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Cecil County, MD Moderate Nonattainment Area
0.070 ppm 8-Hour Ozone
State Implementation Plan
Attainment Demonstration

SIP Number: 23-02

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Cecil County, MD Ozone Moderate Nonattainment Area
State Implementation Plan (SIP)
For the 0.070 ppm National Ambient Air Quality Standard for Ozone

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1.0 EXECUTIVE SUMMARY

This document, entitled the *Cecil County, Maryland Moderate Nonattainment Area 0.070 ppm 8-Hour Ozone State Implementation Plan* ("Moderate Area Attainment Plan" or "the Plan" or "Cecil County SIP"), is a plan to improve air quality in the Maryland portion of the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE region to meet the 2015, 0.070 ppm, National Ambient Air Quality Standards (NAAQS) for ozone (8-hour ozone standard). The Plan consists of a Reasonable Further Progress (RFP) demonstration, on-road mobile source emissions budget, and an attainment demonstration.

Additionally, the plan includes commitments by the state to meet requirements for moderate nonattainment areas, as well as commitments by the state to meet additional U.S. Environmental Protection Agency (EPA) requirements for Cecil County, including a contingency plan and an analysis of Reasonably Available Control Measures (RACM). The plan also presents revised emissions inventories for 2017 based on the MOVES3 model for estimating on- road vehicle emissions. The analysis methodology is consistent with past statewide inventory efforts.

The Moderate Area Attainment Plan is intended to show the progress being made to improve air quality in the Maryland portion of the Philadelphia Nonattainment Area (Philadelphia – Wilmington – Atlantic City, PA – DE – MD – NJ) and the efforts underway to assure that all necessary steps are taken to reach the federal health standard for ground-level ozone by August 2024. The plan has been prepared by the Maryland Department of the Environment (MDE) Air and Radiation Administration to comply with the Clean Air Act Amendments of 1990 (CAAA) and with EPA requirements for Cecil County as stated in EPA's reclassification of the Philadelphia Nonattainment Area, including Cecil County, to moderate.[1]

Introduction

Ground level ozone is considered a significant health-based pollutant, and EPA has set a specific National Ambient Air Quality Standards (NAAQS) for ozone to best protect public health. This standard, known as the 8-Hour Ozone standard, is implemented under the federal Clean Air Act (CAA or "the Act"). Areas of the country that monitor air pollution above the federal standard are designated "nonattainment" and are therefore required to develop and implement air quality plans called State Implementation Plans or SIPs that show how a particular region will reduce pollution to the point where the region meets the federal standards.

The Philadelphia region, which comprises Philadelphia, PA, Wilmington, DE, Atlantic City, NJ, and Cecil County, MD, has been designated nonattainment under the 8-Hour ozone standard. The following document explains the process by which the region will reduce pollution and meet the federal ozone standard by August 2024, which is the designated attainment date for Cecil County.[2]

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[1] EPA-HQ-OAR-2021-0742

[2] The region is required to demonstrate attainment of the standard by the end of the last full ozone season prior to the listed attainment date, which occurs in 2023.

Emissions
A significant portion of this document is related to emissions. Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC) emissions combine to form ozone under heat and sunlight. Reductions in emissions of these ozone precursor pollutants are necessary to reduce ozone pollution. MDE is responsible for creating an emissions inventory for NOx and VOC that estimates the actual emissions created by all the different emission sources in the state. Emissions come from a variety of sources including mobile sources like cars and trucks, point sources like power plants, area sources like household paint, and non-road sources like construction equipment and all-terrain vehicles.

This document details the current emission inventory for NOx and VOC and predicted emissions for the future. It is important to predict emissions in the future to track progress from emission reduction programs and for incorporation into attainment analyses that predict whether a region will meet the air quality standard or not.

The good news exhibited by this document is that NOx and VOC emissions are going down in Cecil County. Control programs aimed at reducing emissions have been developed and implemented, and the reductions required by these programs are significant. The control programs are designed to offset population and economic growth, which strain the emission reductions the control programs provide. Despite these obstacles, the overall trend in ozone forming emissions is downward, and MDE predicts that cleaner air will come with additional reductions.

Control Programs
Over the past several decades, MDE has adopted and implemented numerous control programs (laws, regulations, and voluntary measures) that reduce NOx and VOC emissions in Maryland. Significant control programs include Control of NOx Emissions from Coal-Fired Electric Generating Units (COMAR 26.11.38), NOx Ozone Season Emission Caps for Non-trading Large NOx Units (COMAR 26.11.40), Control of NOx Emissions from Natural Gas Pipeline Compression Stations (COMAR 26.11.29), Volatile Organic Compounds from Adhesives and Sealants (COMAR 26.11.35), and Control of Emissions of Volatile Organic Compounds from Consumer Products (COMAR 26.11.32). In addition, several new control measures are being adopted specifically to help Maryland attain the federal ozone standard. The new programs, in addition to the existing control programs that continue to be implemented and enforced, allow Maryland to develop an attainment demonstration that shows how Maryland will meet the federal ozone standard.

A significant control program is the Control of NOx Emissions from Coal-Fired Electric Generating Units (COMAR 26.11.38) established in 2015, which optimized daily NOx emission rates and substantially reduced NOx from Maryland's coal burning power plants. COMAR 26.11.38 is more stringent than the proposed federal Good Neighbor Transport FIP for the 2015 Ozone NAAQS[3] and is one of the most substantial control programs ever adopted in Maryland.

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[3] 87 FR 20036

Another significant control program is the Maryland Healthy Air Act (HAA) established in 2007, which substantially reduced NOx from Maryland's older coal burning power plants. The HAA is more stringent than the parallel federal rule called the Clean Air Interstate Rule and is the most substantial emission control program ever adopted in Maryland. Overall, the HAA reduced Maryland power plant NOx emissions by 70% (compared to 2002 levels) in 2009 and by 75% by 2012. The 2009 and 2012 reductions were a significant part of the attainment scheme developed by MDE to meet the 2008 federal ozone standard.

Additional control programs implemented by Maryland include several VOC emission reductions programs targeted at industrial adhesives and sealants, portable fuel containers and commercial and consumer products. Other non-traditional measures include an aggressive telework (also called "telecommuting") program and innovative transportation measures.

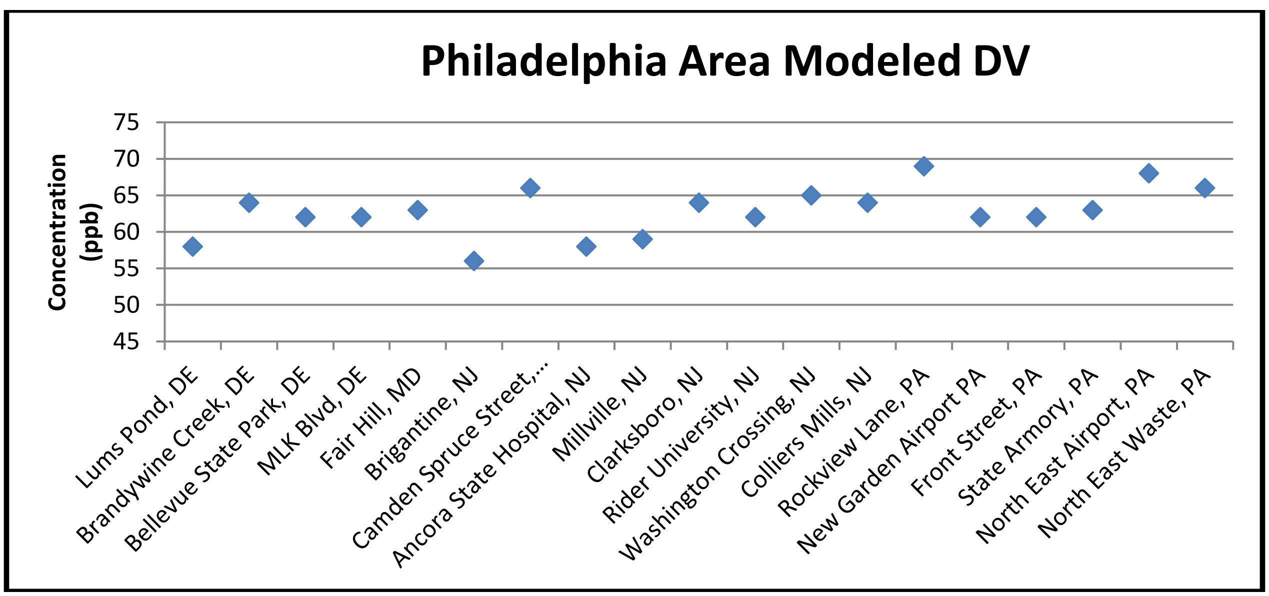
Modeling

A significant part of the attainment demonstration for Maryland consists of air quality modeling analysis. Required by the Act, air quality models are run to examine future air quality conditions and determine whether a region will attain the standard by its designated attainment date. The models are not relied upon as the only attainment test but are an important part of the attainment demonstration for Maryland.

The air quality modeling analysis completed for this SIP shows the Philadelphia Nonattainment Area, including Cecil County, attaining the 8-hour ozone standard. Every air quality monitor located in the nonattainment area are predicted to be at levels consistent with attainment.

The chart below shows a summary of the ozone monitor design values expected in the region based on the modeling analysis. All the air quality monitors in the region are predicted to be well below the 70 ppb 8-hour ozone standard by 2023.

Figure 1-1: 2023 8-Hour Ozone Design Values - 2023 Attainment Modeling



2.0 INTRODUCTION AND BACKGROUND

This document, entitled *Cecil County, Maryland Moderate Nonattainment Area 0.070 ppm 8-Hour Ozone State Implementation Plan*, presents the Maryland Department of the Environment's (MDE) progress in adopting and implementing air pollution control programs needed to attain the 8-hour ozone standard by August 2024[4] in Cecil County. Based on the control measures being implemented and the related air quality modeling results, there is significant evidence that the Philadelphia Nonattainment Area, including Cecil County, will attain the 8-hour ozone standard by the attainment date.

2.1 STATE IMPLEMENTATION PLANS

The State Implementation Plan (SIP or "the Plan") is a detailed document required for states or regions that do not meet air quality standards set by the federal government. The Plan identifies how that state will attain and/or maintain the primary and secondary National Ambient Air Quality Standards (NAAQS) set forth in section 109 of the Clean Air Act (CAA or "the Act") and 40 Code of Federal Regulations 50.4 through 50.12 and which includes federally enforceable requirements. Each state is required to have a SIP that contains control measures and strategies that demonstrate how each area will attain and maintain the NAAQS. These plans are developed through a public process, formally adopted by the State, and submitted by the Governor's designee to the U.S. Environmental Protection Agency (EPA). The Clean Air Act requires EPA to review each plan and any plan revisions and to approve the plan or plan revisions if consistent with the Clean Air Act.

SIP requirements applicable to all areas are provided in Part A, Title 1, Section 110 of the Act. Part D of Title I of the Act specifies additional requirements applicable to nonattainment areas. Section 110 and Part D describe the elements of a SIP, which includes, among other things, emission inventories, a monitoring network, an air quality analysis, modeling, attainment demonstrations, enforcement mechanisms, and regulations which have been adopted by the state to attain or maintain NAAQS. EPA has adopted regulatory requirements which spell out the procedures for preparing, adopting, and submitting SIPs and SIP revisions that are codified in 40 CFR part 51. EPA's action on each state's SIP is promulgated in 40 CFR part 52.

The contents of a typical SIP fall into several categories: (1) State-adopted control measures which consist of either rules/regulations or source-specific requirements (e.g., orders and consent decrees); (2) State-submitted comprehensive air quality plans, such as attainment plans, maintenance plans, rate of progress plans, and transportation control plans demonstrating how these state regulatory and source-specific controls, in conjunction with federal programs, will bring and/or keep air quality in compliance with federal air quality standards; (3) State-submitted "non-regulatory" requirements, such as emission inventories, small business compliance assistance programs, statutes demonstrating legal authority, monitoring networks, etc.); and (4)

[4] The region is required to demonstrate attainment of the standard by the end of the last full ozone season prior to the listed attainment date, which occurs in 2023.

additional requirements promulgated by EPA (in the absence of a commensurate State provision) to satisfy a mandatory Section 110 or Part D (Clean Air Act) requirement.

Once the Administrator of the EPA approves a state plan, the plan 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 EPA's judgment to attain the NAAQS in all or any region of the state, and if the state fails to make the requisite amendments under Section110(c)(1), the EPA Administrator may issue amendments to the SIP that are binding. EPA is required to impose severe sanctions on the states under three circumstances: the state's failure to submit a SIP revision; on the finding of the inadequacy of the SIP to meet prescribed air quality requirements; and the state's failure to enforce the control strategies that are contained in the SIP. Sanctions include withholding federal funds for highway projects other than those for safety, mass transit, or transportation improvement projects related to air quality improvement or maintenance beginning 24 months after EPA announcement. No federal agency or department will be able to award a grant or fund, license, or permit any transportation activity that does not conform to the most recently approved SIP.

2.2 CLEAN AIR ACT

The Clean Air Act was passed in 1970 to protect public health and welfare. Congress amended the Act in 1990 to establish requirements for areas not meeting the National Ambient Air Quality Standards (NAAQS). The Clean Air Act Amendments of 1990 (CAAA) established a process for evaluating air quality in each region and identifying and classifying nonattainment areas according to the severity of its air pollution problem. The CAAA defines ground-level ozone as a criteria pollutant. In 1979, EPA promulgated the 0.12 parts per million (ppm) 1-hour ozone standard. In 1997, EPA issued a revised and stricter ozone standard of 0.08 ppm, or 85 parts per billion (ppb), measured over an eight-hour period. The one-hour ozone standard was consequently revoked in June 2005. The Clean Air Act also sets National Ambient Air Quality Standards for five other criteria pollutants: carbon monoxide, particulate matter, lead, sulfur dioxide, and nitrogen dioxide.

In 2018, EPA designated the Philadelphia metropolitan area, including Cecil County, as a “marginal” nonattainment area for the 0.70 ppm 8-hour ozone standard under Subpart 2 of part D, Title I (Effective Date August 3, 2018)[5]. In 2022, EPA finalized action reclassified the Philadelphia metropolitan area, including Cecil County, to “moderate” for the 0.70 ppm 8-hour ozone standard.[6] With a revised NAAQS, the CAA requires states to review air quality monitoring data and submit ozone boundary designation recommendations. In March 2017, Maryland submitted its original boundary recommendation for the 2015 ozone NAAQS to EPA, based on the ozone air quality monitoring data for the three years of 2014-2016.[7] When Cecil County was classified as Marginal for the 2015 ozone standard, the boundaries remained the same as for the 2008 ozone standard. A map of the nonattainment area is shown in Figure 2-1.

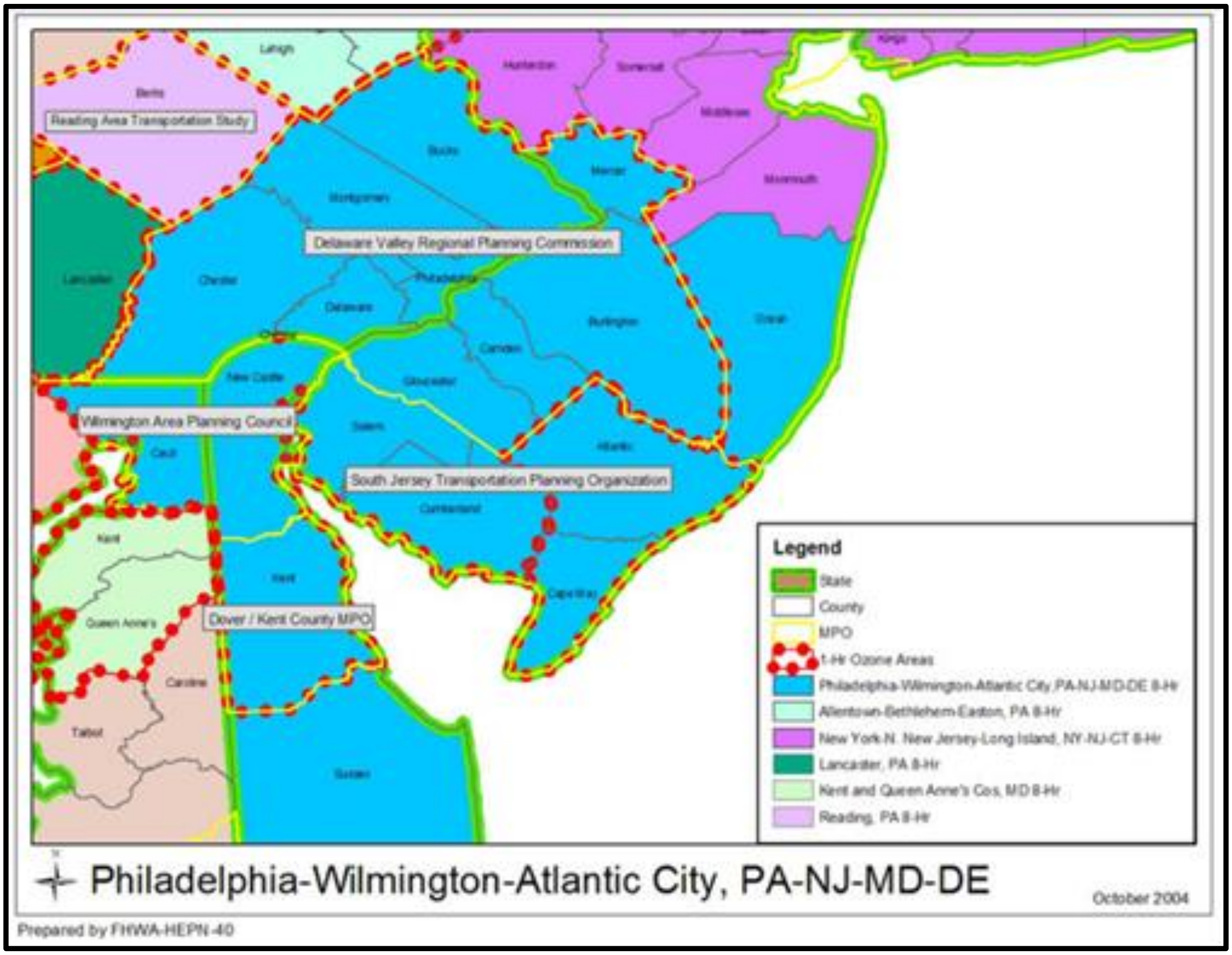
[5] 83 FR 25776

[6] EPA-HQ-OAR-2021-0742

[7] https://www.epa.gov/sites/production/files/2017-05/documents/md_recommendations.pdf

To meet the federal 0.070 ppm 8-hour standard for ozone, nonattainment areas are required to develop their SIP documents to reduce ozone-forming emissions by at least 15 percent between 2017-2023 and to reduce all ozone precursor emissions to a level sufficient to attain the federal 0.070 ppm eight-hour standard by August 2024. However, the region is required to demonstrate attainment of the standard by the end of the last full ozone season prior to the listed attainment date.

Figure 2-1: Map of the Philadelphia Eight-hour Ozone Nonattainment Region



2.3 SIP REQUIREMENTS FOR MODERATE NONATTAINMENT AREAS

The Clean Air Act Section 182 (b) requires moderate nonattainment areas to submit state implementation plan revisions that meet the following planning requirements:

- Reasonable Further Progress: 15% emission reduction from baseline within 6 years of enactment
- Attainment demonstration: Due 3 years after CAA Amendments enactment
- New Source Review (NSR) and Reasonably Available Control Technology (RACT) major source applicability: 100 tons per year (TPY)
- NSR offsets: 1.15 to 1

- NSR permits: required for new or modified major stationary sources
- NOx control for RACT: requirement for major stationary VOC sources also applies to major NOx sources
- RACM/RACT: RACT required for all Control Technique Guideline (CTG) sources and all other major sources
- Inspection and Maintenance (I&M): Basic I&M
- Contingency measures: required for failure to meet Reasonable Further Progress (RFP) milestones or attainment

Before designation as a moderate nonattainment area for the 2015 eight-hour standard, the Philadelphia region, including Cecil County, was designated nonattainment for other ozone standards including the revoked 1979 one-hour ozone standard, the 1997 8-hour ozone standard and the 2008 8-hour ozone standard. As such, many of these programs are already in place; therefore the planning requirements have already been met.

2.4 EIGHT-HOUR OZONE STANDARD

In 2015, EPA issued a revised ozone health standard based on an 8-hour measurement to protect human health against longer exposure periods. Since the late 1980's, more than 3,000 published health studies have indicated that health effects occur at levels lower than the previous standard and that exposure times longer than one hour are of concern. EPA established an 8-hour standard at 0.070 ppm / 70 ppb and defined the new standard as a "concentration-based" form, specifically the 3-year average of the 4th highest daily maximum 8-hour ozone concentration.

EPA changed the form of the standard to a concentration-based form because it more accurately reflects actual human exposure and related health effects. Even at relatively low levels, ozone may cause inflammation and irritation of the respiratory tract, particularly during physical activity. The resulting symptoms can include breathing difficulty, coughing, and throat irritation. Breathing ozone can affect lung function and worsen asthma attacks. Ozone can increase the susceptibility of the lungs to infections, allergens, and other air pollutants. Medical studies have shown that ozone damages lung tissue, and complete recovery may take several days after exposure has ended.

