sources into these model plants, the numerical average of the overall sources was used for the nonattainment area reductions.

The average control efficiency of 75% (from the CTG) and the 64 % penetration were applied to area source graphic art emissions to determine total reductions.

The expected area source emission reductions for 2002 are calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) * Rule Effectiveness (Percentage) * Penetration (Percentage) = Expected Emissions Reduction (Tons per day)

4.496 Tons per day * 1.166 (1.194 in 2005) * 0.75 * 0.8 * 0.64 = 2.012 Tons per day

The expected point source emission reduction from this control measure is estimated to be 0.5 tons per day (0.6 tons per day in 2002 and 2005). This estimate is based upon a survey of all point sources subject to the measure conducted by the Department. The total annual usage of IPA was proportioned to estimate 0.5 tons per day emissions. It was assumed that these emissions (0.5 tons per day) would be eliminated totally.

For sheet-fed lithographic presses, VOC emissions from the fountain solution are estimated by dividing the total annual alcohol use by the operating days. VOC emissions are directly proportional to the amount of wash solvent used or annual consumption divided by operating days. It is assumed that all VOC in the ink is absorbed in the printed matter.

For non-heat-set web systems, calculations are performed the same as for sheet fed but it is assumed 30 percent of the ink solvent is absorbed in the printed matter and the remainder emitted to the atmosphere. Therefore, no VOC reductions are associated with non-heat-set web systems.

For heat-set web systems, a stack test must be performed to determine destruction efficiency (100 percent capture). It is assumed 30 percent of the ink solvent is absorbed in the printed matter and the remainder ducted to the control device.

The total expected emission reductions for the Graphic Arts – Lithographic category in tons per day are the following:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	2.612	0.0	2.6609	0.0

Graphic Arts – Flexographic and Rotogravure Printing

This measure requires smaller printers to use control devices and/or low VOC materials to reduce VOC emissions.

Description of Source Type

This source category consists of numerous small flexographic or rotogravure printers that perform non-continuous sheet fed printing and continuous web or roll printing.

Flexographic printing employs plates with raised images and only the raised image comes in contact with the substrate during printing. Typically, flexographic plates are made of plastic, rubber, or some other flexible material, which is attached to a roller or cylinder for ink application. Modern presses are now equipped with enclosed doctor blade systems which eliminate the fountain roller and fountain, thereby reducing evaporation loss. In a typical flexographic printing operation, the cylinder plate is removed from the press and is cleaned in a separate area.

Gravure printing uses almost exclusively electro-mechanically engraved copper image carriers to separate the image area from the non-image area. Typically, the gravure image carrier is a cyclinder. In gravure printing, ink is applied to the engraved cylinder, then wiped from the surface by the doctor blade, leaving ink only on the engraved image area. The printing substrate is brought into contact with the cylinder with sufficient pressure so that it picks up the ink left in the depressions on the cylinder. In a typical gravure printing operation, the cylinder is removed from the press and is re-plated for the new process.

VOC emissions to the air are caused almost entirely by evaporation of the ink solvents.

Control Strategy for Source Type

Although several control devices were evaluated over the years for rotogravure and flexographic web printers, a catalytic oxidizer has proven to be most successful. For heat set web printers, the dryer emissions are ducted directly into the oxidizer yielding nearly a 100 percent capture of emissions. A typical oxidizer yields 96-98 percent destruction of VOC.

The measure requires that:

- ❖ Printers reduce emissions by using water-based inks that contain less that 25 percent VOC by volume of the volatile portion of the ink, or high solids inks that contain not less than 60 percent nonvolatiles; or

- ❖ If compliance with these requirements cannot be achieved, reduce the VOC content of each ink, or reduce the average VOC content of inks used at each press as follows;

    - ❖ 60 percent reduction for flexographic presses,
    - ❖ 65 percent reduction for packaging rotogravure presses, and
    - ❖ 75 percent reduction for publication rotogravure presses.

Maryland adopted a printing regulation in 1987 that required any person who causes or permits the discharge of any emissions of VOC from any roll-printing utilizing flexography, packaging rotogravure, or publication rotogravure in excess of 550 pounds per day to reduce the discharge by the following percentage indicated:

Roll Printing Method	Reduction
Flexography	60%
Packaging Rotogravure	65%
Publication Rotogravure	75%

This regulation is applicable only to sources emitting over 550 pounds per day and thus only addresses certain point sources. Some web printers were in compliance with this requirement in 1990. Also many printers installed stack afterburners or oxidizers because they were cited for visible emission or nuisance odor violations. Most sources were in compliance with all requirements by early 1992.