2.5 GROUND-LEVEL OZONE

Ground-level ozone is an extremely reactive gas composed of three atoms of oxygen. Ozone (the primary constituent of smog) continues to be a pollution problem throughout many areas of the United States. Unlike many other pollutants, ground-level ozone is not directly emitted into the atmosphere from a specific source. Instead, ground-level ozone is formed when nitrogen oxides (NOx) chemically react with volatile organic compounds (VOC) through a series of complicated chemical reactions in the presence of strong sunshine (ultraviolet light) as shown in Figure 2-2.

Because ozone formation is greatest when the sunlight is most intense, the peak ozone levels typically occur in Maryland during hot, dry, stagnant summertime conditions generally referred to as the ozone season. Peak ozone concentrations exhibit a clear seasonal cycle, with concentrations rising with the onset of warmer weather in the spring and declining again as the autumn approaches. Changing weather patterns can significantly contribute to yearly differences in ozone concentrations. Years with summertime weather conditions that are hot and dry will generally result in many more days of poor air quality than cool and wet summers.

Furthermore, climate change may impact the formation of ozone. Changing humidity and wind patterns may lead to more stagnant atmospheric conditions, which favors ozone production. Additionally, certain regions are experiencing longer, warmer summers, which may prolong the ozone season. It is even predicted that by 2050, warming alone may increase the number of ozone-standard exceedance days by 68% across the Eastern United States. [8]

Figure 2-2: Formation of Ground Level Ozone

The formation of ozone is not an instantaneous process, nor is it limited in geographical scope. While many urban areas tend to have high levels of ozone, even rural areas are subject to increased ozone levels because wind carries ozone and its precursors hundreds of miles from their original sources. Numerous studies and modeling data show compelling evidence that weather patterns often result in the transport of ozone and the pollutants responsible for ozone formation, well beyond the locality that produced the emissions. In many cases, unhealthy days

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[8] Zhang, J, Wei, Y, and Fang, Z. *Ozone Pollution: A Major Health Hazard Worldwide*. Frontiers in Immunology 2019. https://doi.org/10.3389/fimmu.2019.02518

of air pollution experienced in Maryland are exacerbated by pollutants transported into Maryland from neighboring states.

Ground-level ozone can have significant impacts on human health, particularly people with existing respiratory diseases, the elderly, and children. Ozone also impacts the environment and ecosystem health. Scientific evidence suggests that air pollution weakens the immune systems of many types of vegetation and can cause significant crop damage. In addition, rain and snow wash air pollution deposited on vegetation and architectural surfaces into the streams and rivers of the region and finally into the Chesapeake Bay.

2.6 AIR POLLUTION AND THE CHESAPEAKE BAY

Typically, air pollution is thought of as smog that affects people's health and reduces visibility. However, air pollution also contributes to land and water pollution that affects the health of the Chesapeake Bay's resources - its fish, shellfish, and other animals. Over the last forty years, research has provided us with more knowledge on how air pollution can directly affect the Chesapeake Bay.

Pollutants released into the air will eventually make their way back down to the earth's surface. Some of the factors that determine how far pollutants can travel through the air include the makeup of the pollutant, weather conditions (wind, temperature, humidity), type and height of the emission source (smokestack, automobile tailpipe), and the presence of other chemicals in the air. Airborne pollutants fall to the earth's surface by wet deposition (precipitation) or dry deposition (settling or adsorption). Airborne pollutants that deposit on the landscape can be transported into streams, rivers, and the Chesapeake Bay by runoff or through groundwater flow.

Excess nitrogen and chemical contaminants from atmospheric deposition impact the Chesapeake Bay and its watershed. Too much nitrogen entering the Chesapeake Bay leads to eutrophication, a process that causes an accelerated growth of algae. An overabundance of algae in the water blocks sunlight needed for submerged aquatic vegetation to grow. When the algae die, they sink to the bottom and decomposes in a process that depletes the oxygen in the water. According to the Chesapeake Bay Foundation, "without oxygen, underwater grasses, crabs, fish, and other marine life suffocate and die. These dead zones can be truly devastating to biodiversity and are an ongoing cause for concern." [9]

The effects of nitrogen can also be seen in acid rain. Nitrogen oxides (NOx) are one of the key air pollutants that cause acid deposition, which increases the acidity of water and soils and results in adverse effects on aquatic and terrestrial ecosystems. Increases in water acidity can impair the ability of certain fish and aquatic life to grow, reproduce, and survive. Increases in soil acidity can impair the ability of some types of trees to grow and resist disease.

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[9] "Air Pollution." The Issues: Air Pollution, Chesapeake Bay Foundation, https://www.cbf.org/issues/air-pollution/index.html

2.7 HEALTH EFFECTS

Ozone is a highly reactive gas that reacts strongly with living tissues, as well as many synthetic substances. As an oxidizing gas, it can cause oxidative damage to the cells and the lining fluids of the airways, which may trigger immune-inflammatory responses.[10] Too much ozone in the air can be harmful to people who work or exercise outdoors regularly, people with respiratory difficulties, and especially children. The most common symptom of ozone exposure is pain when taking a deep breath. Exposure to ozone can result in both long-term and short-term effects in healthy individuals, as well as those who are already sensitive to air pollution, such as children, asthmatics, and the elderly.

Exposure to ozone presents numerous long-term effects. Research suggests that repeated exposure to ozone may cause damage to lung tissue, thereby reducing lung function. According to EPA, "Long-term exposure to ozone is linked to aggravation of asthma and is likely to be one of many causes of asthma development. Studies in locations with elevated concentrations also report associations of ozone with deaths from respiratory causes."[11]

Children are at greater risk for ozone-related respiratory problems because their lungs are still developing, they breathe more air per pound of body weight than adults, they're more active outside than adults, they have immature immune systems, and they're more likely to have asthma.[12] Additionally, anyone suffering from lung disease has even more trouble breathing when air is polluted with high levels of ozone. According to EPA, "Repeated ozone damage to developing lungs can affect children into adulthood, contributing to permanent reductions in the lungs' ability to function."[13]

Short-term effects of ozone exposure among healthy populations include impaired lung function, throat irritation, pain or burning in the chest when taking a deep breath, chest tightness, wheezing, shortness of breath, and reduced ability to perform physical exercise. Additionally, other potential short-term effects include increased hospital admissions and emergency room visits for respiratory reasons and increased school absences. [14]

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[10] Kelly FJ. Oxidative stress: its role in air pollution and adverse health effects. Occupational and Environmental Medicine 2003;60:612-616. http://dx.doi.org/10.1136/oem.60.8.612

[11] "Health Effects of Ozone Pollution." Ground-level Ozone Pollution, Environmental Protection Agency, https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution

[12] Buka I, Koranteng S, Osornio-Vargas AR. The effects of air pollution on the health of children. Paediatr Child Health. 2006 Oct;11(8):513-6. PMID: 19030320; PMCID: PMC2528642. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2528642/

[13] "Ozone and Children's Health." The National Ambient Air Quality Standards Fact Sheet, Environmental Protection Agency, https://www.epa.gov/sites/production/files/2016-04/documents/20151001childrenhealthfs.pdf.

[14] "Health Effects of Ozone in the General Population." Ozone Pollution and Your Patients' Health, Environmental Protection Agency, https://www.epa.gov/ozone-pollution-and-your-patients-health/health-effects-ozone-general-population#short%20term

2.8 MARYLAND-SPECIFIC AIR POLLUTION HEALTH EFFECTS

According to the U.S. Census Bureau, Maryland's estimated 2019 population is 6,045,680, of whom 1,108,488 were under 15 years of age, and of whom 959,887 were 65 or over.[15] This means that the total number of children and elderly in Maryland was 2,068,375. Approximately one third of Maryland's population is more likely to suffer the adverse effects of air pollution simply as a result of their age.

According to an April 2022[16] report from the American Lung Association, the group of people with respiratory disease in the state of Maryland includes:

- 422,111 adult asthmatics and 100,871 child asthmatics
- 229,485 with Chronic Obstructive Pulmonary Disease (COPD)
- 3,091 with lung cancer

2.9 THE IMPACT OF OZONE UPON AGRICULTURE

Because ozone formation requires sunlight, periods of high ozone concentration coincide with the agriculture growing season in Maryland. Ozone damage to plants can occur with or without any visible signs. Consequently, many farmers are unaware that ozone is reducing their yields. Ozone enters the plant's leaves through its gas exchange pores (stomata), just as other atmospheric gases do in normal gas exchange. The ozone then oxidizes (burns) plant tissue/leaves, thus damaging the plant and reducing survival.

Ozone damage in the plant impedes photosynthesis, resulting in slower plant growth. Such ozone induced problems also decrease the numbers of flowers and fruits a plant will produce and impair water use efficiency and other functions.[17] Plants weakened by ozone may be more susceptible to pests, disease, and drought.

A study was conducted in 2009 that studied the impact of ozone on soybeans in the upper Midwest. It was found that the yield in the study regions was diminished by 2-6%. The annual cost to U.S. farmers will exceed several billion dollars when taking into account that many crops have been shown to be affected by ozone concentrations once a threshold concentration is

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[15] Bureau, U.S. Census. "ACS DEMOGRAPHIC AND HOUSING ESTIMATES." Explore Census Data, United States Census Bureau, https://data.census.gov/cedsci/table?q=maryland&tid=ACSST1Y2019.S0101

[16] American Lung Association State of the Air, April 2022 https://www.lung.org/research/sota/city-rankings/states/maryland

[17] "Ozone Effects on Plants." Effects of Air Pollution, National Parks Service. https://www.nps.gov/subjects/air/nature-ozone.htm#:~:text=Ozone%20causes%20considerable%20damage%20to,leaves%20and%20causes%20reduced%20survival.

reached.[18] On a global level, yield losses due to ozone have been estimated (using 2000 data) to be between $14-$26 billion for wheat, rice, maize, and soybean combined.[19]

2.10 THE AIR QUALITY INDEX (AQI)

The Air Quality Index (AQI) is an index used for reporting forecasted and daily air quality. The AQI uses both a color- coded and numerical scale ranging from 0 to 500 to report how clean or polluted the air is and a description of which groups of people may be at risk. The AQI focuses on health effects people may experience within a few hours or days after breathing polluted air. The AQI is calculated for five major pollutants regulated by the Clean Air Act: particulate matter, ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide.

Figure 2-3: The Air Quality Index (AQI)

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Using the Air Quality Index, the Maryland Department of the Environment and the Metropolitan Washington Council of Governments (COG) issue daily air quality forecasts for the Baltimore metropolitan area (including Cecil County), Washington metropolitan area, Western Maryland, and the Eastern Shore.

Extended range forecasts provide a three-day forecast so people can better plan their week and take the opportunity to arrange carpools, take mass transit, or take other actions to limit pollution when air quality is predicted to be unhealthy.

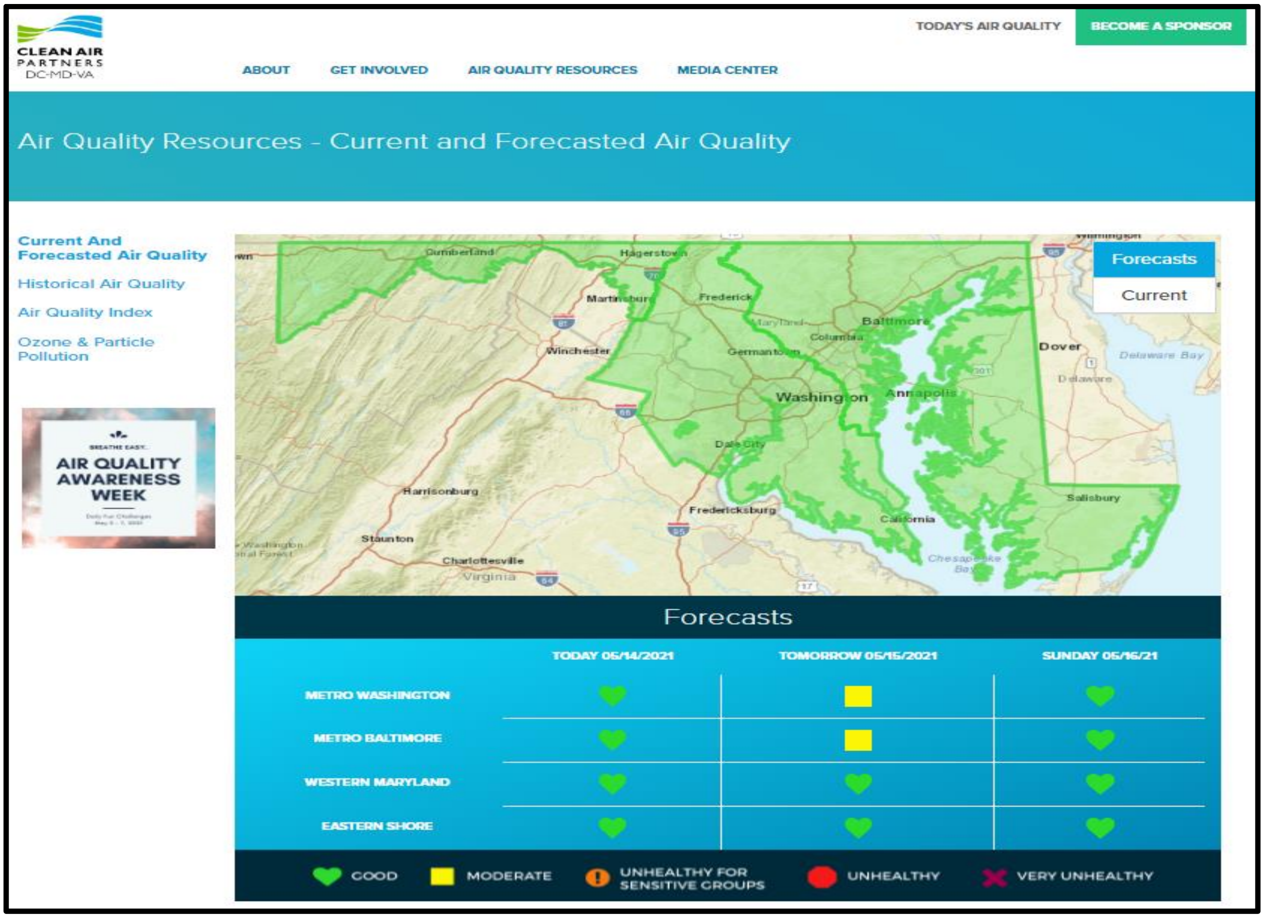
MDE and COG issue the air quality forecasts to local media and hundreds of businesses and individuals throughout the region. Anyone can sign up to receive the free, daily email by visiting

[18] Jack Fishman, John K. Creilson, Peter A. Parker, Elizabeth A. Ainsworth, G. Geoffrey Vining, John Szarka, Fitzgerald L. Booker, Xiaojing Xu, An investigation of widespread ozone damage to the soybean crop in the upper Midwest determined from ground-based and satellite measurements, *Atmospheric Environment*, Volume 44, Issue 18, 2010, Pages 2248-2256, ISSN 1352-2310, https://doi.org/10.1016/j.atmosenv.2010.01.015.

[19] Royal Society, 2008. Ground-level Ozone in the 21st Century: Future Trends, Impacts and Policy Implications. RS Policy Document 15/08. The Royal Society, London, 132 pp https://royalsociety.org/~/media/royal_society_content/policy/publications/2008/7925.pdf

the Clean Air Partners website at http://www.cleanairpartners.net/. The Clean Air Partners website provides the public with easy-access local and national air quality information. Clean Air Partners offers daily AQI forecasts and real-time AQI conditions throughout most of Maryland, the District of Columbia, and Northern Virginia. Users of Clean Air Partners may also sign-up for AirAlerts to receive real-time email notifications when air quality reaches unhealthy levels in the region.

Figure 2-4: Clean Air Partners Air Quality Data and Forecasts



2.11 SOURCES OF OZONE POLLUTION IN CECIL COUNTY

There are a number of diverse sources that discharge VOCs and NOx, the two primary pollutants responsible for ozone formation. Human made sources, called anthropogenic sources, are divided into four categories: point, area, on-road mobile and non-road mobile sources. A fifth category, "biogenic" emissions, includes all naturally occurring sources of VOC emissions from trees, crops, and other forms of vegetation.

Point sources are primarily manufacturing businesses that produce emissions equal to or greater than 25 tons per year (tpy) of VOCs or NOx. Large industrial plants such as power plants and chemical manufacturers are examples of point sources.

Area sources are smaller sources of air pollution whose emissions are too small to be measured individually. Examples of area sources include commercial and consumer products, bakeries, gasoline refueling stations, printing facilities, and auto refinishing shops.

Sources of air pollution that are not stationary are referred to as mobile sources and are broken down into two categories: on-road mobile sources and non-road mobile sources. The former includes cars, vans, trucks and buses (i.e. vehicles that operate on highways). Non-road mobile sources include boats, lawn and garden equipment, construction equipment, and locomotives.

Table 2-1: Top Ten Sources of VOC in Cecil County (2017 and 2023 Emissions)

Rank	Source Category	Source	VOC (Tons/Day)	
			2017	2023
1	Nonroad	Recreational Equipment	2.079	1.323
2	OnRoad Mobile	Cars, Buses, Trucks	1.149	0.920
3	Area	Solvents – Other	1.088	1.158
4	Area	Solvents - C&C	0.725	0.666
5	Area	Architectural Surface Coatings	0.545	0.578
6	Nonroad	Lawn and Garden Equipment	0.236	0.233
7	Area	Petroleum Marketing	0.151	0.161
8	Point	Terumo Cardiovascular Systems Corporation	0.127	0.127
9	Area	Farm Animals	0.080	0.080
10	Point	Rock Springs Generation Facility	0.074	0.074

**The emission estimates above are rounded to the nearest whole number. The figures are MDE's best estimates. Biogenic emissions account for 126.9 tons/day of VOC emissions in Cecil County.*

Table 2-2: Top Ten Sources of NOx in Cecil County (2017 and 2023 Emissions)

Rank	Source Category	Source	NOx (Tons/Day)	
			2017	2023
1	OnRoad Mobile	Cars, Buses, Trucks	4.037	2.638
2	Nonroad	Marine	1.192	0.001
3	Point	Rock Springs Generation Facility	1.111	1.111
4	Nonroad	Recreational Equipment	0.435	0.532
5	Area	Fuel Combustion	0.310	0.335
6	Nonroad	Rail	0.270	1.695
7	Nonroad	Construction and Mining Equipment	0.237	0.125
8	Point	Cecil County Central Landfill	0.182	0.189
9	Nonroad	Pleasure Craft	0.131	0.000
10	Point	W.L. Gore & Associates, Inc - Cherry Hill Plant	0.121	0.121

**The emission estimates above are rounded to the nearest whole number. The figures are MDE's best estimates.*
*** Onroad Mobile 2023 emissions reflect the Mobile Vehicle Emissions Budgets established in this SIP*

2.12 FREQUENCY OF VIOLATION OF FEDERAL HEALTH STANDARD FOR OZONE

Since the Clean Air Act Amendments of 1990, Maryland has made significant improvements in the quality of air. National, state, and local programs have all contributed to dramatically limiting the amount of pollution that is generated, which has reduced the number of days that unhealthy air is experienced throughout the region. Mandated reductions in emissions from businesses and industries and technological improvements in automobiles have brought about a steady progress in air quality.

Figure 2-5: 8-Hour Ozone Exceedance Days of the Cecil County, MD Fair Hill Monitor

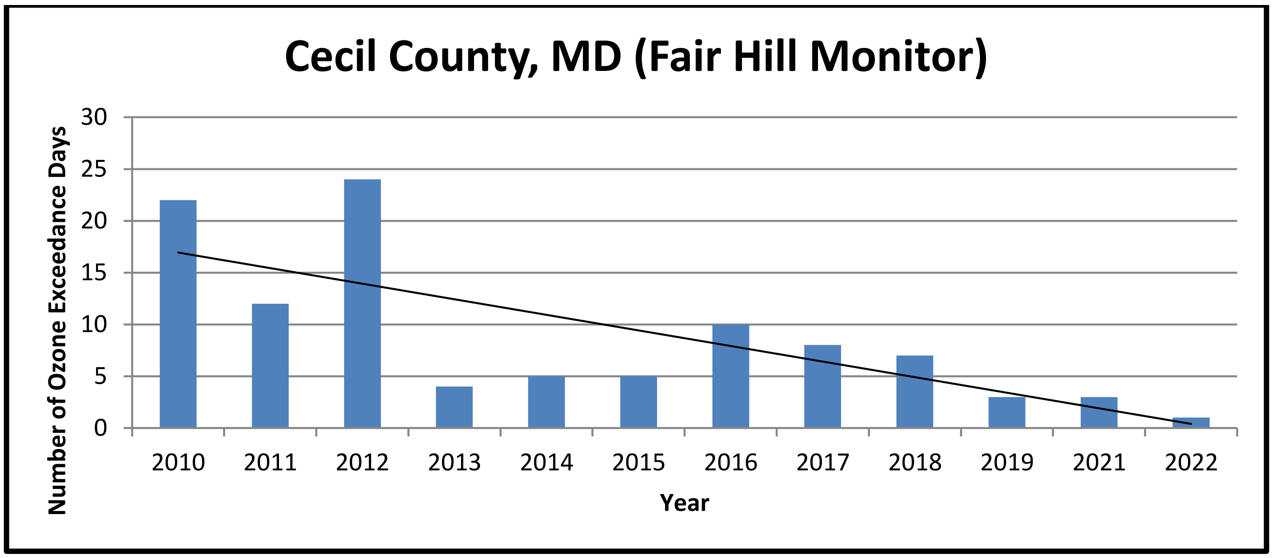
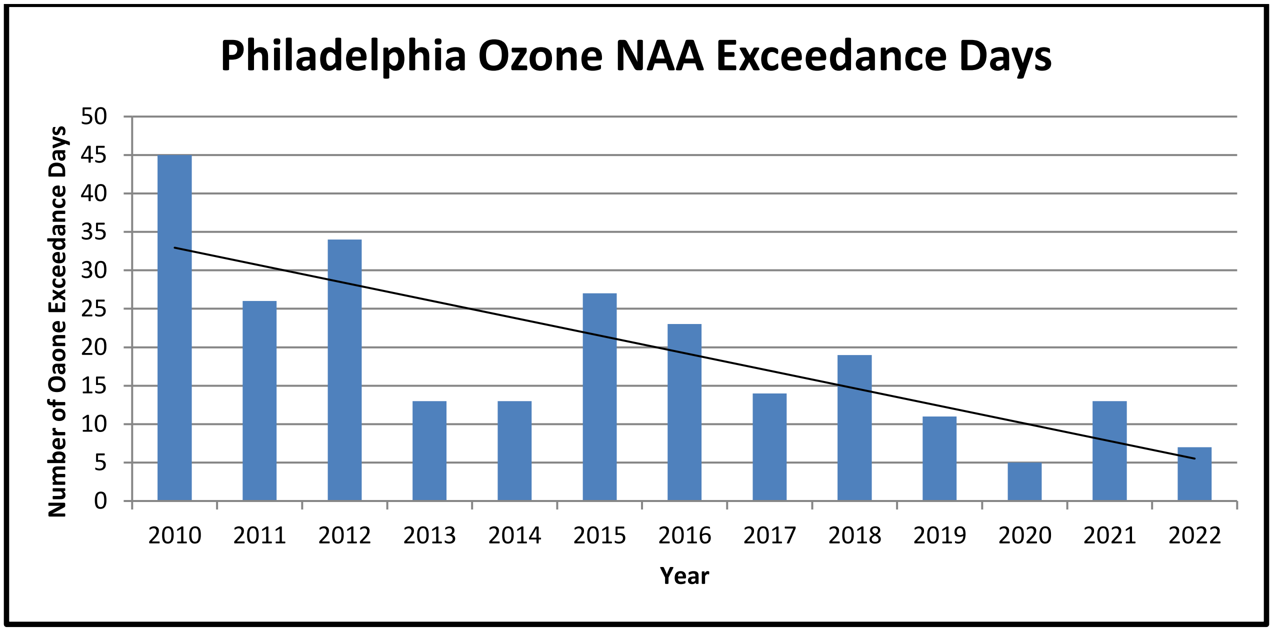


Figure 2-6: 8-Hour Ozone Exceedance Days of the Philadelphia Ozone Nonattainment Area



The federal 8-hour ozone standard is set at 0.07 parts per million (70 parts per billion) of ozone averaged over an eight-hour period. Figure 2-5 applies the eight-hour standard to historic data and shows the number of days that exceeded levels under the new standard. The figure also clearly shows an improving trend in Cecil County's air quality since 1980. While annual fluctuations can be attributed to weather (hot, stagnant summers are favorable for ozone formation), the downward trend is indicative of controls on sources of air pollution and the resulting levels of ozone precursors present in the ambient air.

2.13 REQUIRED SIP PRINCIPLES

Section 110 of the 1990 Clean Air Act Amendments (CAAA) specifies the conditions under which EPA approves SIP submissions. These requirements are being followed by the Maryland Department of the Environment in developing this SIP. In order to develop effective control strategies, EPA has identified four fundamental principles that SIP control strategies must adhere to in order to achieve the desired emissions reductions. These four fundamental principles are outlined in the General Preamble to Title I of the Clean Air Act Amendments of 1990 at *Federal Register 13498* (EPA, 1992a). The four fundamental principles are as follows:

1. Emissions reductions ascribed to the control measure must be quantifiable and measurable;
2. The 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;
3. Measures are replicable; and

4. The control strategy must 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.

2.14 SANCTIONS

EPA must impose various sanctions if the State does not submit a plan; or submits a plan that EPA does not approve; or fails to implement the plan. These sanctions include withholding federal highway funding; withholding air quality planning grants; and imposing a federal plan ("federal implementation plan"). Failure to submit or implement a plan will have significant consequences for compliance with conformity requirements.

2.15 REASONABLE FURTHER PROGRESS

As a moderate area, EPA requires the Philadelphia Nonattainment area, including Cecil County, demonstrate Reasonable Further Progress (RFP) towards attainment by 2023.[20] EPA's implementation guidance requires that moderate ozone nonattainment areas with an approved 15% VOC reduction plan for the period 1990-1996 (required for former 1-hour ozone nonattainment areas), such as Cecil County, demonstrate a 15% Reasonable Further Progress by 2023. Chapter 5 contains Cecil County's Reasonable Further Progress demonstration for the years 2017-2023. The region will need to fulfill the 2017-2023 reasonable further progress requirements by January 1, 2024.

In order to demonstrate reasonable further progress, a region must show that its expected emissions, known as "controlled inventories," of NOx and VOC will be less than or equal to the target levels set for the end of the reasonable further progress period, or "milestone year." For the RFP period 2017-2023, the "target inventories" of emissions are the maximum quantity of anthropogenic emissions permissible during the 2017 milestone year.

2.16 ANALYSIS OF REASONABLY AVAILABLE CONTROL MEASURES (RACM)

An extensive list of potential control measures was analyzed and evaluated against criteria used for potential RACM measures. Individual measures must meet the following criteria: will reduce emissions by the 2022 ozone season; are enforceable; are technically feasible; are economically feasible; would not create substantial or widespread adverse impacts within the region; the emission reductions from the source being controlled exceed a *de minimis* threshold, defined as 0.1 tons per day. Based on the analysis completed for Cecil County there were no identified RACM measures that if implemented would advance attainment in the Cecil County portion of the Philadelphia Nonattainment area.

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[20] Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard, Federal Register, Vol 70, No. 228, Nov.29, 2005, pp. 71612-71705.

2.17 CONTINGENCY MEASURES

In the event that the reductions anticipated in the 2017-2023 Reasonable Further Progress demonstrations or the 2023 attainment demonstration are not realized within the timeframes specified, contingency measures must be ready for implementation. EPA issued guidance that states that contingency measures should provide for a 3% reduction in adjusted 2017 base year inventory for both Reasonable Further Progress and attainment. Less than a 3% reduction is acceptable provided the state provides further analysis and explanation for the reduction amount. A minimum of 0.3 percent VOC must be included. The measures proposed as contingency measures are listed in Chapter 9. Chapter contains details on these measures, how they would be implemented and enforced, and the amount of reduction benefit expected.

3.0 THE 2017 BASE-YEAR INVENTORY

3.1 BACKGROUND AND REQUIREMENTS

The 2017 Base-Year Inventory is published in a separate document entitled, *2015 8-Hour Ozone NAAQS (0.070 ppm) Base Year Emissions Inventory Marginal Nonattainment Area SIP for the Cecil County, MD Nonattainment Area*, and dated June 29, 2020 (the "2020 Marginal SIP Cecil County"). This document was submitted to the U.S. Environmental Protection Agency (EPA) Region III. Maryland Department of the Environment (MDE) prepared the document, and the document remains intact to fulfill the State Implementation Plan (SIP) inventory requirement of the Clean Air Act (CAA). It is available for inspection at the Maryland Department of the Environment, Air and Radiation Administration, 1800 Washington Boulevard, Suite 730, Baltimore, Maryland 21230. Relevant portions of the 2020 Marginal SIP Cecil County, are included in Appendix A, including source category listings and descriptions, methods and data sources, emission factors, controls, spatial and temporal allocations, and example calculations.

The emissions inventory covers the Cecil County portion of the Philadelphia Nonattainment Area, shown in Figure 2-1, which is classified as a moderate nonattainment area for ozone by the EPA. The 2017 emissions inventory is the starting point for calculating the emissions reductions required to meet the goal of a 15% reduction in VOC/NOx emissions from anthropogenic sources by 2023. Meeting this 2023 goal means meeting reasonable further progress requirements prescribed for moderate nonattainment areas by the Clean Air Act Amendments (CAAA) and EPA.

The 2020 Marginal SIP Cecil County, which was previously submitted to EPA, addressed emissions of volatile organic compounds (VOC), nitrogen oxides (NOx), and carbon monoxide (CO) on a typical summer ozone season day and annual basis. Included in the inventory were stationary anthropogenic (human-made), biogenic (naturally occurring), and non-road and on-road mobile sources of ozone precursors.

This SIP revision updates the 2017 Base Year Inventory to include emission estimates using the updated and mandated EPA approved MOVES3 Model for on-road and off-road mobile sources.

3.2 EMISSIONS BY SOURCE

3.2.1 POINT SOURCES

For emissions inventory purposes, point sources are defined as stationary, commercial, or industrial operations that emit more than 10 tons per year of VOCs or 25 tons per year or more of NOx or CO. The point source inventory consists of actual emissions for the base-year 2017 and includes sources within Cecil County.

For source category listings and descriptions, methods and data sources, emission factors, controls, spatial and temporal allocations, and example calculations please refer to Appendix A-1.

For Base-Year Emission Inventory data from Point Sources please refer to Appendix A-2.

3.2.2 QUASI-POINT SOURCES

The Maryland Department of the Environment Air and Radiation Administration has identified several facilities that due to size and/or function are not considered point sources. These establishments contain a wide variety of air emission sources, including traditional point sources, on-road mobile sources, off-road mobile sources, and area sources. For each particular establishment, the emissions from these sources are totaled under a single point source, and summary documents include these “quasi-point” sources as point sources.

Quasi-point sources will include all emissions at the facility regardless of whether they are classified as point, area, nonroad, or mobile source emissions. These emissions are actual emissions reported for the facilities.

No quasi-point sources were identified within Cecil County, Maryland.

3.2.3 AREA SOURCES

Area sources are sources of emissions too small to be inventoried individually and which collectively contribute significant emissions. Area sources include smaller stationary point sources not included in the states' point source inventories, such as printing establishments, dry cleaners, and auto refinishing companies, as well as non-stationary sources.

Area source emissions typically are estimated by multiplying an emission factor by some known indicator of collective activity for each source category at the county or county-equivalent level. An activity level is any parameter associated with the activity of a source, such as production rate or fuel consumption that may be correlated with the air pollutant emissions from that source. For example, the total amount of VOC emissions emitted by commercial aircraft can be calculated by multiplying the number of landing and takeoff cycles (LTOs) by an EPA-approved emission factor per LTO cycle for each specific aircraft type.

Several approaches are available for estimating area source activity levels and emissions. These include apportioning statewide activity totals to the local inventory area and using emissions per employee or other unit factors. For example, solvent evaporation from consumer and commercial products such as waxes, aerosol products, and window cleaners cannot be routinely determined for many local sources. The per capita emission factor assumes that emissions in a given area can be reasonably associated with population. This assumption is valid over broad areas for certain activities such as dry cleaning and small degreasing operations. For some other sources an employment-based factor is more appropriate as an activity surrogate.

For source category listings and descriptions, methods and data sources, emission factors, controls, spatial and temporal allocations, and example calculations please refer to Appendix A-1.

For Base-Year Emission Inventory data from Area Sources please refer to Appendix A-4.

3.2.4 ON-ROAD MOBILE SOURCES

On-road mobile sources include all vehicles registered to use the public roadways. The predominant emissions source in this category is automobiles, although trucks and buses are also significant sources of emissions.

The computation of highway vehicle emissions required two primary entities: a) vehicle emission factors and b) vehicle activity.

The emission factors are generated by using the latest version of U.S. EPA's emission factor model MOVES3. EPA's MOtor Vehicle Emission Simulator (MOVES) is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics.[21] Vehicle activity (vehicle miles traveled, or "VMT") is usually obtained from the Maryland State Highway Administration (SHA). VMT data from SHA, based on vehicle traffic counts on the roadway system, is mainly used for the rural counties.

In a simple modeling scenario, the product of the emission factor and vehicle miles traveled should yield emission levels. Proper units and conversions are used to arrive at reasonable emission estimates.

In a complex modeling scenario, many emissions types, such as exhaust, evaporative, diurnal, crankcase, and refueling emissions, are computed separately and treated with the appropriate activity levels.

MOVES3 expects enormous amount of local data input, such as the fleet characteristics, fleet mileage accrual rates, speed, fuel parameters, inspection and maintenance (I/M) program in place, and weather data.

In the MOVES3 model, the total highway vehicle population is characterized by the following 13 source use types (the terminology MOVES has to describe vehicles), which are subsets of five Highway Performance Monitoring System (HPMS) vehicle types, as shown in the table below:

[21] MOVES3 is now the latest official version of MOVES and has been updated and improved from the previous version

Table 3-1: MOVES3 Source Types and HPMS Vehicle Groups

Source Types			HPMS Class Groups	
11	Motorcycle		10	Motorcycle
21	Passenger Car		25	Light Duty Vehicle
31	Passenger Truck		40	Bus
32	Light Commercial Truck		50	Single Unit Truck
41	Other Bus		60	Combination Truck
42	Transit Bus			
43	School Bus			
51	Refuse Truck			
52	Single Unit Short-haul Truck			
53	Single Unit Long-haul Truck			
54	Motor Home			
61	Combination Short-haul Truck			
62	Combination Long-haul Truck			

MOVES3 further classifies the vehicle types by the fuel that the vehicle uses. For example, all motorcycles are gasoline based, and transit and urban buses are diesels. School buses can be either gasoline-driven or diesel-driven vehicles, and so on.

MOVES3 also allows for the modeling of other fuel type vehicles such as hybrids and alternate fuel vehicles (AFV) as a special case in a complex modeling initiative.

Table 3-2: MOVES3 On-road Fuel Types

fuelTypeID	Description
1	Gasoline
2	Diesel Fuel
3	Compressed Natural Gas (CNG)
5	E-85
9	Electricity

The MOVES3 model produces emission factors for each of the 13 vehicle types and one composite factor for all vehicle types.

A post-processing system takes care of all emission computations of the modeling domain by aggregating the emissions from roads/links appropriate to the area. It also produces meaningful reports by area, vehicle type, and roadway type.

For source category listings and descriptions, methods and data sources, emission factors, controls, spatial and temporal allocations, and example calculations please refer to Appendix A-1.

For Base-Year Emission Inventory data and detailed documentation for MOVES3 on-road mobile sources please refer to Appendix A-5 and Appendix E.

3.2.5 NONROAD SOURCES

3.2.5.1 Nonroad Model Sources

Emissions for all nonroad vehicles and engines except for those at BWI airport (aircraft, ground support equipment (GSE) and, auxiliary power units (APU)), locomotives, and commercial marine vessels were calculated using USEPA's MOVES3-Nonroad model.

The USEPA's MOVES3 NONROAD model estimates emissions from equipment such as recreational marine vessels, recreational land-based vehicles, farm and construction machinery, lawn and garden equipment, aircraft ground support equipment (GSE) and rail maintenance equipment. This equipment is powered by diesel, gasoline, compressed natural gas or liquefied petroleum gas engines.

Maryland ran the MOVES3 NONROAD model for Cecil County. The MOVES3 NONROAD model utilizes USEPA nonroad defaults for equipment populations and growth factors and interfaces with USEPA MOVES highway defaults for fuel specific parameters and climatological data. Maryland did not make any changes to the default values.
Emissions of nonroad ozone precursor pollutants are the same in MOVES3 as in MOVES2014b. The only nonroad input that was changed for MOVE3 was the sulfur level of nonroad diesel fuel. This leads to very small decreases in exhaust $PM_{2.5}$.

Emissions from the "nonroad vehicles and engines" category result from the use of fuel in a diverse collection of vehicles and equipment, including those in the following categories:

- Recreational vehicles, such as all-terrain vehicles and off-road motorcycles;
- Logging equipment, such as chain saws;
- Agricultural equipment, such as tractors;
- Construction equipment, such as graders and back hoes;
- Industrial equipment, such as fork lifts and sweepers;
- Residential and commercial lawn and garden equipment, such as leaf and snow blowers; and
- Aircraft ground support equipment.

The nonroad model estimates emissions for each specific type of nonroad equipment by multiplying the following input data estimates:

- Equipment population for base year (or base year population grown to a future year), distributed by age, power, fuel type, and application;
- Average load factor, expressed as average fraction of available power;
- Available power, in horsepower;
- Activity, in hours of use per year; and
- Emission factor with deterioration and/or new standards.

The emissions are then temporally and geographically allocated using appropriate allocation factors.

The MOVES-Nonroad model allocates activity monthly through the National County Database (NCD). The model can calculate emissions for a variety of time periods; an entire year, one of four seasons, or any particular month. Emissions for the period selected are estimated either for the total period or for a typical day (weekday or weekend) in that period.

Average Ozone Season Day (OSD) daily emissions were estimated using the month of July's weekends and weekdays emissions. The weekend and weekday emissions were multiplied by the fraction of weekend or weekday days for the month of July. (Note: fraction weekday portion for example is calculated by dividing day the number of weekdays in July (23 days in 2020) by the total number of days in July (31). The sum of the products (weekday daily emissions times weekday fraction plus weekend daily emissions times weekend day fraction), is the average of weekend day emissions.

The MOVES3 NONROAD model also accounts for all USEPA emission standards for nonroad equipment. There are multiple standards that vary by equipment type, rated power, model year, and pollutant. A partial summary of the emission control programs accounted for in the MOVES3 NONROAD model is presented in Table 3-3 below.

Table 3-3: Control Programs Included in the USEPA's NONROAD Model

Regulation/(USEPA's emission standard reference guide)	Description
Control of Air Pollution; Determination of Significance for Nonroad Sources and Emission Standards for New Nonroad Compression Ignition Engines At or Above 37 Kilowatts 59 FR 31036 June 17, 1994 (EPA-420-B-16-022, March 2016)	This rule establishes Tier 1 exhaust emission standards for HC, NOx, CO, and PM for nonroad compression-ignition (CI) engines ≥37kW (≥50hp). Marine engines are not included in this rule. The start dates and pollutants affected vary by hp category as follows: 50-100 hp: Tier 1,1998; NOx only 100-175 hp: Tier 1, 1998; NOx only 175-750 hp: Tier 1, 1996; HC, CO, NOx, PM >750 hp: Tier 1, 2000; HC, CO, NOx, PM

Regulation/(USEPA's emission standard reference guide)	**Description**
Emissions for New Nonroad Spark Ignition Engines At or Below 19 Kilowatts; Final Rule 60 FR 34581 July 3, 1995 (EPA-420-B-16-028, March 2016)	This rule establishes Phase 1 exhaust emission standards for HC, NOx, and CO for nonroad spark-ignition engines ≤19kW (≤25hp). This rule includes both handheld (HH) and non-hand-held (NHH) engines. The Phase 1 standards become effective in 1997 for : Class I NHH engines (<225cc), Class II NHH engines (≥225cc), Class III HH engines (<20cc), and Class IV HH engines (≥20cc and <50cc). The Phase 1 standards become effective in 1998 for: Class V HH engines (≥50cc)
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 61 FR 52088 October 4, 1996 (EPA-420-B-16-026, March 2016)	This rule establishes exhaust emission standards for HC+ NOx for personal watercraft and outboard (PWC/OB) and Stern Inboard (SI) marine engines. The standards are phased in from 1998-2010 for PWC/OB and from 2010- 2012 for SI engines.
Control of Emissions of Air Pollution From Nonroad Diesel Engines *63*FR 56967 October 23, 1998 (EPA-420-B-16-22, March 2016)	This final rule sets Tier 1 standards for engines under 50 hp, phasing in from 1999 to 2004. It also phases in more stringent Tier 2 standards for all engine sizes from 2001 to 2006, and yet more stringent Tier 3 standards for engines rated over 50 hp from 2006 to 2008. The Tier 2 standards apply to NMHC+ NOx, CO, and PM, whereas the Tier 3 standards apply to NMHC+ NOx and CO. The start dates by hp category and tier are as follows: hp<25: Tier 1, 2000; Tier 2, 2005; No Tier 3 25-50 hp: Tier 1, 1999; Tier 2, 2004; No Tier 3 50-100 hp: Tier 1, 1998: Tier 2, 2004; Tier 3, 2008 100-175 hp: Tier 1, 1997: Tier 2, 2003; Tier 3, 2007 175-300 hp: Tier 1, 1996: Tier 2, 2003; Tier 3, 2006 300-600 hp: Tier 1, 1996; Tier 2, 2001; Tier 3, 2006 600-750 hp: Tier 1, 1996; Tier 2, 2002; Tier 3, 2006 >750 hp: Tier 1, 2000; Tier 2, 2006, No Tier 3 This rule does not apply to marine diesel engines > 50 hp.
Phase 2: Emission Standards for New Nonroad Nonhandheld Spark Ignition Engines At or Below 19 Kilowatts 64 FR 15207 March 30, 1999 (EPA-420-b-16-028, March 2016)	This rule establishes Phase 2 exhaust emission standards for HC+ NOx for nonroad nonhandheld (NHH) spark ignition engines ≤19kW (≤25hp). The Phase 2 standards for Class I NHH engines (<225cc) become effective on August 1, 2001 or August 1, 2003 for any engine initially produced on or after that date. The Phase 2 standards for Class II NHH engines (≥225cc) are phased in from 2001-2005.