The Maryland regulation was amended at the end of 1993 to change the trigger level for installing a control device to 100 pounds per day. In addition, the regulation now addresses all flexographic, packaging rotogravure and publication rotogravure printers who apply a clear protective coating over the printed matter. The provisions of the regulation do not apply to printing on fabric, metal or plastic.

Therefore, the expected point source emission reduction from this control measure are included in the base year uncontrolled emission inventory. However, area source controls have not been reflected in the base year emission inventory.

The 15% RPP did not include rule effectiveness in the calculation for point sources because this measure constitutes an irreversible process change for the web printers. EPA guidance on rule effectiveness states that it is not required for sources for which an irreversible process change has been applied to (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology, and Sample Calculations

Based on a November 1996 EIIP document entitled Graphic Arts, the estimated percentage of product market share for rotogravure printing is 18 percent and the estimated percentage of market share for flexographic printing is 18 percent. This percentage contribution was applied to total graphic arts area source emissions, to estimate total emissions from either flexographic or rotogravure printing.

The average control efficiency for flexographic printers is assumed to be 60% (from COMAR 26.11.19.10) * 90% (estimated percent of emisssions attibutable to evaporation of ink solvent).

The average control efficiency for rotogravure printers is assumed to be 70% (from COMAR 26.11.19.10) * 90% (estimated percent of emisssions attibutable to evaporation of ink solvent).

The average control efficiency for each type of printing operation and the 18 % penetration were applied to area source graphic art emissions to determine total reductions.

The expected area source emission reductions for 2002 are calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) * Rule Effectiveness (Percentage) * Penetration (Percentage) = Expected Emissions Reduction (Tons per day)

Flexographic Printing
4.496 Tons per day * 1.166 (1.194 in 2005) * (0.6 * 0.9) * 0.8 * 0.18 = 0.408 Tons per day

Rotogravure Printing
4.496 Tons per day * 1.166 (1.194 in 2005) * (0.70 * 0.9) * 0.8 * 0.18 = 0.476 Tons per day

The total expected emission reductions in tons per day are the following:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	0.8832	0.0	0.9044	0.0

Enhanced Rule Compliance

This measure involves enhancing rule compliance by increasing or in other ways improving the enforcement of existing regulations.

Description of Sources Covered

Enhanced rule compliance or rule effectiveness reflects the ability of a regulatory program to achieve all the emission reductions that could have been achieved by *full compliance* with the applicable regulations at *all* sources at *all times*.

This control measure covers the specific sources and source categories listed in Table 6.5. These sources and source categories have been determined by the Department to be areas in which rule effectiveness can be improved.

Control Strategy

Enhanced Rule Compliance or rule effectiveness (RE) improvement refers to an improvement in the implementation of and compliance with a regulation. These RE improvements may take several forms, ranging from more frequent and in-depth training of inspectors to larger fines for sources that do not comply with a given rule. RE improvements are important control strategies in areas that have already adopted RACT for many of their larger sources prior to 1990.

The purpose of a RE improvement is to give state and local agencies additional means for achieving actual reductions for their State Implementation Plans (SIPs). Title I of the Clean air Act identifies RE improvements as one of the measures that can be used to meet the 15-percent volatile organic compound (VOC) reduction requirements by November 15, 1996.

To estimate the creditable emission reduction from enhanced rule compliance, and to determine an appropriate RE value, the Department used the EPA developed methodology (matrix method) to quantify the predicted improvement. The RE value was calculated to be 92% for the source categories affected by the regulation. This yields a RE improvement of 12% over the 80% default value. Other source categories listed in the RPP and Stage I vapor recovery yield RE improvements of 7%. This corresponds to a total emission reduction of 4.5 tons per day.