Regulation/(USEPA's emission standard reference guide)	**Description**
Phase 2: Emission Standards for New Nonroad Spark-Ignition Handheld Engines At or Below 19 Kilowatts and Minor Amendments to Emission Requirements Applicable to Small Spark-Ignition Engines and Marine Spark-Ignition Engines; Final Rule 65 FR 24268 April 25, 2000 (EPA-420-B-16-028, March 2016)	This rule establishes Phase 2 exhaust emission standards for HC+ NOx for nonroad handheld (HH) spark-ignition engines ≤19kW (≤25hp). The Phase 2 standards are phased in from 2002-2005 for Class III and Class IV engines and are phased in from 2004-2007 for Class V engines. The Phase 3 standards are phased in from 2011- 2012 for Class I, II and III-V.
Control of Emissions From Nonroad Large Spark-Ignition Engines and Recreational Engines (Marine and Land-Based); Final Rule 67 FR 68241 November 8, 2002 (EPA-420-B-16-023, March 2016) (EPA-420-B-16-027, March 2016) (EPA-420-B-16-029, March 2016) (EPA-420-B-16-025, March 2016)	This rule establishes exhaust and evaporative standards for several nonroad categories: 1) Two tiers of emission standards are established for large spark-ignition engines over 19 kW. Tier 1 includes exhaust standards for HC+ NOx and CO and is phased in from 2004-2006. Tier 2 becomes effective in 2007 and includes exhaust standards for HC+ NOx and CO, as along with evaporative controls affecting fuel line permeation, diurnal emissions and running loss emissions. 2) Exhaust and evaporative emission standards are established for recreational vehicles, which include snowmobiles, off-highway motorcycles, and all-terrain vehicles (ATVs). For snowmobiles, HC and CO exhaust standards are phased-in from 2006-2012. For off-highway motorcycles, HC+ NOx and CO exhaust emission standards are phased in from 2006-2007. For ATVs, HC+NOx and CO exhaust emission standards are phased in from 2006-2007. Evaporative emission standards for fuel tank and hose permeation apply to all recreational vehicles beginning in 2008 and for Stern Inboard (SI) marine engines beginning in 2009. 3) Exhaust emission standards for recreational marine diesel engines over 50 hp for NOx becomes effective in 2004. This is a "Tier 1" standard. While the "Tier 2" standard for HC+ NOx, CO, and PM begins in 2006-2009, depending on the engine displacement. "Tier 3" standards begin in 2009-2014.

Regulation/(USEPA's emission standard reference guide)	**Description**
Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel; Final Rule (Clean Air Nonroad Diesel Rule – Tier 4) 69 FR 38958 June 29, 2004 (EPA-420-B-16-022, March 2016)	This final rule sets Tier 4 exhaust standards for CI engines covering all hp categories (except marine and locomotives), and also regulates nonroad diesel fuel sulfur content. 1) The Tier 4 start dates and pollutants affected vary by hp and tier as follows: Hp<25: 2998, PM only 25-50 hp: Tier 4 transitional, 2008, PM Only Tier 4 final, 2013, NMHC+ NOx and PM 50-75 hp: Tier 4 transitional, 2008; PM only Tier 4 final, 2013, NMHC+NOx and PM 75-175 hp: Tier 4 transitional, 2012, HC, NOx, and PM; Tier 4 final, 2014, HC, NOx,, PM 175-750 hp: Tier 4 transitional, 2011, HC, NOx, and PM; Tier 4 final, 2014, HC, NOx,, PM >750 hp: Tier 4 transitional, 2011, HC, NOx, and PM; Tier 4 final, 2015, HC, NOx,, PM 2) This rule will reduce nonroad diesel fuel sulfur levels in two steps. First, starting in 2007, fuel sulfur levels in nonroad diesel fuel will be limited to a maximum of 500 ppm, the same as for current highway diesel fuel. Second, starting in 2010, fuel sulfur levels in most nonroad diesel fuel will be reduced to 15 ppm.
Control of Emissions From Nonroad Spark-Ignition Engines and Equipment; Final Rule (Bond Rule) 73 FR 59034 October 8, 2008 (EPA-420-B-16-026, March 2016)	This rule establishes exhaust and evaporative standards for small SI engines and marine SI engines: 1) Phase 3 HC+ NOx exhaust emission standards are established for Class I NHH engines starting in 2012 and for Class II NHH engines starting in 2011. There are no new exhaust emission standards for handheld engines. New evaporative standards are adopted for both handheld and nonhandheld equipment. The new evaporative standards control fuel tank permeation, fuel hose permeation, and diffusion losses. The evaporative standards begin in 2012 for Class I NHH engines and 2011 for Class II NHH engines. For handheld engines, the evaporative standards are phased-in from 2012-2016. 2) More stringent HC+ NOx and CO standards are established for Pleasure craft/Outboard (PWC/OB) and stern inboard (SI) marine engines beginning in 2010. In addition, new exhaust HC+ NOx and CO standards are established for SI marine engines also beginning in 2010. High performance SI marine engines are subject to separate HC+ NOx and CO exhaust standards that are phased-in from 2010-2011. New evaporative standards were also adopted for all SI marine engines that control fuel hose permeation, diurnal emissions, and fuel tank permeation emissions. The hose permeation, diurnal, and tank permeation standards take effect in 2009, 2010, and 2011, respectively.

For Base-Year Emission Inventory data for non-road mobile sources please refer to Appendix A-6.

3.2.5.2 Marine – Air – Rail Sources

Aircraft (military, commercial, general aviation, and air taxi) and auxiliary power units (APU) operated at airports along with locomotives and diesel marine vessels are also considered nonroad sources and are included in the nonroad category.

Aircraft and APU emissions were calculated by MDE through landing and take-off data surveys. Emissions from locomotives and commercial diesel marine vessels were also produced by MDE.

For source category listings and descriptions, methods and data sources, emission factors, controls, spatial and temporal allocations, and example calculations please refer to Appendix A-1.

For Base-Year Emission Inventory data for rail sources please refer to Appendix A-6.

3.2.6 BIOGENIC EMISSIONS

An important component of the inventory is biogenic emissions. Biogenic emissions are those resulting from natural sources. Biogenic emissions are primarily VOCs that are released from vegetation; they are emitted throughout the day. Biogenic emissions of NOx include lightning and forest fires. EPA used a biogenic computer model (BELD5) to estimate biogenic emissions for each county in the country for all twelve months of the year 2017.

Emissions data for the Cecil County was acquired from the EPA website (https://gaftp.epa.gov/air/nei/2017/data_summaries/2017v1/2017nei_beld5_biogenics_report.xlsx). EPA has recommended that states use these emissions in case they do not have their own estimated biogenic emissions.

4.0 REASONABLE FURTHER PROGRESS PROJECTED 2023 INVENTORY

Part II of the Environmental Protection Agency (EPA)'s rule to implement the 8-hour NAAQS requires the Philadelphia ozone nonattainment area to achieve a 15 percent reduction by 2023 using reductions in either VOC or NOx emissions or with any combination of the two.[22]

The reductions must be calculated from the anthropogenic emissions levels reported in the 2017 Base-Year Inventory after those levels have been adjusted to reflect the expected growth in emissions between 2017 and 2023. The 2017 Base-Year Inventory is described in Chapter 3. This chapter presents the 2023 Projection Inventory, the estimation of the levels of emissions to be expected in those years before the consideration of emission controls.

The 2023 projected inventory is derived by applying the appropriate growth factors to the 2017 Base-Year Emissions Inventory. EPA guidance describes four typical indicators of growth. In order of priority, they are as follows: (1) product output, or the amount of product being produced; (2) value added, or "the value of a product sold by a firm less the value of the goods purchased and used by the firm to produce the product;"[23] (3) earnings, and (4) employment. Surrogate indicators of activity, for example population growth, are also acceptable methods.

A short description of the projection methods per source category is described in the following sections. For a complete description of all the methods used to project the Base Year inventory, see Appendix B.

4.1 GROWTH PROJECTION METHODOLOGY

The following sections describe the methods followed to determine the 2023 projected inventory.

4.1.1 GROWTH PROJECTION METHODOLOGY FOR POINT SOURCES

The growth in point source emissions is projected using data from the Maryland Department of Labor, Licensing and Regulation (DLLR), Maryland Industry Projections (http://www.dllr.state.md.us/lmi/iandoproj/industry.shtml). The industry projection data from the DLLR was correlated to standard NAICS (North American Industry Classification System) industry employment codes. The calculated growth per NAICS industry employment code is used as the growth surrogate for each major source. Maryland does not allow for negative NAICS growth surrogates (less than one) for a SIP inventory. Therefore, all growth surrogates

[22] EPA 40 CFR Parts 51, 52 & 90, Federal Register. Vol.70, No. 228, Nov. 29, 2005, pp.71612-71705.

[23] STAPPA-ALAPCO-EPA Emission Inventory Improvement Program, Emission Projections, prepared by The Pechan-Avanti Group, Springfield, VA, December 1999.

calculated to be less than one are defaulted to a growth surrogate of one indicating no growth for the facility.

Table 4-1: 2017-2023 NAICS-Based Employment Growth Factors [24]

NAIC	Industry	Employment			Percent Change	Employment		Growth
		2018	2028	Change		2017 Interpolated	2023 Interpolated	GF-2023
ALL	**Total All Industries**	**2,894,598**	**3,199,942**	**305,344**	**10.5%**	2,864,063.60	3,047,270.00	1.06397
	Self-Employed Workers, All Jobs	218,609	237,311	18,702	8.6%			
	Total Wage and Salary Employment	**3,113,207**	**3,437,253**	**324,046**	**10.4%**			
11	**Agricultural, Forestry, Fishing and Hunting**	**5,388**	**5,731**	**343**	**6.4%**	5,353.70	5,559.50	1.03844
111	Crop Production	2,904	3,065	161	5.5%	2,887.90	2,984.50	1.03345
112	Animal Production	1,222	1,209	-13	-1.1%	1,223.30	1,215.50	0.99362
113	Forestry and Logging	197	172	-25	-12.7%	199.50	184.50	0.92481
114	Fishing, Hunting and Trapping	77	72	-5	-6.5%	77.50	74.50	0.96129
115	Support Activities for Agriculture and Forestry	988	1,213	225	22.8%	965.50	1,100.50	1.13982
21	**Mining, Quarrying, and Oil and Gas Extraction**	**1,189**	**544**	**-645**	**-54.2%**	1,253.50	866.50	0.69126
212	Mining (except Oil and Gas)	904	340	-564	-62.4%	960.40	622.00	0.64765
213	Support Activities for Mining	285	204	-81	-28.4%	293.10	244.50	0.83419
	Utilities	**11,250**	**10,897**	**-353**	**-3.1%**	11,285.30	11,073.50	0.98123
221	Utilities	11,250	10,897	-353	-3.1%	11,285.30	11,073.50	0.98123
23	**Construction**	**169,450**	**175,926**	**6,476**	**3.8%**	168,802.40	172,688.00	1.02302
236	Construction of Buildings	37,559	38,270	711	1.9%	37,487.90	37,914.50	1.01138
237	Heavy and Civil Engineering Construction	17,559	17,025	-534	-3.0%	17,612.40	17,292.00	0.98181
238	Specialty Trade Contractors	114,332	120,631	6,299	5.5%	113,702.10	117,481.50	1.03324
31-33	**Manufacturing**	**127,977**	**127,341**	**-636**	**-0.5%**	128,040.60	127,659.00	0.99702
311	Food Manufacturing	16,608	19,599	2,991	18.0%	16,308.90	18,103.50	1.11004
312	Beverage and Tobacco Product Manufacturing	3,839	4,009	170	4.4%	3,822.00	3,924.00	1.02669
313	Textile Mills	366	281	-85	-23.2%	374.50	323.50	0.86382
314	Textile Product Mills	884	937	53	6.0%	878.70	910.50	1.03619
315	Apparel Manufacturing	852	394	-458	-53.8%	897.80	623.00	0.69392
316	Leather and Allied Product Manufacturing	204	175	-29	-14.2%	206.90	189.50	0.91590

[24] Maryland Department of Labor, Licensing and Regulation (DLLR), Maryland Industry Projections (http://www.dllr.state.md.us/lmi/iandoproj/industry.shtml)

NAIC	Industry	Employment			Percent Change	Employment		Growth
		2018	2028	Change		2017 Interpolated	2023 Interpolated	GF-2023
321	Wood Product Manufacturing	2,560	3,102	542	21.2%	2,505.80	2,831.00	1.12978
322	Paper Manufacturing	3,519	3,123	-396	-11.3%	3,558.60	3,321.00	0.93323
323	Printing and Related Support Activities	8,134	6,539	-1,595	-19.6%	8,293.50	7,336.50	0.88461
324	Petroleum and Coal Products Mfg	838	767	-71	-8.5%	845.10	802.50	0.94959
325	Chemical Manufacturing	13,623	12,464	-1,159	-8.5%	13,738.90	13,043.50	0.94938
326	Plastics and Rubber Products Manufacturing	6,012	4,749	-1,263	-21.0%	6,138.30	5,380.50	0.87655
327	Nonmetallic Mineral Product Manufacturing	4,112	3,821	-291	-7.1%	4,141.10	3,966.50	0.95784
331	Primary Metal Manufacturing	853	339	-514	-60.3%	904.40	596.00	0.65900
332	Fabricated Metal Product Manufacturing	8,343	8,124	-219	-2.6%	8,364.90	8,233.50	0.98429
333	Machinery Manufacturing	7,159	7,274	115	1.6%	7,147.50	7,216.50	1.00965
334	Computer and Electronic Product Manufacturing	20,553	18,602	-1,951	-9.5%	20,748.10	19,577.50	0.94358
335	Electrical Equipment, Appliance, and Component Manufacturing	1,960	1,757	-203	-10.4%	1,980.30	1,858.50	0.93849
336	Transportation Equipment Manufacturing	18,544	21,878	3,334	18.0%	18,210.60	20,211.00	1.10985
337	Furniture and Related Product Manufacturing	4,104	4,540	436	10.6%	4,060.40	4,322.00	1.06443
339	Miscellaneous Manufacturing	4,910	4,867	-43	-0.9%	4,914.30	4,888.50	0.99475
42	**Wholesale Trade**	**90,374**	**89,297**	**-1,077**	**-1.2%**	90,481.70	89,835.50	0.99286
423	Merchant Wholesalers, Durable Goods	45,708	45,725	17	0.0%	45,706.30	45,716.50	1.00022
424	Merchant Wholesalers, Nondurable Goods	29,331	28,693	-638	-2.2%	29,394.80	29,012.00	0.98698
425	Wholesale Electronic Markets and Agents and Brokers	15,335	14,879	-456	-3.0%	15,380.60	15,107.00	0.98221
44-45	**Retail Trade**	**294,777**	**285,320**	**-9,457**	**-3.2%**	295,722.70	290,048.50	0.98081
441	Motor Vehicle and Parts Dealers	38,299	37,784	-515	-1.3%	38,350.50	38,041.50	0.99194
442	Furniture and Home Furnishings Stores	10,797	11,307	510	4.7%	10,746.00	11,052.00	1.02848
443	Electronics and Appliance Stores	8,895	6,526	-2,369	-26.6%	9,131.90	7,710.50	0.84435
444	Building Material and Garden Equipment and Supplies Dealers	24,801	27,015	2,214	8.9%	24,579.60	25,908.00	1.05404
445	Food and Beverage Stores	67,447	65,006	-2,441	-3.6%	67,691.10	66,226.50	0.97836
446	Health and Personal Care Stores	20,766	22,594	1,828	8.8%	20,583.20	21,680.00	1.05329
447	Gasoline Stations	12,036	12,046	10	0.1%	12,035.00	12,041.00	1.00050
448	Clothing and Clothing Accessories Stores	26,263	21,941	-4,322	-16.5%	26,695.20	24,102.00	0.90286
451	Sporting Goods, Hobby, Book, and Music Stores	11,078	8,496	-2,582	-23.3%	11,336.20	9,787.00	0.86334

NAIC	Industry	Employment			Percent Change	Employment		Growth
		2018	2028	Change		2017 Interpolated	2023 Interpolated	GF-2023
452	General Merchandise Stores	52,854	51,316	-1,538	-2.9%	53,007.80	52,085.00	0.98259
453	Miscellaneous Store Retailers	15,708	13,831	-1,877	-11.9%	15,895.70	14,769.50	0.92915
454	Nonstore Retailers	5,833	7,458	1,625	27.9%	5,670.50	6,645.50	1.17194
48-49	**Transportation and Warehousing**	**91,657**	**105,886**	**14,229**	**15.5%**	90,234.10	98,771.50	1.09461
481	Air Transportation	5,934	6,235	301	5.1%	5,903.90	6,084.50	1.03059
482	Rail Transportation	4,000	3,836	-164	-4.1%	4,016.40	3,918.00	0.97550
483	Water Transportation	983	1,259	276	28.1%	955.40	1,121.00	1.17333
484	Truck Transportation	17,983	21,085	3,102	17.2%	17,672.80	19,534.00	1.10531
485	Transit and Ground Passenger Transport	12,540	14,438	1,898	15.1%	12,350.20	13,489.00	1.09221
487	Scenic and Sightseeing Transportation	385	358	-27	-7.0%	387.70	371.50	0.95822
488	Support Activities for Transportation	11,213	12,438	1,225	10.9%	11,090.50	11,825.50	1.06627
492	Couriers and Messengers	15,073	16,583	1,510	10.0%	14,922.00	15,828.00	1.06072
493	Warehousing and Storage	23,546	29,654	6,108	25.9%	22,935.20	26,600.00	1.15979
51	**Information**	**37,248**	**37,904**	**656**	**1.8%**	37,182.40	37,576.00	1.01059
511	Publishing Industries	9,876	9,624	-252	-2.6%	9,901.20	9,750.00	0.98473
512	Motion Picture and Sound Recording Industries	4,026	3,654	-372	-9.2%	4,063.20	3,840.00	0.94507
515	Broadcasting (except Internet)	4,242	4,023	-219	-5.2%	4,263.90	4,132.50	0.96918
517	Telecommunications	13,523	14,220	697	5.2%	13,453.30	13,871.50	1.03109
518	Data Processing, Hosting and Related Services	3,512	3,038	-474	-13.5%	3,559.40	3,275.00	0.92010
519	Other Information Services	2,069	3,345	1,276	61.7%	1,941.40	2,707.00	1.39435
52	**Finance and Insurance**	**97,093**	**93,729**	**-3,364**	**-3.5%**	97,429.40	95,411.00	0.97928
521	Monetary Authorities - Central Bank	156	157	1	0.6%	155.90	156.50	1.00385
522	Credit Intermediation and Related Activities	44,390	40,951	-3,439	-7.7%	44,733.90	42,670.50	0.95387
523	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	16,870	18,685	1,815	10.8%	16,688.50	17,777.50	1.06525
524	Insurance Carriers and Related Activities	35,164	33,300	-1,864	-5.3%	35,350.40	34,232.00	0.96836
525	Funds, Trusts, and Other Financial Vehicles	513	636	123	24.0%	500.70	574.50	1.14739
53	**Real Estate and Rental and Leasing**	**46,893**	**52,176**	**5,283**	**11.3%**	46,364.70	49,534.50	1.06837
531	Real Estate	34,510	39,202	4,692	13.6%	34,040.80	36,856.00	1.08270
532	Rental and Leasing Services	12,021	12,614	593	4.9%	11,961.70	12,317.50	1.02974