Expected Emission Reductions

To estimate creditable emissions reductions from RE improvements, state and local agencies require a methodology to quantify the predicted RE increase. The methodology must measure the impact of specific improvement measures available to a state or local agency. In the absence of any compliance or emissions data to quantitatively assess RE improvement measures, EPA's Ozone/Carbon Monoxide Programs branch developed a RE matrix. The RE matrix is based on a questionnaire that EPA used to estimate base rule effectiveness for source categories. The following principles guided the development of the matrix:

- ❖ All state and local agencies should be guaranteed at least 80 percent base RE;
- ❖ State and local agencies with an RE well above the 80-percent default should receive more emissions

reduction credits for an RE improvement than agencies near the 80-percent default;

- ❖ RE improvements should be documented in a permit or in a SIP revision; and,
- ❖ One-hundred-percent RE is achieved in cases of direct determination of emissions or elimination of VOCs or other pollutants through an irreversible process change.

The matrix is divided into 13 categories representing the range of activities and conditions that influence rule effectiveness. The 13 categories are:

- Training of Plant Operators
- Inspector Training
- Educational Opportunities for Source
- Procedures for Operation and Maintenance of Control and/or Process Equipment
- Clarity of Testing Procedures and Schedules
- Rule Effectiveness Evaluation Program
- Monitoring
- Type of Inspection
- Administrative Authority-Prison
- Administrative Authority-Fines
- Administrative Authority-Citations
- Media Publication of Enforcement Action
- Follow-up Inspections

The matrix includes subcategories for six of these categories. Control measures, which are the most specific item in the matrix, are arranged in descending order, with the first measure having the most significant impact on RE.

The table following shows the expected emission reductions through 2005.

Implementation Schedule

Since 1990, MDE has obtained the authority to impose administrative penalties of up to $2,500 per day per violation and civil penalties of up to $25,000 per day per violation. MDE also has the authority to pursue criminal penalties of up to $25,000 and one year in jail for a first offense, and up to $50,000 and two years in jail for subsequent offenses.

Enhanced monitoring of sources has also increased since 1990. Several sources are telemetered and can be evaluated from the office continuously. These sources also submit quarterly compliance summaries.

MDE has also held workshops for regulated sources on new regulatory requirements.
By 1996, many Title V permits will include the requirement that equipment operators follow and sign daily operation and maintenance instructions. The permits will also include specific stack testing requirements including, approved stack testing methods as well as the required frequency of the testing. In addition, by 1996, there will be in place increased inspector training and frequency of inspections, as well as, mandatory follow-up of violations within 30 days.

The expected emission reductions in tons per day are the following:

	2002 VOC	2002 NOx	2005 VOC	2005 NOx
Baltimore	4.9	0.0	5.1	0.0

State Air Toxics

Description of Sources Covered

This measure addresses stationary sources that are covered by Maryland's air toxics regulations that have achieved VOC reductions above and beyond current federally enforceable limits. In general, Maryland's air toxics regulations cover any source required to obtain a permit to construct or annually renewed state permit to operate.

Control Strategy

The Department adopted the air toxics regulations in 1988. VOC reductions above and beyond current federally enforceable limits will be made federally enforceable through the use of Section 112(l) of the Act, Title V permits and The General Provisions of Title III of the Act. Maryland's Title V permit program is scheduled for adoption in 1994. The General Provisions for Title III were proposed in the Federal Register on August 11, 1993. Section 112(l) was proposed in the Federal Register on May 19, 1993.

Expected Emissions Reductions

Table 6.6 lists the specific sources covered by this measure, the 1990 base year VOC emissions, the estimated VOC reduction in tons per day and a brief explanation of why, under the State air toxics regulations, the reduction was required. The following table shows the expected emission reductions in tons per day for 2002 and 2005.

Implementation Schedule

Maryland's air toxics regulations were adopted in 1988. Maryland plans to include the sources covered by this measure in the earliest round of Title V permits.

TABLE 6.6. VOC EMISSION REDUCTIONS FROM STATE AIR TOXICS REQUIREMENTS

Company	1990 Base Year Inventory Emissions (TPY)	Emission Reduction by 2002 (TPD)	Emission Reduction by 2005 (TPD)	Description of Controls used to obtain Emission Reductions
American Cyanamid	169	0.006	0.006	Added after condensers on "Daymax" mixers and solvent storage tanks
Quebecor	1068	0.90	0.98	Increased capture efficiency and ink reformulation to lower toluene content
Sweetheart Cup	59	0.11	0.12	Use of infrared inks and encapsulation of printing units
Vista	60	0.04	0.05	Increased number of process vents controlled and installed flare
TOTAL	--	1.1	1.2	

The expected emission reductions in tons per day are the following:

	2002 VOC	2002 NOx	2005 VOC	2005 NOx
Baltimore	1.1	0.0	1.2	0.0

Reasonably Available Control Technology -- NOx RACT

This measure requires control of nitrogen oxides (NOx) emissions by installing RACT.
Description of Source Category

NOx RACT will apply to industrial and commercial fuel burning equipment and combustion installations. Title I of the Act requires major sources to submit proposed RACT by November 15, 1993. Affected sources must achieve compliance with RACT by May 1995.