NAIC	Industry	Employment			Percent Change	Employment		Growth
		2018	2028	Change		2017 Interpolated	2023 Interpolated	GF-2023
533	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	362	360	-2	-0.6%	362.20	361.00	0.99669
54	**Professional, Scientific, and Technical Services**	**269,255**	**302,247**	**32,992**	**12.3%**	265,955.80	285,751.00	1.07443
541	Professional, Scientific, and Technical Services	269,255	302,247	32,992	12.3%	265,955.80	285,751.00	1.07443
55	**Management of Companies and Enterprises**	**28,661**	**31,028**	**2,367**	**8.3%**	28,424.30	29,844.50	1.04996
551	Management of Companies and Enterprises	28,661	31,028	2,367	8.3%	28,424.30	29,844.50	1.04996
56	**Administrative and Support and Waste Management and Remediation Services**	**181,921**	**208,510**	**26,589**	**14.6%**	179,262.10	195,215.50	1.08899
561	Administrative and Support Services	172,462	198,485	26,023	15.1%	169,859.70	185,473.50	1.09192
562	Waste Management and Remediation Service	9,459	10,025	566	6.0%	9,402.40	9,742.00	1.03612
61	**Educational Services**	**323,109**	**374,126**	**51,017**	**15.8%**	318,007.30	348,617.50	1.09626
611002	State Education Employment	41,234	49,213	7,979	19.4%	40,436.10	45,223.50	1.11839
611003	Local Education Employment	152,642	173,187	20,545	13.5%	150,587.50	162,914.50	1.08186
611005	Private Education Employment	129,233	151,726	22,493	17.4%	126,983.70	140,479.50	1.10628
62	**Healthcare and Social Assistance**	**393,458**	**490,719**	**97,261**	**24.7%**	383,731.90	442,088.50	1.15208
621	Ambulatory Health Care Services	151,870	201,761	49,891	32.9%	146,880.90	176,815.50	1.20380
622	Hospitals	113,804	137,620	23,816	20.9%	111,422.40	125,712.00	1.12825
623	Nursing and Residential Care Facilities	73,481	84,525	11,044	15.0%	72,376.60	79,003.00	1.09155
624	Social Assistance	54,303	66,813	12,510	23.0%	53,052.00	60,558.00	1.14148
71	**Arts, Entertainment and Recreation**	**48,676**	**57,892**	**9,216**	**18.9%**	47,754.40	53,284.00	1.11579
711	Performing Arts, Spectator Sports, and Related Industries	8,700	9,099	399	4.6%	8,660.10	8,899.50	1.02764
712	Museums, Historical Sites, and Similar Institution	1,863	2,167	304	16.3%	1,832.60	2,015.00	1.09953
713	Amusement, Gambling, and Recreation Industries	38,113	46,626	8,513	22.3%	37,261.70	42,369.50	1.13708
72	**Accommodation and Food Services**	**247,691**	**302,515**	**54,824**	**22.1%**	242,208.60	275,103.00	1.13581
721	Accommodation	32,025	37,991	5,966	18.6%	31,428.40	35,008.00	1.11390
722	Food Services and Drinking Places	215,666	264,524	48,858	22.7%	210,780.20	240,095.00	1.13908
81	**Other Services (Except Government)**	**130,004**	**133,484**	**3,480**	**2.7%**	129,656.00	131,744.00	1.01610
811	Repair and Maintenance	25,269	26,602	1,333	5.3%	25,135.70	25,935.50	1.03182
812	Personal and Laundry Services	34,202	36,451	2,249	6.6%	33,977.10	35,326.50	1.03971

NAIC	Industry	Employment			Percent Change	Employment		Growth
		2018	2028	Change		2017 Interpolated	2023 Interpolated	GF-2023
813	Religious, Grantmaking, Civic, Professional, and Similar Organizations	62,195	62,903	708	1.1%	62,124.20	62,549.00	1.00684
814	Private Households	8,338	7,528	-810	-9.7%	8,419.00	7,933.00	0.94227
49	**Postal Service**	**12,587**	**10,569**	**-2,018**	**-16.0%**	12,788.80	11,578.00	0.90532
4911	Postal Service	12,587	10,569	-2,018	-16.0%	12,788.80	11,578.00	0.90532
99-92	**Government**	**285,839**	**303,999**	**18,160**	**6.4%**	284,023.00	294,919.00	1.03836
9991	Federal Government, Excluding Post Office	132,460	139,812	7,352	5.6%	131,724.80	136,136.00	1.03349
9200	State Government, Excluding Education and Hospitals	55,814	59,692	3,878	6.9%	55,426.20	57,753.00	1.04198
9993	Local Government, Excluding Education and Hospitals	97,565	104,495	6,930	7.1%	96,872.00	101,030.00	1.04292

For source category listings and descriptions, projection methods and data sources, and surrogate growth indicators, please refer to Appendix A-1.

Point source emission projection data is contained in Appendix A-2.

4.1.2 GROWTH PROJECTION METHODOLOGY FOR QUASI-POINT SOURCES

Quasi-point sources will include all emissions at the facility regardless of whether they are classified as point, area, nonroad, or mobile source emissions. These emissions are actual emissions reported for the facilities. Actual emissions will be forecast to the projection years using surrogates specific to each quasi-point source. The growth factor indicators and their sources are listed below by facility (names are in italics).

No quasi-point sources are located in Cecil County, MD.

4.1.3 GROWTH PROJECTION METHODOLOGY FOR NONPOINT/AREA SOURCES

Nonpoint/area source projections are typically made using growth surrogates gathered from local information.

Nonpoint/area growth surrogate indicators data were gathered from the following data sources:

- County-level population (POP), housing (HOU), employment (EMP) and vehicle miles travelled (VMT) projections from Maryland Department of Planning.

The surrogate growth activity indicators for each nonpoint/area source category listed in the discussion per source category below.

Area projection inventories are contained in Appendix B. The growth factors used for the 2023 projection year are presented in Table 4-1. The growth factors were applied to emissions categories by specific jurisdictions.

Table 4-2: 2017-2023 Growth Factors [25]

Jurisdiction	Population [7]	Household [7]	Employment [7]	VMT [7]
Cecil County	1.0245	1.0332	1.1069	1.0749

The 2023 emissions for area sources are calculated by multiplying the 2017 base-year area emissions by the above growth factors for the appropriate year for each jurisdiction. Each area source category was matched to an appropriate growth surrogate based on the activity used to generate the base-year emission estimates. Surrogates were chosen as follows:

Surface Coating – depending on whether emission factors were based on employment or population, surrogate chosen varied with individual subcategories. For example, automobile refinishing category was grown using employment, as the emission factor was based on it, but population was chosen for growing traffic markings as its emission factor was based on population.

Commercial/Consumer Solvent Use – population was chosen as the growth surrogate since 2002 emissions are based on per capita emission factors.

Residential Fuel Combustion – households was chosen as the growth surrogate.

Industrial/Commercial/Institutional Fuel Combustion – employment was chosen as the growth surrogate except for the commercial/institutional coal combustion category, where no growth was assumed.

Vehicle Fueling (Stage II) and Underground Tank Breathing – all gasoline marketing categories were based on vehicle miles traveled (VMT) data since VMT is an appropriate surrogate for gasoline sales. Emission factors for these categories are based on gasoline sales.

Open Burning – population was chosen as the growth surrogate as yard wastes, land debris, and the like increase with population.

Structural Fires, Motor Vehicle Fires – population was chosen as the growth surrogate.

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[25] Employment, population, and household growth factors based on Maryland Department of Planning Projections. VMT growth factors based on VMT estimates provided by MDE Mobile Sources Control Program.

Publicly Owned Treatment Works (POTW) – households was chosen as the growth surrogate.

Dry Cleaning – population was chosen as the surrogate.

Graphic Arts – population was used to estimate growth since emissions are based on per capita emission factors.

Surface Cleaning – employment growth was used as the surrogate.

Tank Truck Unloading – growth in VMT was applied to this category since base-year emissions are calculated using gasoline sales.

Municipal Landfills – Base-year emissions are estimated using data on total refuse deposited. Population was chosen as a surrogate since deposited waste is from the general population rather than industrial facilities.

Asphalt Paving – population was chosen as the surrogate since base-year emissions are calculated using per capita emission factors.

Bakeries, Breweries – population was chosen as the surrogate.

Soil/Groundwater Remediation – zero growth was applied to this category. The number of remediations during the ozone season, used to generate base-year emissions, does not directly correlate to population, households, or employment growth.

General Aviation and Air Taxi Emissions – Emissions from small airports were projected using the EGAS 5.0 model. The Maryland Aviation Administration (MAA) provided commercial aircraft operations information at Baltimore Washington International (BWI) Airport. Emissions were calculated using FAA-approved activity data and the Emissions Dispersion Modeling system (EDMS) model. Emissions were grown by FAA Terminal Area Forecasts (TAFs).

Aircraft Refueling Emissions – emissions from refueling of aircrafts was projected based on employment.

Portable Fuel Container Emissions – emissions from portable fuel containers were grown based on population.

Railroad Locomotives – employment growth was used as the surrogate.

Forest Fires, Slash Burning, Prescribed Burning – zero growth was applied to this category.

Accidental Oil Spills – zero growth was applied to this category.

Incineration – zero growth was applied to this category.

Pesticide Application – zero growth was applied to this category.

For source category listings and descriptions, projection methods and data sources, and surrogate growth indicators, please refer to Appendix A-1.

Area source emission projection data is contained in Appendix A-4.

4.1.4 Growth Projection Methodology: Nonroad Sources

4.1.4.1 Nonroad Model Sources

Emissions for all nonroad vehicles and engines except for those at BWI airport (aircraft, ground support equipment (GSE) and, auxiliary power units (APU)), locomotives, and commercial marine vessels were calculated using USEPA's MOVES3-Nonroad model.

The USEPA's MOVES3 NONROAD model estimates emissions from equipment such as recreational marine vessels, recreational land-based vehicles, farm and construction machinery, lawn and garden equipment, aircraft ground support equipment (GSE) and rail maintenance equipment. This equipment is powered by diesel, gasoline, compressed natural gas or liquefied petroleum gas engines. Maryland ran the MOVES3 NONROAD model for Cecil County. The MOVES3 NONROAD model utilizes USEPA nonroad defaults for equipment populations and growth factors and interfaces with USEPA MOVES highway defaults for fuel specific parameters and climatological data. Maryland did not make any changes to the default values.

The MOVES-Nonroad model allocates activity monthly through the National County Database (NCD). The model can calculate emissions for a variety of time periods; an entire year, one of four seasons, or any particular month. Emissions for the period selected are estimated either for the total period or for a typical day (weekday or weekend) in that period. Average Ozone Season Day (OSD) daily emissions were estimated using the month of July's weekends and weekdays emissions. The weekend and weekday emissions were multiplied by the fraction of weekend or weekday days for the month of July. (Note: fraction weekday portion for example is calculated by dividing day the number of weekdays in July (23 days in 2020) by the total number of days in July (31). The sum of the products (weekday daily emissions times weekday fraction plus weekend daily emissions times weekend day fraction), is the average of weekend day emissions.

4.1.4.2 Marine – Air – Rail Sources

The Marine-Air-Rail (M-A-R) source emissions were forecasted to the projection years using surrogate economic or operational data. Aircraft emission projections were grown using Federal Aviation Administration (FAA) Aircraft Operations Forecasts (TAFs or LTOs). Locomotives emission projections were grown using U.S. Energy Information Administration (EIA) Annual Energy Outlook (AEO) Rail data. Marine Vessels emission projections were grown using EIA AEO Marine Shipment data. The growth factors for the M-A-R sources are presented in the table below.

For source category listings and descriptions, projection methods and data sources, and surrogate growth indicators please refer to Appendix A-1.

Nonroad mobile source emission projection data is contained in Appendix A-6.

4.1.5 Growth Projection Methodology: Onroad Sources

The 2023 mobile source inventory was created through the MOVES3 model. A full description of this mobile emission estimating process can be found in Appendix E of this report.

4.1.6 Biogenic Emission Projections

Biogenic emission inventories for 2023 are the same as those used for the 2017 base year for Cecil County. Year-specific biogenic inventories for are not estimated. Base year emissions for 2017 were estimated by EPA using BELD model. No 2023 biogenic inventories were prepared as these inventories are not used to determine rate of progress.

4.2 OFFSET PROVISIONS, EMISSION REDUCTION CREDITS, AND POINT SOURCE GROWTH

The Clean Air Act (CAA or “the Act”) requires that emissions growth from major stationary sources in nonattainment areas be offset by emissions reductions that would not otherwise be achieved by other mandated controls. The offset requirement applies to all new major stationary sources, and to existing major stationary sources that have undergone major modifications. At the same time, existing sources’ emissions increases resulting specifically from increases in capacity utilization are not subject to the offset requirement.

For the purposes of the offset requirement, major stationary sources include all stationary sources exceeding an applicable size cutoff. The New Source Review (NSR) thresholds for Cecil County are 10 tpy VOC and 25 tpy NOx.

EPA has issued guidance on the inclusion of emission reduction credits in the projected emissions inventory. The guidance states:

> The base year inventory includes actual emissions from existing sources and would not normally reflect emissions from units that were shutdown or curtailed before the base year, as these emissions are not ‘in the air.’ To the extent that these emission reduction credits are to be considered available for use as offsets and are thus ‘in the air’ for purposes of demonstrating attainment, they must be specifically included in the projected emissions inventory used in the attainment

demonstration along with other growth in emissions over the base year inventory. This step assures that emissions from shutdown and curtailed units are accounted for in attainment planning.[26]

MDE has included emission reduction credits in the attainment demonstration projected inventory. No eligible emission reduction credits were found for Cecil County, MD.

4.3 ACTUAL VS. ALLOWABLE EMISSIONS IN DEVELOPMENT OF THE 2023 PROJECTED EMISSIONS INVENTORIES

For the purposes of calculating the 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 subject to a pre-1990 regulation and that the state does not anticipate subjecting to additional regulation, emissions projections should be based on actual emissions levels. Actual emissions levels should also be used for emissions projections for sources or source categories that were unregulated as of 1990. For sources that are expected to be subject to post-1990 regulations, projections should be based on new allowable emissions.

To simplify comparisons between the base-year and the projected year, EPA guidance states that comparisons should be made only between like emissions: actual to actual, or allowable to allowable, not actual to allowable. As a result, all base-year and all projection-year emissions estimates are based on actual emissions.

Maryland regulation defines "actual emissions" and “allowable emissions” as follows:[27]

> “Actual emissions” means the average rate, in tons per year, at which a source discharged a pollutant during a 2-year period which precedes the date of a completed application for an NSR source or other specified date, and which is representative of normal source operation... Actual emissions shall be calculated using the source's operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period.
>
> “Allowable emissions” means the maximum emissions a source or installation is capable of discharging after consideration of any physical, operational, or emissions limitations required by [state regulations] or by federally enforceable conditions which restrict operations and which are included in an applicable air quality permit to construct, permit to operate, secretarial order, plan for compliance, consent agreement, court order, or applicable federal requirement.

[26] Federal Register, Vol. 71, No. 243, page 75910, December 19, 2006.

[27] See Code of Maryland Regulations (COMAR) 26.11.01.01

4.4 PROJECTION INVENTORY RESULTS

Chapter 6 of this SIP describes the control measures that have been or will be implemented from 2017 through 2023 that will reduce emissions. Most control measures are required by federal or state regulations. Projected controlled inventories for 2023 assume a number of control measures to be in place by these years as identified in Chapter 6.

Table 4-4 presents the projected controlled emissions for the 2023 attainment year resulting from implementation of the control measures.

4.5 2023 CONTROLLED EMISSIONS FOR REASONABLE FURTHER PROGRESS

The projection of 2023 controlled emissions is simply the 2023 uncontrolled emissions minus the emission reductions achieved from the federal control measures and the reasonable further progress control measures implemented by states for the 8-hour ozone SIP. This information is presented in Table 4-4. Controlled inventories are contained in Appendix A. Details on mobile source controlled inventories can be found in Appendix E.

Table 4-3: 2023 Projected Controlled VOC & NOx Emissions (tons/day) – Cecil County

Emission Source Category	Cecil County, MD VOC Emissions*	Cecil County, MD NOx Emissions*
Onroad Mobile	1.15**	3.30**
Point	0.42	1.61
Area	2.79	0.36
M-A-R	0.07	1.70
Nonroad Model	1.63	0.84
Total	**6.06**	**7.81**

*Small discrepancies may result due to rounding.

** Onroad Mobile 2023 emissions reflect the Mobile Vehicle Emissions Budgets established in this SIP

5.0 2023 REASONABLE FURTHER PROGRESS REQUIREMENTS

5.1 INTRODUCTION

On April 13, 2022, the Environmental Protection Agency (EPA) proposed to determine that the Philadelphia area, including Cecil County, MD, failed to attain the 2015 ozone standard by the applicable attainment date, and the effect of failing to attain by the attainment date is that such areas will be reclassified by operation of law to “moderate” upon the effective date of the final reclassification notice.[28] In 2022, EPA finalized action that reclassified the Philadelphia metropolitan area, including Cecil County, to “moderate” for the 0.70 ppm 8-hour ozone standard.[29] EPA made this classification under the Clean Air Act (CAA or “the Act”) Subpart 2, Section 182(b).

As a moderate nonattainment area under the 2015 ozone NAAQS, the Philadelphia Nonattainment Area, including Cecil County, is required to demonstrate Reasonable Further Progress (RFP) towards attainment by 2023. EPA’s implementation guidance requires that a moderate area, such as Cecil County, with an approved 15% Volatile Organic Compounds (VOC) reduction plan for the period 1990-1996 (required for former 1-hour ozone non-attainment areas) demonstrate a 15% RFP by 2023. This chapter contains Cecil County’s RFP demonstration for the years 2017-2023.

In order to demonstrate RFP, a region must show that its expected emissions, known as “controlled inventories,” of NOx and VOC will be less than or equal to the target levels, or “target inventories,” set for the end of the reasonable further progress period, or “milestone year.” For the RFP period 2017-2023, the target inventories of emissions are the maximum quantity of anthropogenic emissions permissible during the 2023 milestone year.

This section describes the methodology used to establish the regional target inventories and controlled inventories for 2023. Because the expected NOx and VOC emissions will be less than or equal to the target levels, Cecil County will meet the RFP requirements for 2023.

The Reasonable Further Progress emission inventories utilize the latest EPA models (MOVES3) providing revised up-to-date mobile sources emission estimates.

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[28] 87 FR 21842 https://www.federalregister.gov/documents/2022/04/13/2022-07513/determinations-of-attainment-by-the-attainment-date-extensions-of-the-attainment-date-and

[29] EPA-HQ-OAR-2021-0742

5.1.1 Reasonable Further Progress (RFP) Demonstrated in Previous State Implementation Plans

Since 1990, the Clean Air Act (CAA or "the Act") has required ozone nonattainment areas to demonstrate progress towards attaining the ozone standard. This requirement is referred to as the Reasonable Further Progress requirement, or RFP. During the period 1990-1996, areas in nonattainment of the one-hour ozone standard were required to reduce VOC emissions by 15%. Since 1996, regions have been required to demonstrate a 9% rate of progress every three years until the region's attainment date (3% per year).

The CAA included restrictions on the use of control measures to meet the 15% requirements. Reductions in ozone precursors resulting from four types of federal and state regulations could not be used to meet rate of progress. These four types of programs are as follows:

(1) Federal Motor Vehicle Control Program (FMVCP) tailpipe and evaporative standards issued in January 1, 1990;
(2) Federal regulations limiting the Reid Vapor Pressure (RVP) of gasoline in ozone nonattainment areas;
(3) State regulations correcting deficiencies in reasonably available control technology rules
(4) State regulations establishing or correcting inspection and maintenance (I/M) programs for on-road vehicles.

These four control programs no longer provide any significant benefit, thus this subtraction of benefit step in the RFP calculation is no longer shown or needed.

EPA proposed "to remove the burden of performing this calculation for purposes of RFP for the 2008 ozone NAAQS based on the de minimis nature of these non-creditable reductions"[30] in a document entitled "State Implementation Plan Requirements: 2008 National Ambient Air Quality Standards for Ozone" posted by the Environmental Protection Agency on Jun 6, 2013.

The basic procedures of developing target levels for the 15% Plan are described in EPA's guidance, *Adjusted Base Year Emissions Inventory and the 1996 Target for the 15% Rate of Progress Plans*.

[30] State Implementation Plan Requirements: 2008 National Ambient Air Quality Standards for Ozone https://www.regulations.gov/document/EPA-HQ-OAR-2010-0885-0066

5.2 GUIDANCE FOR CALCULATING REASONABLE FURTHER PROGRESS (RFP) EMISSION TARGET LEVELS

The Clean Air Act Amendments (CAAA) of 1990 provide the primary guidance for calculating the VOC and NOx target levels used in a region's RFP plans. In November 2005 as part of its final implementation rule for the 8-hour ozone standard, EPA issued guidance to assist the states in RFP development.

The guidance that applies to Cecil County is guidance for previously severe 1-hour ozone nonattainment areas with an approved 15% RFP plan for the period 1990-1996. Since Cecil County is a former severe 1-hour ozone nonattainment area and has an approved 15% RFP plan for the above period, "Method 2" of the guidance applies to the region.[31] The region is required to reduce emissions by 15% from 2017-2023 to demonstrate RFP, according to Method 2.

EPA's guidance (Method 2) states that the target level of VOC and NOx emissions in 2017 needed to meet the 2023 RFP requirement is any combination of VOC and NOx reductions from the adjusted base year 2017 inventories (base year 2017 emissions minus non-creditable emissions reduction occurring between 2017 and 2023, as stated above these non-creditable emissions are insignificant) that total 15 percent. For example, the target level of VOC emissions in 2023 could be a 10 percent reduction from the adjusted base year 2017 VOC inventory and a 5 percent reduction from the adjusted NOx inventory. The actual projected 2023 VOC and NOx inventories for all sources with all control measures in place and including projected 2023 growth in activity must be at or lower than the target levels of VOC and NOx emissions.

This section briefly summarizes the requirements and procedures for calculating the target emission levels required for an RFP demonstration. RFP demonstrations build upon each other, starting from the base year of 2017.

5.2.1 2023 VOC AND NOX TARGET LEVELS

EPA's *Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard* – Phase II mandates that to meet the Reasonable Further Progress requirement, the Philadelphia ozone nonattainment area, including Cecil County, needs to reduce its emissions by 15% between 2017 and 2023 using either reductions in VOC or NOx or any combination of the two. The Cecil County portion of the Philadelphia nonattainment area is able to demonstrate reasonable further progress for the period 2017-2023.

[31] Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard—Phase 2, Appendix A to Preamble—Methods to Account for Non-Creditable Reductions When Calculating ROP Targets for the 2008 and Later ROP Milestone Years," in Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard, 70 Fed. Reg. at 716196 (Nov.29, 2005).