NOx emissions vary significantly from source to source, even with sources that are similar in size and design. NOx emissions depend upon numerous factors such as age of equipment, characteristics of fuel being burned, configuration of and type of burners, and operational techniques.

Control Strategy

The Department currently has a NOx RACT regulation in place, which establishes requirements for source categories. The regulation allows affected sources several compliance options; meet applicable standards by reducing on-site emissions, using an averaging plan, meeting pre-established standards, or requesting an alternative standard.

Expected Emissions Reductions and Methodology

The expected emission reductions were determined from the NOx RACT regulations which affected utilities for the Baltimore nonattainment area. The Department has determined the following emission reductions by 2002 and 2005 in tons per day which is carried forward from 1999:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	0.0	43.5	0.0	43.5

Ozone Transport Commission (OTC) NOx Phase II

Description of Source Category

On Tuesday, September 27, 1994, the OTC initiated a major agreement to cut emissions of NOx from power plants and other major stationary sources of pollution throughout the Northeast and Mid-Atlantic States. The agreement, in the form of a Memorandum of Understanding (MOU), recognizes that further reductions in NOx emissions are needed to enable the entire Ozone Transport Region (OTR) to meet the NAAQS.

Control Strategy

The agreement is a phased approach to controlling emissions of NOx from power plants and other large fuel combustion sources. The first phase (known as Phase II because one phase of emission reductions, RACT, has already been initiated) is to be implemented in May 1999. This phase includes three control zones in the region: an inner zone ranging from the Washington, D.C. metropolitan area northeast to southeastern New Hampshire; an outer zone ranging out from the inner zone to western Pennsylvania; and a northern zone which includes much of northern New York and northern New England, including most of New Hampshire.

Control requirements vary with the zone in which sources are located, but the most stringent requirements are in the inner zone. The next phase (known as Phase III) includes additional pollution reductions and the equalization of control requirements in the inner and outer zones. New scientific data and modeling studies could provide the basis for a modified plan. These pollution reductions would be initiated in May 2003.

Estimated Emissions Reductions and Methodology

During Phase II, sources in the inner and outer zones will be required to limit emissions to 0.2 lbs of NOx per mmBTU or to make reductions of 55-65% from the 1990 base year inventory, whichever measure is less stringent. Sources in the northern zone will only be required to comply with RACT. Sources in the northern zone will be required to limit emissions to 0.2 lbs of NOx per mmBTU or to reduce emissions by 50-65%. Therefore, affected sources in the Baltimore nonattainment area must reduce their emissions by 65% from their 1990 levels by 1999. The NOx SIP Call requirements superseded Phase III of the OTC MOU. The expected emissions reductions in tons per day for Phase II in 2002 and the NOx SIP Call in 2005 are the following:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Baltimore	0.0	90.0	0.0	133.035

7.0 CONTINGENCY MEASURES

The Act requires the State to adopt specific contingency measures that will take effect without further action by the State or the EPA if the State fails to reduce VOC/NOx emissions by an additional 3% per year from 1997 through 2005.

The contingency measures identified by the State must be sufficient to secure an additional 3 percent reduction in ozone precursor emissions in the year following the year in which the failure has been identified. If the shortfall is less than 3 percent, a contingency measure need only cover that smaller percentage. If the shortfall is greater than 3 percent, the State, in an annual tracking report to EPA, must either identify the additional actions it will take to cure the shortfall before the next milestone or maintain a reserve of contingency measures capable of covering a shortfall greater than 3 percent. Early implementation of an emission reduction measure to be implemented in the future is acceptable as a contingency measure.

The following contingency plan has been developed.

7.1 Surplus Reductions from Existing Measures

Some emission control strategies listed to meet the 2002 and 2005 target levels are expected to result in more emission reductions than are needed to meet the requirements. If other measures fail to meet expected reductions, the excess from the following measures will be used to make up the difference:

- open burning ban
- state air toxics