The target levels for 2023 reasonable further progress plans are calculated according to the EPA's final rule mentioned above. The general formula for calculation of 2023 target levels is as follows:

Equation 5-1

Target Level $_{2023}$	=	2017 RFP base year emissions	-	reductions required to meet the reasonable further progress requirement	-	non-creditable emissions reduction between 2017 and 2023

Calculation of 2023 Target Levels

Equations 5-1 provides the general formula for calculating post-1996 target levels. Since the region has chosen to demonstrate the 2023 reasonable further progress using 4.50% VOC reduction, the 2023 VOC target level becomes:

Equation 5-2

2023 VOC Target Level	=	2017 RFP Base-Year emissions	-	9.0% VOC Reduction	-	non-creditable emissions reduction between 2017 and 2023

And the NOx target level becomes:

Equation 5-3

2023 NOx Target Level	=	2017 RFP Base-Year emissions	-	6.0% NOx Reduction	-	non-creditable emissions reduction between 2011 and 2023

*VOC & NOx non-creditable mobile emissions are essentially zero

Step 1: Develop 2017 Base Year Inventories and 2017 Reasonable Further Progress Base Year Inventories

The 2017 Base-Year Inventory was submitted to EPA Region III on June 29, 2020 as a separate document entitled, *"2015 8-Hour Ozone NAAQS (0.070 ppm) Marginal Area State Implementation Plan for the Cecil County, MD Nonattainment Area (SIP # 20-09)."* The document was prepared by the Maryland Department of the Environment and remains intact to fulfill the SIP inventory requirement of the CAA. It is available for inspection at the Maryland Department of the Environment, Air and Radiation Administration, 1800 Washington Boulevard, Suite 730, Baltimore, Maryland 21230.

The RFP base-year inventory includes only anthropogenic emissions generated within Cecil County and is required to utilize the most recent EPA models and methods when estimating emissions. As such, the 2017 RFP inventory updates the 2017 Base-Year Inventory by using the MOVES3 model to estimate on-road mobile and non-road mobile emissions. A summary of the reasonable further progress base year VOC and NOx emissions are presented in Table 5-1.

Table 5-1: 2017 Reasonable Further Progress Base-Year Inventory

Source	VOC (tons/ozone season day)	NOx (tons/ozone season day)
Point	0.42	1.60
Area	2.73	0.33
Non-Road	2.42	1.05
M-A-R	0.06	1.46
On-Road	1.15	4.04
TOTAL	6.77	8.48

Note: Small discrepancies may result due to rounding

Step 2: Develop 2017 and 2023 Reasonable Further Progress Adjusted Year Inventories

According to the 1990 CAAA, reductions necessary to meet the reasonable further progress requirement must be calculated from an emissions baseline that excludes the effects of the non-creditable Federal Motor Vehicle Control Program (FMVCP) and Reid Vapor Pressure (RVP) programs described in Section 5.2. Therefore the 2017 baseline must be adjusted by subtracting the VOC and NOx reductions that will result from these two programs between 2017 and 2023. The resulting inventory is referred to as the 2017 Adjusted Base Year Inventory.

EPA proposed that when calculating RFP emission reduction targets, states no longer need to calculate and deduct emissions related to (1) pre-1990 motor vehicle exhaust or evaporative emission control measures; (2) Reid Vapor Pressure rules adopted by November 15, 1990; (3) measures to correct previous RACT requirements and vehicle Inspection, and; (4) Maintenance program corrections (all of which are specified in CAA sec. 182(b)(1)(D) as not being creditable toward RFP) because such reductions are de minimis and the calculation and deduction process is tedious.

This step has therefore been eliminated and the emissions produced in Table 5-1 remain the same.

Step 3: Calculation of 2023 Target Levels

The VOC and NOx target levels for 2023 are calculated in Table 5-2 below:

Table 5-2: Calculation of VOC and NOx Target Levels for 2017 (Ozone Season tons per day)

	Description	Formula	VOC	NOx
A	2017 Base Year Inventory		26.88	9.31
B	Biogenic Emissions		20.10	0.82
C	2017 Rate-of Progress Base Year Inventory	A – B	6.77	8.48
D	FMVCP/RVP Reductions Between 2017 and 2023		0.00	0.00
E	2017 Adjusted Base Year Inventory Calculated Relative to 2023	C – D	6.77	8.48
F	Ratio		0.0900	0.0600
G	Emissions Reductions Required Between 2017 and 2023	E * F	0.61	0.51
H	Target Level for 2023 [$TL_{(2023)}$]	C - D – G	6.16	7.98
	Emission Level Obtained 2023 - Enforceable MVEB 1		6.06	7.81
	Emission Level Obtained 2023 - Enforceable MVEB 2 CM Applied		6.00	7.68

5.3 COMPLIANCE WITH 2023 REASONABLE FURTHER PROGRESS REQUIREMENTS

In order to demonstrate reasonable further progress for the period 2017-2023, Cecil County region must show that expected emissions in 2023 are equal to or less than the 2023 target levels presented in Table 5-2.

The 2023 controlled inventories are inventories of all anthropogenic VOC and NOx emissions expected to occur in Cecil County during 2023. The inventories were developed as described in Chapter 4 and are displayed in Table 4-4. As summarized in Table 5-3, the 2023 controlled VOC and NOx inventories are less than the 2023 target inventories. Table 5-3 demonstrates Cecil County fulfills the 2017-2023 reasonable further progress requirements.

Table 5-3: Cecil County Comparison of 2023 Controlled and Target Inventories Ozone Season Daily Emissions

Description	VOC	NOx
2023 Target Levels	6.16	7.98
2023 Controlled Emissions*	6.06	7.81

* 2023 Controlled Emissions estimated using the SIP established Motor Vehicle Emission Budget (MVEB)

References

U.S. EPA, "Guidance on the Adjusted Base Year Emissions Inventory and the 1996 Target for the 15% Rate of Progress Plans"

U.S. EPA, "Guidance on the Post-1996 Reasonable Further Progress Plan and the Attainment Demonstration," February 18, 1994.

U.S. EPA, "NOx Substitution Guidance," December 1993.

6.0 CONTROL MEASURES

This chapter is divided into three sections.

Section 6.1 identifies the control measures that were put in place as part of the development of the 2017 base year emissions inventory for the Cecil County portion of the Philadelphia Nonattainment Area. The control measures were instituted as part of the 1-Hour Ozone SIP for Cecil County (2002) and/or part of the 8-Hour Ozone reasonable further progress demonstration (2008). These regulations/control measures continue to be in existence and continue to reduce emissions and ozone concentrations in the region. However the State of Maryland is not taking credit for these control measures in this SIP.

Section 6.2 of this chapter identifies measures implemented after 2017 that were not part of the baseline inventory and are giving specific emission reductions to the region's 8-hour Ozone reasonable further progress demonstration. The State of Maryland is taking credit for these new enforceable measures in this SIP.

Section 6.3 identifies nontraditional and voluntary measures such as Energy Efficiency and Renewable Energy (EE/RE) and many transportation emission reduction measures. These measures are not commitments to programs but present information on programs that could provide ozone benefits. The State of Maryland is not taking formal credit in the SIP for measures that are identified in Section 6.3.

6.1 CONTROL MEASURES INCLUDED IN THE 2017 BASE YEAR INVENTORY

6.1.1 ON-ROAD MOBILE MEASURES

Vehicle Inspection and Maintenance (I/M)

The Clean Air Act (CAA or "the Act") requires motor vehicle inspection and maintenance (I/M) programs in moderate ozone nonattainment areas and MSA/CMSA portions of the OTR with urbanized populations over 200,000. In Maryland, this required an I/M program in 14 jurisdictions including all the jurisdictions in Cecil County. The Maryland VEIP Programs includes three tests that are administered:

- Gas cap test
- On-board diagnostic (OBD) test
- Tailpipe test (Idle test)

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 requires a uniform level of evaporative emission controls which are more stringent than most evaporative controls used in existing vehicles. These federally implemented programs affect light duty vehicles and trucks.

Reformulated Gasoline in On-road Vehicles

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. Since January 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.

Tier 2 Vehicle Emission Standards

On December 21, 1999, the EPA announced new regulations affecting tailpipe emissions standards for the production of new cars and light trucks weighing up to 8,500 pounds. Commonly referred to as "Tier 2," these standards take effect beginning in 2004. The emissions reduction benefits of this Tier 2 program for the Maryland region will be significant, including passenger cars that are 77 percent cleaner than those on the road today. Light-duty trucks, such as Sport Utility Vehicles (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. In effect, the rule forces SUVs and light trucks to meet the same tailpipe emission standards as cars.

As part of the new tailpipe standard, the EPA also announced standards for lower sulfur in gasoline. The lower sulfur standards are necessary to enable passenger vehicles to meet Tier 2 emission standards.

National Low Emission Vehicle Program

The National Low Emission Vehicle Program (National LEV) program is a vehicle technology program resulting in the production of light duty vehicles and light-duty trucks with significantly lower tailpipe emissions. The National LEV program is applicable to 1999 and later model-year vehicles sold in the Ozone Transport Region (OTR) and 2001 and later model-year vehicles sold throughout the United States. The National LEV program was developed through an unprecedented, cooperative, voluntary effort by the northeastern states, auto manufacturers, environmentalists, fuel providers, U.S. EPA and other interested parties. National LEV vehicles are 70 percent cleaner than 1998 models. The National LEV program will result in substantial reductions in volatile organic compounds (VOCs) and oxides of nitrogen (NOx), which contribute to unhealthy levels of smog in many areas across the country.

Federal Heavy-Duty Diesel Engine Rule

EPA's heavy-duty diesel engine (HDDE) rule addresses diesel vehicles weighing more than 8,500 pounds. These standards took effect in 2007 and reduced emissions from new HDDEs by 95%. In order to achieve the new standards, ultra-low sulfur diesel fuel will also be needed.

New Vehicle On-Board Vapor Recovery Systems

Gasoline dispensing pump vapor control devices, commonly referred to as Stage II Vapor Recovery Control, are systems that control volatile organic compound (VOC) vapor releases during the refueling of motor vehicles. This process takes the vapors normally emitted directly into the atmosphere when pumping gas and recycles them back into the fuel storage tanks, preventing them from polluting the air. Maryland adopted Stage II vapor recovery regulations for the Baltimore and Washington nonattainment areas and Cecil County, in January of 1993. The Stage II vapor recovery regulation requires that the gasoline dispensing system be equipped with nozzles that are designed to return the vapors, through a vapor line, into the gasoline tank.

Since 1998, new passenger cars, light-duty trucks, and most heavy-duty gasoline powered vehicles have been equipped with onboard refueling vapor recovery (ORVR) systems. ORVR systems are carbon canisters installed directly on automobiles to capture the fuel vapors evacuated from the gasoline tank before they reach the nozzle of a gas pump. The fuel vapors captured in the carbon canisters are then combusted in the engine when the automobile is in operation.

The phase-in of ORVR controls has essentially eliminated the need for Stage II vapor recovery systems.

6.1.2 AREA SOURCE MEASURES

There are state regulations that address the control of VOCs from various sources and processes in Maryland:[32]

- Sintering Plants
- Iron and Steel Production Installations
- Automotive and Light-Duty Truck Coating
- Can Coating
- Coil Coating
- Large Appliance Coating
- Paper, Fabric, Film, and Foil Coating
- Solid Resin Decorative Surface Manufacturing.
- Plastic Parts and Business Machines Coating.
- Metal Parts and Products Coating

[32] See the Code of Maryland Regulations (COMAR) 26.11.10, 26.11.14, and 26.11.19.

- Cold and Vapor Degreasing
- Industrial Solvent Cleaning Operations Other Than Cold and Vapor Degreasing
- Flexographic and Rotogravure Printing
- Flexible Packaging Printing
- Lithographic and Letterpress Printing
- Dry Cleaning Installations
- Drum and Pail Coating
- Aerospace Coating Operations
- Brake Shoe Coating Operations
- Structural Steel-Coating Operations
- Manufacture of Synthesized Pharmaceutical Products
- Paint, Resin, and Adhesive Manufacturing and Adhesive Application
- Equipment Leaks
- Yeast Manufacturing.
- Screen Printing and Digital Imaging
- Expandable Polystyrene Operations
- Emissions from Commercial Bakery Ovens
- Vinegar Generators
- Vehicle Refinishing
- Leather Coating
- Explosives and Propellant Manufacturing
- Reinforced Plastic Manufacturing
- Fiberglass Boat Manufacturing
- Marine Vessel Coating Operations
- Pleasure Craft Coating Operations.
- Bread and Snack Food Drying Operations
- Distilled Spirits Facilities
- Chemical Production and Fluoropolymer Material Installations
- Medical Device Manufacturing
- Wood Coating Operations
- Flat Wood Paneling Coatings

Municipal Landfills

A municipal solid waste landfill is a disposal facility where household waste is placed and periodically covered with inert material. Landfill gases are produced from the decomposition and chemical reactions of the refuse in the landfill. They consist primarily of methane and carbon dioxide, with volatile organic compounds making up less than one percent of the total emissions. The control strategy for this source category is based upon federal rules.

Burning Ban

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. Emissions from open burning include oxides of nitrogen, hydrocarbons, carbon dioxide (CO_2), carbon monoxide (CO) and other toxic compounds. Emissions levels from open burning are high due to the inefficient and uncontrolled manner in which the material is burned. The Department adopted a regulation that prohibits open burning during the peak ozone period (June to August). There are exemptions for agricultural burning, fire training and recreational activities.

Surface Cleaning/Degreasing

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. MDE adopted regulations in 1995 to require small degreasing operations such as gasoline stations, autobody paint shops and machine shops to use less polluting degreasing solvents in serious and severe ozone nonattainment areas. Also, solvent baths and rags soaked with solvents must be covered under this regulation.

Architectural and Industrial Maintenance Coatings

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. VOC emissions result from the evaporation of solvents from the coatings during application and drying. A federal measure requires reformulation of architectural and industrial maintenance coatings. The users of these coatings are small and widespread, making the use of add-on control devices technically and economically infeasible.

Commercial and Consumer Products

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. This measure requires the reformulation of certain consumer products to reduce their VOC content. Product reformulation can be accomplished by substituting water, other non-VOC ingredients, or low-VOC solvents for VOCs in the product.

Commercial and Consumer Products Phase II

Phase II of the Consumer Products Rule involves adopting the CARB 7/20/05 Amendments which sets new or revises existing limits on 13 consumer product categories. It uses more stringent VOC content limits than the existing federal consumer products rule. The rule also contains requirements for labeling and reporting. Manufacturers of various specialty chemicals are named in the rule, such as aerosol adhesives, floor wax strippers, dry cleaning fluids and general purpose cleaners.

Automobile Refinishing

Automobile refinishing is the repainting of worn or damaged automobiles, light trucks and other vehicles. Volatile organic compound emissions result from the evaporation of solvents from the coatings during application, drying and clean up techniques. This regulation requires large and small autobody refinishing operations to use low VOC content materials in the refinishing process and cleanup, and to use efficient spray guns to control application. The Department adopted regulations in 1995 requiring the use of reformulated coatings.

Motor Vehicle & Mobile Equipment Coating Operations MVME-OTC2009

This rule applies to all commercial and non-commercial coating applications of vehicles and their parts and components at facilities involved in the non-assembly line production, modification, or refinishing of motor vehicles and mobile equipment. Commercial and non-commercial facilities with coating operations considered within the scope of this rule include, but are not limited to: autobody repair/paint shops, production autobody paint shops, new car dealer repair/paint shops, fleet operator repair/paint shops, custom-made car fabrication facilities, truck bodybuilders, and residences.

The USEPA promulgated a national rule in 1998 (40CFR, Part 59, Subpart B) to limit the VOC content of coatings used refinishing automobiles. The federal standards were estimated to reduce nationwide emissions of VOC by about 37 percent compared to uncontrolled 1998 emissions. The 2002 OTC model rule established requirements for using higher efficiency coating application equipment, such as high volume-low pressure paint guns, using spray gun cleaning equipment that minimizes solvent loss, and enclosed spray gun cleaning. The Federal VOC limits on the paints was maintained in the model rule. An incremental control effectiveness of 38 percent was estimated for the OTC 2001 model rule (post-1998 federal standard emissions).

The 2009 OTC model rule for Motor Vehicle and Mobile Equipment Non-assembly Line Coating Operations (2009 OTC MVME model rule) seeks to limit the VOC content in coatings and cleaning solvents used in motor vehicle and mobile equipment non-assembly line coating operations. The 2009 OTC MVME model rule is an update of the 2002 OTC MERR model rule. The OTC developed the 2009 OTC MVME Model Rule using the CARB 2005 Suggested Control Measure (SCM) for Automotive Coatings as a guideline. The CARB 2005 SCM estimated a 65 percent reduction in VOC emissions from 2002 CARB baseline emissions, which are post-1998 federal standard emissions. Similar reductions of 65 percent are expected from implementation of the 2009 OTC MVME Model Rule.

Manufacturers of various specialty chemicals named in the rule, such as aerosol adhesives, floor wax strippers, dry cleaning fluids and general purpose cleaners.

Graphic Arts – Lithographic Printing

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 are caused by evaporation of the ink solvents, alcohol in the fountain or dampening solution, and equipment wash solvents. These VOC discharges may also cause visible emissions and nuisance odors. MDE adopted a regulation in 1995 to require printers to use control devices and/or low VOC materials to reduce VOC emissions.

Screen Printing

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. 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. This measure requires smaller printers to use water based and/or low VOC materials to reduce VOC emissions. 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 were obtained through the use of ink reformulation, process printing modification, and material substitution for cleaning operations. This regulation became effective on June 5, 1995.

Graphic Arts – Flexographic and Rotogravure Printing

This source category consists of numerous small flexographic or rotogravure printers that perform non-continuous sheet fed printing and continuous web or roll printing. MDE adopted a printing regulation in 1987 that requires smaller printers to use control devices and/or low VOC materials to reduce VOC emissions. VOC emissions are caused almost entirely by evaporation of the ink solvents. Although several control devices were evaluated over the years for rotogravure and flexographic web printers, a catalytic oxidizer has proven to be most successful. A typical oxidizer yields 96-98 percent destruction of VOC. Most sources were in compliance with all requirements by early 1992.

Industrial Adhesives and Sealants Rule

This rule establishes VOC content limitations for industrial and commercial application of solvent-based adhesives and sealants. Controls will cover adhesives, sealants, adhesive primers, sealer primers, adhesive application to substrates, and aerosol adhesives. VOC content limits are similar to those contained in the CARB Reasonably Available Control Technology (RACT) or Best Available Control Technology (BACT) document for adhesives and sealants (Dec. 1998).

Sources affected include manufacturers and distributors of industrial adhesives and sealants.

6.1.3 NON-ROAD MEASURES

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. Small gasoline-powered engine equipment includes, for example, lawn mowers, trimmers, generators, and compressors. 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.

Non-Road Diesel Engines Tier I and Tier II

This measure takes credit for NOx emissions reductions from emissions standards promulgated by the EPA for non-road, compression-ignition (i.e., diesel-powered) utility engines. The measure affects diesel-powered (or other compression-ignition) heavy-duty farm, construction equipment, industrial equipment, etc., rated at or above 37 kilowatts (37 kilowatts is approximately equal to 50 horsepower). 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 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.

Marine Engine Standards

Of the 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. This measure controls exhaust emissions from new spark-ignition (SI) gasoline marine engines, including outboard engines, personal watercraft engines, and jet boat engines.

Emissions standards for large spark ignition engines

This EPA measure controls VOC and NOx emissions from several groups of previously unregulated nonroad engines, including large industrial spark-ignition engines, recreational vehicles, and diesel marine engines. The emission standards apply to all new engines sold in the United States and any imported engines manufactured after these standards begin. Controls on the category of large industrial spark-ignition engines are first required in 2004. Large industrial spark-ignition engines are those rated over 19 kW used in a variety of commercial applications; most use liquefied petroleum gas, with others operating on gasoline or natural gas. Controls on the other engine categories are required beginning in years after 2005.

Reformulated gasoline use in non-road motor vehicles and equipment

This federally mandated measure requires the use of lower polluting "reformulated" gasoline in Cecil County, as part of the Philadelphia Nonattainment Area. The emission reductions result from the use of the federally reformulated gasoline in non-road mobile sources. This measure affects the various non-road mobile sources that burn gasoline, such as small gasoline-powered engine equipment including lawn mowers, trimmers, generators, and compressors. VOC emissions result from combustion and evaporation of gasoline used to power this equipment.

Railroad Engine Standards

This measure establishes emission standards for oxides of nitrogen, hydrocarbons, carbon monoxide, particulate matter, and smoke for newly manufactured and remanufactured diesel-powered locomotives and locomotive engines, which were previously unregulated. This regulation took effect in 2000 and affects railroad manufacturers and locomotive re-manufacturers. It involves adoption of three separate sets of emission standards with the applicability dependent on the date a locomotive is first manufactured.

Emission Control Area

In a rule published on April 30, 2010, EPA adopted standards that apply to Category 3 (C3) engines installed on U.S. vessels and to marine diesel fuels produced and distributed in the United States. That rule added two new tiers of engine standards for C3 engines: Tier 2 standards that begin in 2011 and Tier 3 standards that begin in 2016. It also includes a regulatory program to implement Annex VI to the International Convention for the Prevention of Pollution from Ships (a treaty called "MARPOL") in the United States, including engine and fuel sulfur limits, and extends the Emission Control Area (ECA) engine and fuel requirements to U.S. internal waters. The rule also revised our domestic CAA diesel fuel program to allow for the production and sale of diesel fuel with up to 1,000 ppm (0.10 %) sulfur for use in C3 marine vessels, phasing in by 2015.

This federal rule affects ocean-going vessels and large ships.

6.1.4 Point Source Measures

The Maryland Healthy Air Act (HAA)

In April of 2006, the Maryland General Assembly enacted the Maryland Healthy Air Act. The Maryland General Assembly record related to the HAA and the final version of the Act itself can be found at: https://mgaleg.maryland.gov/2006rs/fnotes/bil_0004/sb0154.pdf

The MDE Regulations (Code of Maryland Regulations) can be found at:
https://dsd.maryland.gov/Pages/COMARSearch.aspx#k=26.11.27#l=1033
The HAA is one of the toughest power plant emission laws on the East Coast. The HAA requires reductions in nitrogen oxides (NO_x), sulfur dioxide (SO_2) and mercury emissions from large coal burning power plants. The Healthy Air Act also requires that Maryland become involved in the Regional Greenhouse Gas Initiative (RGGI) which is aimed at reducing greenhouse gas emissions.

The Maryland Department of the Environment has been charged with implementing the HAA through regulations. As enacted, these regulations constitute the most sweeping air pollution emission reduction measure proposed in Maryland history.

The Healthy Air Act NOx reduction requirements affect the fossil fuel fired electric generating units below. While none of the HAA affected sources are located in Cecil County, Maryland, MDE lists this important regulation in the SIP as emission reductions from these upwind facilities will have a substantial impact on the air quality in Cecil County.

Brandon Shores	Units 1 & 2	Anne Arundel County
H. A. Wagner	Units 2 & 3	Anne Arundel County
C. P. Crane	Units 1 & 2	Baltimore County

Chalk Point	Units 1 & 2	Prince George's County
Dickerson	Units 1, 2, 3	Montgomery County
Morgantown	Units 1 & 2	Charles County
R. Paul Smith	Units 3 & 4	Washington County

The emission reductions from the Healthy Air Act come in two phases. The first phase requires reductions in the 2009/ 2010 timeframe, and compared to a 2002 emissions baseline, reduce NO_x emissions by almost 70%, SO_2 emissions by 80% and mercury emissions by 80%.

The second phase of emission control occurs in the 2012/ 2013 timeframe. At full implementation the HAA reduced NO_x emissions by approximately 75 percent from 2002 levels, SO_2 emissions were reduced by approximately 85 percent from 2002 levels, and mercury emissions were reduced by 90 percent.

The 2012 ozone season and annual HAA NOx caps are shown in the table below.

Table 6-1: Annual and Ozone Season Maryland Healthy Air Act NOx Emissions

Unit	2012 HAA Annual Caps	2012 HAA Ozone Season Caps
Brandon Shores 1	2,414	1,124
Brandon Shores 2	2,519	1,195
Wagner 2	555	229
Wagner 3	1,115	481
Crane 1	686	284
Crane 2	737	317
TOTALS	8,026	3,630

Maryland NOx Regulation for Coal-fired EGUs

After the adoption of the Healthy Air Act, Maryland realized that ozone season mass caps are not always the best method for addressing short term daily ozone problems. MDE moved to enact further regulations on coal-fired EGUs that limited NOx emissions to a 24-hour block average rate.

The Maryland regulation that is federally enforceable can be found here: https://www.epa.gov/sips-md/maryland-sip-control-nitrogen-oxide-emissions-coal-fired-electric-generating-units

Between the HAA and the MD NOx Regulation, Maryland has a combination of NOx mass caps and rate caps, making the combination one of the toughest power plant emission laws on the East Coast.

Affected Sources

The MD NOx Regulation for Coal-fired EGUs affect the coal-fired electric generating units below. While none of the affected sources are located in Cecil County, Maryland, the MDE lists this important regulation in the SIP as emission reductions from these upwind facilities will have a substantial impact on the air quality in Cecil County.

Brandon Shores	Units 1 & 2,	Anne Arundel County
H. A. Wagner	Units 2 & 3	Anne Arundel County
C. P. Crane	Units 1 & 2	Baltimore County
Chalk Point	Units 1 & 2	Prince George's County
Dickerson	Units 1, 2, 3	Montgomery County
Morgantown	Units 1 & 2	Charles County
AES Warrior Run	Unit 1	Allegany County

Expandable Polystyrene Products

These sources use expandable polystyrene beads that contain pentane, a VOC, to manufacture foam products such as foam cups, board insulation, and custom shapes. VOC emissions typically occur during storage and pre-expansion of the beads, during manufacturing, and during "aging" when the blowing agent (pentane) slowly diffuses from the foam before shipping. This control measure requires Reasonably Available Control Technologies (RACT) to be installed at operations that manufacture foam cups, foam insulation and other foam products. The regulation became effective in July 1995.

Yeast Manufacturing

Yeast is produced using an aerated fermentation process under controlled conditions. In June 1995, MDE required RACT to be installed at two yeast-manufacturing operations in the Baltimore nonattainment area. The regulation results in an overall emission reduction of approximately 60 to 70 percent from the 1990 baseline by requiring affected sources to meet specific VOC emission standards.

Commercial Bakery Ovens

This measure requires commercial bakeries using yeast to leaven bread and bread products to install RACT. Commercial bakeries generate VOC emissions from the fermentation and baking processes used to produce yeast-raised baked goods. These emissions are primarily ethanol. The regulation requires control equipment dependent upon thresholds that are based on cost effectiveness criteria.

Federal Air Toxics

This measure covers sources that are required to comply with federal air toxics requirements. The Department has delegation to implement federal air toxics rules that will achieve VOC emissions reductions. Federal rules that may achieve such reductions include the following: federal NESHAPs for vinyl chloride production plants, benzene emissions from equipment leaks, benzene storage vessels, coke by-product recovery plants, benzene transfer operations, and benzene waste operations; and the EPA Maximum Achievable Control Technology (MACT) program.

Enhanced Rule Compliance

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.

State Air Toxics

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. The Department adopted the air toxics regulations in 1988.

NOx RACT -- Reasonably Available Control Technology

This measure requires control of nitrogen oxides (NOx) emissions by installing RACT. NOx RACT will apply to utility, industrial and commercial fuel burning equipment and combustion installations. The regulation established cost-effective controls on all installations located at major NOx sources. This first phase of stationary source NOx reductions resulted in an approximate 22% reduction in NOx emissions.

NOx Phase II/Phase III Ozone Transport Commission (OTC)/NOx Budget Rule (Phase II) and NOx SIP Call (Phase III)

In 1994, the OTC member states signed a major agreement to reduce NOx emissions from power plants and other major stationary sources of pollution throughout the Northeast and Mid-Atlantic states. The agreement recognized that further reductions in NOx emissions are needed to enable the entire Ozone Transport Region (OTR) to meet the NAAQS. The Department adopted a “NOx Budget” rule to require a second phase of stationary source NOx reductions as part of this regulatory initiative. This regulation requires large stationary sources to reduce summertime NOx emissions by approximately 65% from 1990 levels. The regulation also includes provisions allowing sources to comply by trading “allowances.” This regulation requires affected sources to have met these requirements by May 2000.

In late 1998, the U.S. EPA adopted its “NOx SIP Call” to reduce ozone transport in the Eastern United States. This regional NOx reduction program requires 22 states, including Maryland, to submit regulations and a revision to State Implementation Plans (SIPs) to further reduce NOx emissions by 2007. Maryland’s Phase III regulations achieve approximately 23% additional reductions from large stationary sources such as power plants, cement kilns and large industrial boilers. The regulations require affected sources to add specific control equipment, reduce emissions, or trade to meet the allowable amount ("cap") of seasonal NOx emissions by 2003.

Cement Kiln Operation

Portland cement manufacturing is an energy intensive process in which cement is made by grinding and heating a mixture of raw materials such as limestone, clay, sand, and iron ore in a rotary kiln. Nationwide, about 82 percent of the industry's energy requirements are provided by coal. Waste-derived fuels (such as scrap tires, used motor oils, surplus printing inks, etc.) provide about 14 percent of the energy. NO_x emissions are generated during fuel combination by oxidation of chemically-bound nitrogen in the fuel and by thermal fixation of nitrogen in the combustion air.

There are four main types of kilns used to manufacture Portland cement: long wet kilns, long dry kilns, pre-heater kilns, and pre-calciner kilns. Currently, there are two cement-manufacturing facilities located in Maryland: Holcim (US) Inc. located in Hagerstown, MD which operates a long dry kiln with average annual NO_x emissions of 1,403 tons/yr and Lehigh Cement located in Union Bridge, MD which operates a rotary kiln with a pre-heater system with average annual NO_x emissions of 3,961 tons/yr.

Two cement manufacturing facilities operate within the State of Maryland. The Holcim facility is located outside of the Baltimore Nonattainment Area. The facilities and locations are listed below:

Lehigh Cement Company	Holcim Company
MDE Facility ID: 013-0012	MDE Facility ID: 043-0008
Carroll County, MD	Washington County, MD

Lehigh Cement Company

Lehigh Cement Company LLC owns and operates a Portland cement manufacturing plant in Union Bridge, MD. The plant is located in both Carroll and Frederick Counties. The original plant was built in 1910. The plant was purchased by Lehigh Cement Company, a division of the Heidelberg Cement Group, in 1925 and has undergone a series of modernizations and expansions, including replacing four existing long-dry kilns with one pre-heater/pre-calciner kiln system in 2001. As of 2013, the plant was producing up to 2.3 million tons cement per year. The newest plant, modernized as a hybrid 5-stage pre-heater/pre-calciner rotary kiln, began production in 2001 and to date, remains the largest cement production facility in North America, incorporating some of the most modern pollution control technology available today.

Holcim (U.S.) SNCR equipped

Holcim Cement Plant is a Delaware corporation located in Hagerstown, Washington County, Maryland. The Hagerstown facility consists of two components, the Portland cement manufacturing plant and the quarry adjacent to the plant. The site quarries limestone, operates a limestone crushing plant, a raw mill system, a cement kiln/clinker cooler system, a finish mill system, and a packaging and shipping operation. Although cement production at this location dates back to 1903, the current long dry kiln has been in operation since 1971. The maximum annual clinker production from the kiln is 693,500 tons.

As part of a federal action, the Portland cement plant in Washington County will be upgrading the kiln to a pre-heater/pre-calciner kiln by September 6, 2016. The kiln will then be required to meet a year round NOx limit of 1.8 lbs NOx/ton of clinker on a 30-day rolling average.

Control Strategy

COMAR 26.11.30 (Control of P*ortland Cement Manufacturing Plants*) applies to Portland cement manufacturing facilities and limits NOx emissions from these sources by requiring cement kilns to install low NO_x burners or mid-kiln firing.

On and after April 1, 2017, Portland cement kilns will need to meet a NOx emission limitation based upon recommended control measures for cement kilns from the 2007 Ozone Transport Commission (OTC) Technical Support Document on Identification and Evaluation of Candidate Control Measures. The proposed NOx emission rate for long dry kilns is 3.4 pounds of NOx per ton of clinker produced and for pre-calciner kilns, an emissions rate of 2.4 pounds of NOx per ton of clinker produced.

The NOx emission requirements under COMAR 26.11.30.07 only requires affected sources to increase the amount of ammonia reagent used in existing pollution control equipment to meet the proposed NOx emission limitations in 2017.

As a result of this regulation, the Portland cement plant in Carroll County will reduce annual NOx emissions by about 14% or 400 tons based on 2012/2013 production. The Portland cement plant in Washington County will reduce annual NOx emissions by about 53% or 510 tons based on 2012/2013 production.

As part of a federal action, the Portland cement plant in Washington County will be upgrading the kiln to a pre-heater/pre-calciner kiln by September 6, 2016. Under the federal action, the kiln will then be required to meet a year round NOx limit of 1.8 lbs NOx/ton of clinker on a 30-day rolling average. The 1.8 lbs NOx/ton per ton of clinker standard is lower than the 2.4 lbs NOx/ton of clinker contained in COMAR 26.11.30.07, so the actual reductions from the plant are expected to be greater than calculated.

6.2 CONTROL MEASURES FOR REASONABLE FURTHER PROGRESS

The following measures have been implemented or have effective dates in Maryland since 2017, which is the baseline emissions inventory year for 8-Hour Ozone. These measures were not part of the baseline emissions inventory for the 8-Hour Ozone SIP, but emission reductions from these measures are included in the 2023 attainment inventory and used in the reasonable further progress calculations for Cecil County. The benefits summarize the emission credits available from the listed measures based on the difference between a 2017/18 controlled and uncontrolled inventory.

6.2.1 On-Road Mobile Measures

Vehicle Inspection and Maintenance (I/M)

The Clean Air Act (CAA or "the Act") requires basic motor vehicle inspection and maintenance (I/M) programs in moderate ozone nonattainment areas and MSA/CMSA portions of the OTR with urbanized populations over 200,000. In Maryland, the I/M program is required in 14 of the 23 jurisdictions in the state and including Cecil County

Vehicle inspection and maintenance, or I/M, is the periodic inspection of the emissions control systems of motor vehicles. The goal of I/M program is to identify and repair high-emitting vehicles to improve air quality. EPA sets new vehicle emission standards to protect public health, but those regulations do not guarantee proper operation and maintenance of the vehicle's emission controls over its lifetime. Maryland implements the I/M program to identify high-emitting vehicles and notify owners or operators to have their vehicles repaired.
The Maryland VEIP Programs includes three tests that are administered:

- Gas cap test
- On-board diagnostic (OBD) test
- Tailpipe test (Idle test)

Federal Tier 2 Vehicle Emission Standards

On December 21, 1999, the EPA announced new regulations affecting tailpipe emissions standards for the production of new cars and light trucks weighing up to 8,500 pounds. Commonly referred to as "Tier 2," these standards take effect beginning in 2004. The emissions reduction benefits of this Tier 2 program for the Maryland region will be significant, including passenger cars that are 77 percent cleaner than those on the road today. Light-duty trucks, such as Sport Utility Vehicles (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. In effect, the rule forces SUVs and light trucks to meet the same tailpipe emission standards as cars.

As part of the new tailpipe standard, the EPA also announced standards for lower sulfur in gasoline. The lower sulfur standards are necessary to enable passenger vehicles to meet Tier 2 emission standards.

Federal Tier 3 Motor Vehicle Emission and Fuel Standards

Starting in 2017, Tier 3 sets new vehicle emissions standards and lowers the sulfur content of gasoline, considering the vehicle and its fuel as an integrated system.

- The Tier 3 vehicle standards reduce both tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles.
- The Tier 3 gasoline sulfur standard will make emission control systems more effective for both existing and new vehicles and will enable more stringent vehicle emissions

standards. Removing sulfur allows the vehicle's catalyst to work more efficiently. Lower sulfur gasoline also facilitates the development of some lower-cost technologies to improve fuel economy and reduce green- house gas (GHG) emissions, which reduces gasoline consumption and saves consumers money.

- The tailpipe standards include different phase-in schedules that vary by vehicle class but generally phase in between model years 2017 and 2025. In addition to the gradual phase-in schedules, other flexibilities include credits for early compliance and the ability to offset some higher-emitting vehicles with extra-clean models.
- The fuel sulfur standards include an averaging, banking, and trading (ABT) program that will allow refiners and importers to spread out their investments through an early credit program and rely on ongoing nationwide averaging to meet the sulfur standard. EPA is also finalizing flexibilities such as the ability to carry over credits from Tier 2 to Tier 3 and hardship provisions for extenuating circumstances, as well as flexibility provisions for small businesses (small manufacturers of Tier 3 vehicles and small refiners), small volume manufacturers, and small volume refineries.
- The Tier 3 program continues the successful transition that began with EPA's Tier 2 program, finalized in 2000, in which EPA treated vehicles and fuels as a system to reduce both gasoline sulfur and vehicle emissions. While there were claims at the time that the program would cause fuel prices to increase far in excess of EPA's estimates and would result in closures and fuel supply shortages, the Tier 2 program was a success and resulted in gasoline sulfur reductions of up to 90 percent and enabled the use of new emission control technologies in cars and trucks with no serious negative impacts on the refining industry. EPA's Clean Diesel Program similarly utilized a systems approach to reducing sulfur emissions from diesel fuels and enabling cleaner diesel technologies with the Highway Diesel Rule (finalized in 2001) and the Nonroad Diesel Rule (finalized in 2004) again with no serious negative impacts. Now that the U.S. refining industry routinely produces lower sulfur fuel products, new market opportunities for international fuel exports have opened up.

National Low Emission Vehicle Program

The National Low Emission Vehicle Program (National LEV) program is a vehicle technology program resulting in the production of light duty vehicles and light-duty trucks with significantly lower tailpipe emissions. The National LEV program is applicable to 1999 and later model-year vehicles sold in the Ozone Transport Region (OTR) and 2001 and later model-year vehicles sold throughout the United States. The National LEV program was developed through an unprecedented, cooperative, voluntary effort by the northeastern states, auto manufacturers, environmentalists, fuel providers, U.S. EPA and other interested parties. National LEV vehicles are 70 percent cleaner than 1998 models. The National LEV program will result in substantial reductions in volatile organic compounds (VOCs) and oxides of nitrogen (NOx), which contribute to unhealthy levels of smog in many areas across the country.

MD Clean Cars Program (California Low Emission Vehicle II Standards)

The Maryland Clean Cars Program adopts California's stricter vehicle emission standards. These standards, known as California Low Emission Vehicle Standards II (Cal LEV II), became effective in Maryland for model year 2011 vehicles, significantly reducing a number of emissions including volatile organic compounds (VOCs) and nitrogen oxides (NOx). The VOC reduction achieved from this program was expected to be greater than the existing Federal standards and the NOx reduction was expected to be greater than the existing Federal Tier 2 standards that were in place at the time of its adoption. The Clean Cars Program also represents the first program that directly regulates the most prevalent greenhouse gas pollutant, carbon dioxide (CO_2) emissions. In addition to regulating GHG from passenger vehicles, the Clean Cars Program includes a Zero Emissions Vehicle (ZEV) mandate that car manufacturers must meet.

MD Clean Cars Program (California Low Emission Vehicle III Standards)

Since initially adopting the Clean Cars Program, California has developed stricter tailpipe and GHG standards. These standards, known as Cal LEV III, were also adopted by Maryland in 2012. The LEV III Program takes effect in model years 2015-2025 and sets all new emissions standards for criteria pollutants as well as GHGs. By 2025, vehicles will emit 75% less smog-forming pollutants and 34% less GHG emissions under Cal LEV III. The LEV III Program also strengthens the ZEV mandate, increasing the requirements for ZEVs beginning in 2018. ZEVs include electric vehicles and plug-in electric hybrids.

Reformulated Gasoline in On-road Vehicles

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. Since January 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.

6.2.2 Non-Road Mobile Measures

The non-road mobile source emissions were calculated using the EPA MOVES3 model. The MOVES3 model is the latest estimator of non-road emissions and is recommended by EPA for producing SIP non-road mobile sources emission inventories.

The algorithms used by the MOVES3 model to estimate emissions from nonroad equipment types vary depending on the processes and pollutants being modeled and the equipment type. They also depend on whether the equipment uses a spark-ignition (SI) or compression-ignition (CI) engine, and the engine horsepower (hp) size class. The MOVES nonroad technical reports at https://www.epa.gov/moves/nonroad-technical-reports provide detailed information on algorithms and inputs for the nonroad calculations.

The MOVES nonroad module estimates emissions as the product of an adjusted emission factor multiplied by rated power, load factor, engine population and activity. Starting with base-year equipment populations by technology type and model year, the model uses growth factors to estimate the population in the analysis year. Estimates of median life at full load, load factors, activity and age distributions are then combined to generate estimates of nonroad emissions by equipment type, fuel type and age. Equipment populations are also allocated to county and season; national equipment populations are allocated to the county level using surrogate data. For the RFP plan, the model was executed using generic data. Emissions for 2017/2023 were developed using the updated version of the model.

Once the base year and future year emissions estimates were generated by the MOVES3 Nonroad model, the effectiveness of control strategies for each year of interest was evaluated. Emissions reductions from federal controls on non-road equipment was calculated by subtracting the future year emissions estimates from the base year emissions estimates.

Examples of the control measures in the Nonroad model include:

- Nonroad Vehicle Engine Standards (Tier 1, 2 and 3)
- Nonroad Diesel Fuel Standards
- New Nonroad Spark-Ignition (SI) Engines
- Heavy Duty Nonroad Diesel Engines
- Small Nonroad SI Engines (Phase II)
- Large Nonroad SI and Recreational Marine

6.2.3 COMMERCIAL AND CONSUMER PRODUCTS PHASE III AND IV

The Maryland Department of Environment (MDE) submitted a revision to its SIP for COMAR 26.11.32—Control of Emissions of Volatile Organic Compounds from Consumer Products[33] on November 16, 2017. The revision was promulgated in order to institute the requirements of the 2010 and 2014 OTC model rules for consumer products. The 2010 OTC model rule reflected changes made by the 2006 CARB rule. The 2014 OTC model rule reflected changes made by the 2009 CARB rule.

The revision further enhances VOC standards for specific consumer products and introduces VOC standards for new products. The amendments consist of updates to the VOC content limits and standards for a variety of consumer product categories, including personal care products, household products, automotive cleaners, and adhesives. The regulations set forth content and labeling requirements for flammable multi-purpose solvents and paint thinners. In addition, the regulations prohibit the sale, offer for sale, supply, or manufacture for use in the State of certain products manufactured on or after January 1 that contain methylene chloride, perchloroethylene, or trichloroethylene. These products include any bathroom and tile cleaner, construction panel and floor covering adhesive, electronic cleaner labeled "Energized Electronic Equipment use only," general purpose cleaner, or oven or grill cleaner. The amendments also establish VOC standards for 11 new consumer product categories. In addition, the amendments further strengthen the VOC standards for 15 consumer product categories based on improved reformulations of these products that are capable of achieving lower VOC emissions while

[33] 83 FR 39009 https://www.federalregister.gov/documents/2018/08/08/2018-16776/approval-and-promulgation-of-air-quality-implementation-plans-maryland-amendment-to-control-of

demonstrating an ability to maintain performance specifications for the products. The amendments also incorporate new definitions and numerous modifications to existing definitions to improve clarity. In particular, MDE amended the structure of the definition, exemptions, and VOC standard for the artist's thinner/solvent consumer product category without changing the regulatory language, which remains consistent with the 2009 CARB rule and the 2014 OTC model rule.

Emission Reductions
CARB and OTC have estimated that the Phase III and IV emission reductions between a range of 10.3 to 15% of the total commercial and consumer products category. MDE used the lowest control efficiency value of 10.3%.

6.3 SUPPLEMENTAL OR INNOVATIVE MEASURES

Inclusion of the following programs in the control measures portion of this attainment plan does not create an enforceable commitment by MDE or the State to implement the programs or to achieve any specific emission reductions projected as a result of implementation of the programs, and neither MDE, nor the State, makes any such commitment.

In addition, MDE does not rely on any emission reductions projected as a result of implementation of these programs to demonstrate attainment. While the emission reductions from these programs could be substantial and could lead to significant regional air quality benefits, actual air quality benefits are uncertain. Consequently, projected emission reductions from these programs are not included in the emission inventory, the attainment modeling, the reasonable further progress calculation, or any other area of the SIP where specific projected emission reductions are identified.

EPA's voluntary measures policy, "Guidance on Incorporating Voluntary Mobile Source Emission Reduction Programs in State Implementation Plans," establishes criteria under which emission reductions from voluntary programs are creditable in a SIP. This policy permits states to develop and implement voluntary and/or innovative programs that partner with local jurisdictions, businesses, and private citizens to implement emission-reducing behaviors at the local level. MDE reviewed the guidance and determined that the emission reductions from these measures cannot be quantified to the degree necessary for inclusion in the SIP at this time.

6.3.1 ANTI-TAMPERING INITIATIVE

MDE is initiating a new effort to reduce motor vehicle tampering. Tampering with vehicle emission control equipment is illegal and leads to significant increases in emissions and risks to public health and the environment. Vehicle tampering can include totally removing a vehicle's emission control system, installing replacement parts that do not meet the manufacturer's specifications, reprogramming computer components, or installing performance chips to bypass or defeat emission control systems. Recently, Maryland, the EPA, and other states have begun to investigate and act against companies and individuals who tamper with the emission control systems on vehicles. The Volkswagen case was the first major EPA action taken to address this issue. At that time, this issue was not understood to be a major emissions problem. EPA, through its National Compliance Initiative, has shown that it is a major problem that can be linked to Maryland's challenging ozone problem. EPA estimates that from 2009-2019, Maryland had 5,900 diesel trucks operating with deleted (totally removed) emissions devices. This resulted in excess NOx emissions of 600 tons/year and excess fine particle emissions of 6.4 tons per year during this period. MDE is working with EPA to begin implementing an enhanced enforcement program to eliminate these illegal activities.

In 2022, MDE adopted an updated anti-tampering regulation that clarifies and expands Maryland's anti-tampering regulations (COMAR 26.11.20.02). The adopted regulation prohibits the manufacture, sale, installation, and use of any device that prevents a motor vehicle's air pollution control system from operating as originally designed. Additionally, it requires a vehicle dealer or business that sells, auctions or transfers a motor vehicle to maintain records confirming all air pollution control systems are in operating conditions at the time of sale and codifies the Department's rights to conduct inspections and surveillance of new and used motor vehicles for the purposes of determining compliance. Lastly, MDE is working with EPA, local law enforcement, and organizations including auto dealers, auctioneers, and traders to raise awareness of the issue and new regulations, as well as provide training. More information on MDE's developing program and implementation efforts related to this important effort can be found on the MDE anti-tampering webpage:
https://mde.maryland.gov/programs/air/MobileSources/Pages/Anti-Tampering.aspx

6.3.2 Anti-Idling Initiative

Maryland's Idling Law (Transportation Article §22-402) states that a motor vehicle engine may not be allowed to operate more than 5 consecutive minutes when the vehicle is not in motion, except as follows:

- When a vehicle is forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control;
- When it is necessary to operate heating and cooling or auxiliary equipment installed on the vehicle;
- To bring the vehicle to the manufacturer's recommended operating temperature; or
- When it is necessary to accomplish the intended use of the vehicle.

A significant amount of heavy-duty diesel vehicle idling can be reduced by using currently available idle control technologies. Some of these technologies can also provide sleeper/cab heating and cooling, heat for engine warming, and electrical power for battery charging and on-board accessories. Technologies include:

- Electronic Idle Limiters – Idle limiting devices that are software-based idle limit controls
    - Idle Shutdown System
    - Automatic Stop-Start System

- Auxiliary Devices – Auxiliary devices are truck-mounted and can be used to provide some or all of the necessities that would normally require the truck engine to idle.
    - Fuel Operated Heaters
    - Auxiliary Power Units (APU)
    - Battery Air Conditioning Systems (BAC)
    - Thermal Storage Systems
- Truck Stop Electrification (TSE) – Electric power (120V AC or 240V AC) is supplied to the HVAC system and to on-board appliances from the local electric power grid.

Idle Free Maryland

MDE's Idle Free MD program is a voluntary partnership between the state, the private sector, and Maryland schools. The program is designed to educate about the hazards to health and the environment from unnecessary idling of motor vehicles, which include carbon monoxide, nitrogen oxide compounds that contribute to ozone creation, and greenhouse gas emissions. MDE has been partnering with schools throughout the state to help them implement or reinvigorate their own idle reduction programs. Having such a school policy not only clears the air on their campuses but goes toward their certification as a Maryland Green School. MDE also continues to collaborate with the Maryland Motor Truck Association (MMTA) on education and outreach efforts.

6.3.3 EMISSION REDUCTIONS FROM TRANSPORTATION MEASURES

Substantial funding commitments have come from State and local agencies and private employers for promotion of strategies to reduce mobile emissions. Examples of these measures include idling reduction, ridesharing, telecommuting, and transit use as well as vehicle replacement and retrofit measures, and bicycle and pedestrian programs. These funding commitments produce reductions in emissions, some of which are being reflected in transportation plans.

Although these programs are working to reduce emissions from mobile sources and play an important role in the transportation sector's contribution to cleaner air, neither MDE, nor the State intends their inclusion in this SIP to constitute enforceable commitments to implement these programs or to achieve any emission reductions projected as a result of implementing these programs, and neither MDE, nor the State makes any such commitment. These directionally correct programs will continue to be used outside of the SIP for transportation planning purposes as needed.

The following are descriptions of selected emission reduction strategies in Maryland.

Commuter Choice Maryland/Commuter Connections

Commuter Choice Maryland

Commuter Choice Maryland is a statewide Maryland Department of Transportation (MDOT) program designed to ease traffic congestion by providing employers and commuters with resources that make commuting easier, safer, cheaper, and greener. The program connects commuters to a variety of transportation options that fit their lifestyle, schedule, and budgets, such as transit, ridesharing, bike/walk, telework/flexible work, guaranteed ride home, and cash in lieu of parking. For employers, the program offers complimentary consultations and technical assistance to guide them through the process of setting up low-cost commuter programs and applying for available tax credits. Encouraging folks to opt for alternative commuting options would reduce emissions from the mobile sector.

MDOT incenTrip

incenTrip is a multimodal trip planning app that rewards points for each commute trip you plan and take during peak commuting times and log into the app. More points are rewarded when users take trips that help reduce congestion and improve air quality such as ridesharing, taking transit, or biking. Users can earn up to $600 can be earned per calendar year. The goal is to reduce the number of single-occupancy vehicles on the road and encourage Maryland commuters to consider alternate modes of transportation.

Commuter Connections

The Commuter Connections program offers a variety of services to commuters in the Metropolitan Washington and Baltimore regions, and receives annual funding from the Washington DC government, the Maryland and Virginia departments of Transportation, and US Department of Transportation. Services include ride-matching, guaranteed ride home, marketing and education about alternate commuting options, employer outreach, and sponsorship of Car Free days and Bike to Work events. The Maryland Transit Administration (MTA) Commuter Connections television show airs on Maryland cable stations and provides information about MARC, Metro SubwayLink, Light RailLink, MobilityLink (Paratransit), CityLink, LocalLink, and Commuter Bus.

Traffic Relief Plan

The goal of MDOT's Traffic Relief Plan is to reduce traffic congestion, increase economic development, enhance safety, and return quality of life to Maryland commuters. The Traffic Relief Plan will incorporate many projects around the state including improvements to highways and transit. The largest initiative in the Traffic Relief Plan will evaluate improvements to major corridors including I-695, I-95, I-70, MD 295, and others to relieve congestion. Some of the projects include adding express lanes, reconfiguring interchanges, and much more. For example, MDOT/MDTA committed $210 million to extend 7.75 miles of the northbound I-95 Express lanes (one additional lane) from north of MD 43 in Baltimore County to MD 24 in Harford County. In addition, MDOT SHA has dedicated $50.3 million to deploy cutting-edge

SMART traffic signals to improve traffic operation and ease congestion for approximately 700,000 drivers per day on 14 major corridors across the state.

Op Lanes Maryland I-495 & I-270 Managed Lanes Study
I-495 and I-270 have the highest commuting times in the country. Utilizing traffic data and an environmental impact statement, the preferred alternative to achieve congestion relief is Alternative 9 – Phase 1 South. This proposed alternative will provide two HOT lanes on I-495 from GW Memorial Parkway to west of MD 187, and then on I-270 from I-495 to I-370 including the I-270 east spur to MD 187 with no action at this time for I-495 from east of MD 187 to west of MD 5. Benefits would include improved travel speeds and reliability, equitable access, toll-free options, and bicycle and pedestrian improvements.

Transportation System Management & Operations (TSMO) Strategies

TSMO is MDOT SHA's integrated approach to planning, engineering, operating, and maintaining existing facilities to maximize their full-service potential, and ultimately improve the safety, security, and reliability of the transportation network. TSMO strategies address both recurring and non-recurring sources of congestion. Compared to capacity expansion, TSMO strategies are inexpensive and cost-effective, take little or no extra right-of-way, and can be deployed in months rather than years. A list of strategies that improve air quality can be found below.

- **Bike Facilities** will give roadway users an alternative mode of transportation and reduce environmental impacts by replacing vehicle trips.
- **Bus on Shoulder** allows public transit buses to bypass congestion by using roadway shoulders. This could increase transit ridership with improved travel times and alleviate congestion around planned events (fairs, sporting events, races, etc.).
- **CAV Technology** will improve mobility as automation enhances traffic flow and network capacity. This will also reduce fuel consumption and gas emissions.
- **Dynamic Lane Reversal** increases directional roadway capacity to accommodate changes in traffic demand. This will improve travel time reliability, reduce congestion, provide additional capacity without roadway widening, and facilitate directional traffic flow for events and emergencies.
- **Dynamic Lane Use Control** actively manages roadway operations by regulating land use with dynamic signage which eases congestion by improving system efficiencies.
- **Electronic Payment / Toll Collection** addresses reoccurring congestion due to traditional methods such as toll booths.
- **Hard Shoulder Running** allows motorists to travel on shoulders during peak travel demand which will increase capacity on roads to address congestion caused by bottlenecks.
- **Integrated Corridor Management** is the coordination among facilities and modes in a transportation system to improve the efficiency of travel among corridors. This type of coordination gives travelers real-time information and encourages travelers to choose a facility or transportation mode that will get them to their destination the fastest.

- **Managed Lanes** are freeway lanes where operational strategies are implemented, or exclusive access is provided, based on vehicle occupancy or tolling. This improves travel time reliability and relieves congestion.
- **Parking Management** provides real-time parking availability information to drivers in order to reduce unnecessary congestion and assist drivers in finding a place to park. This reduces fuel consumption and gas emissions by easing recurring congestion at peak travel times and nonrecurring congestion due to special events.
- **Pedestrian Facilities** can improve mobility because roadway users have an alternative mode of transportation.
- **Queue Warning** is a warning delivered by signs to alert motorists that traffic is slowed or stopped. These warnings create speed harmonization which can reduce delays, fuel consumption, and gas emissions.
- **Road Diets** are a design strategy that reduces the number of travel lanes in a roadway and repurposes the space for other uses and travel modes. This strategy reduces delays by separating left-turning vehicles at signalized intersections.
- **Traffic Calming** is a physical design and traffic control measures used on existing roadways (ex. Speed bumps) which can lead to an increase in non-motorized activity.
- **Traffic Incident Management** is the use of technologies and strategies that help transportation operations staff detect, verify, and respond to traffic incidents. This improves mobility and helps clear the roadway as quickly as possible.
- **Traffic Signal Coordination** improves mobility by reducing signal control delay as well as reduces fuel consumption and gas emissions by cutting the number of stops and starts.
- **Transit Priority** enhances transit services by giving transit vehicles added importance in transportation system operations. This priority reduces transit travel times which can lead to an increase in ridership and allow more people to travel the same route in fewer vehicles.
- **Weigh-in-Motion** replaces highway weigh stations for trucks with sensors that capture the weight as they continue to move at highway speeds. This eliminates stopping and idling which reduces fuel consumption and gas emissions.

Clean and Efficient Truck Engines

Heavy duty vehicles utilizing Diesel fuel are part of MDOT's fleet of vehicles and equipment. MDOT uses discretionary funds and grant funds to replace Diesel engines with models using Clean Diesel, Hybrid technologies, and alternative fuels. Vehicle procurement and replacement schedules adhere to industry standards and federal requirements governing service life requirements.

Discretionary and grant funding that support vehicle replacements with clean and efficient technologies includes Volkswagen Mitigation Settlement funding, Diesel Emission Reduction Act (DERA) funding, and Congestion Mitigation and Air Quality (CMAQ) funding. Utilizing these funding sources, MDOT MTA has replaced Transit Buses with Clean Diesel Buses, MDOT MAA has converted portions of its Parking Shuttle Fleet to Clean Diesel, and MDOT MPA has converted Dray Trucks. Planning and pilot projects are underway to further convert portions of MDOT fleets to Battery Electric Models.

Along Maryland trucking corridors, Truck Stop Electrification (TSE) allows truckers to shut down their engine and obtain electric power and "creature comforts" while resting. TSEs reduce diesel emissions and reduce noise and wear and tear on the truck engine. As of 2017, there is one TSE in Maryland that is powered by ShorePower on I-95 at exit 109A (Elkton). MDOT's *Statewide Truck Parking Study (2020)* addressed truck parking needs in further detail and proposed a series of further actions to advance safe and efficient truck parking on Maryland trucking corridors.

Energy Efficiency and Solar Program

MDOT has committed to reducing conventional energy use through efficiency measures and expansion of renewable energy sources. The Department has installed solar, wind, and geothermal energy systems at numerous MDOT facilities. These systems generate 1,829 megawatt hours annually, saving the State $200,000 and reducing carbon dioxide emissions by 1,285 metric tons. MDOT completed a comprehensive Energy Plan that details energy consumption, conservation strategies, and future energy conservation goals.

MDOT's Solar Energy Contract

Furthering the Hogan Administration's commitment to the environment and to using transportation dollars wisely, MDOT will run several of its facilities throughout the state with solar power. The Board of Public Works, chaired by Governor Larry Hogan, approved MDOT's Renewable Energy Master Contract at its February 7, 2018 meeting.

MDOT owns or controls more than 874 facilities, including buildings, parking garages, and parking lots that can be considered for photovoltaic (PV) system development. The projects will promote environmental goals such as Maryland's greenhouse gas reduction goal of 40% by 2030 (SB0323), and Renewable Portfolio Standard (RPS) of 25% by 2020 with 2.5% solar carve-out (HB1106).

Connected and Automated Vehicles (CAV)

CAV involves new technologies that allow vehicles to "communicate" with other vehicles and infrastructure, as well as allow for varying levels of automated driving. Connected vehicles include safety features, such as forward-collision warning, automatic emergency braking, pedestrian automatic emergency braking, and adaptive lighting. Automated vehicles allow for the use of technology for some of the driving tasks instead of a human driver. Cruise control is an automated feature that has been around for more than 50 years; some modern cruise control systems can automatically speed up and slow down your car to keep a set following distance relative to the car ahead for auto stop and go in traffic jams. Other automated features include lane departure warning, traction control, parking assist, and collision alerts. These features work together to lower the number of collisions, reduce delays and commutes, promote more consistent speeds, decrease idling, and allow for more efficient movement of vehicles. Overall, CAV technologies are a new means of improving safety and air quality.

Asset Management

The 2012 Moving Ahead for Progress in the 21st Century Act (MAP-21) called upon the Secretary of Transportation to establish systems for monitoring and managing transportation assets to improve safety, increase reliability, reduce costs, and improve lifecycle performance, including the establishment of measures to monitor asset management performance. The 2015 Fixing America's Surface Transportation Act (FAST Act) reaffirmed this requirement. Subsequent rules developed by the FHWA and FTA lay out the specific asset management requirements.

MDOT State Highway Administration (SHA) Asset Management Program

MDOT SHA plans, designs, builds, operates, maintains, and improves the majority of Maryland's freeways, highways, and non-toll bridges. To keep this critical infrastructure operational, MDTO SHA launched the Asset Management Program in 2021 to make transparent, data-driven decisions to maintain assets in a state of good repair. The Asset Management Program is managed by a specialized in-house operations office and enables optimal outcomes from MDOT SHA's maintenance and capital investments while following federal guidelines.

2019 Strategic Asset Management Plan (SAMP)

The MDOT SAMP, developed through coordination with MDOT's Asset Management Working Group, is intended to guide the Asset Management Program for MDOT, its five Transportation Business Units (TBUs), and one authority. The implementation of the SAMP enables MDOT to strategically manage its assets through a comprehensive approach based on sound asset management practices. The SAMP's goals and strategies focus on addressing seven critical DOT assets: facilities, pavement, structures, tunnels, rail, vehicle fleet and equipment, and major information technology (IT) systems.

MVA Customer Connect System

Customer Connect is a modernization of MDOT MVA's system and offers customers a more efficient and seamless level of service. All services are now located in a central location, creating an easier shopping experience. Account users can get a 360-degree view of their MDOT MVA to-dos including renewal and expiration dates. Customers can look up correspondence and receipts, apply for a disability product, make an appointment, and start an application online for service. These new and improved online features allow users to complete various forms and renewals virtually, reducing the need to travel to a physical MVA location.

Baltimore Link

BaltimoreLink is a complete overhaul and rebranding of the core transit system operating within the city and throughout the greater Baltimore region. Launched in June 2017, BaltimoreLink utilizes a more efficient and reliable bus network by spreading out the routes

within the downtown core and creating a grid of high-frequency routes. BaltimoreLink improves service quality and reliability; maximizes access to high-frequency transit; strengthens connections between MTA's bus and rail routes; aligns the network with existing and emerging job centers; and engages riders, employees, communities, and elected officials in the planning process.
With the implementation of BaltimoreLink, including associated infrastructure improvements such as dedicated bus lanes and transit signal priority installation, on-time performance (OTP) rose to 75% in December 2021, with a long term target of 85%. Overall, an updated bus system incentivizes Marylanders to utilize public transit more and consequently lowers emissions.

Outreach Programs – Walktober

October in Maryland becomes 'WALKTOBER', a month where the MDOT and its partnering agencies (Maryland Department of Planning, the Maryland Department of Health, Maryland Highway Safety Office, Maryland Department of Natural Resources, America Walks, and AARP) promote and host events and webinars spotlighting Maryland pedestrian safety, health, and commuting options in current walk programs and Initiatives. The program encourages walking as an alternative to driving. Reducing short vehicle trips can therefore reduce vehicle miles traveled and emissions.

Park and Ride Lots

MDOT maintains 112 Park and Ride lots across the state. On MDOT's Ride Share website, an interactive map is available that displays the location, space availability, ADA features, and amenities of each Park & Ride lot. Park and Ride lots enable commuters to access Buses and other forms of transit, and commuters may also coordinate Ridesharing with other drivers at Park and Ride lots. Ridesharing is an effective means of limiting the cars on the road, leading to better air quality.

Transit-Oriented Development (TOD)

Transit-Oriented Development (TOD) is an approach to land development that is defined as "a dense, mixed-use deliberately-planned development within a half-mile of transit stations that is designed to increase transit ridership." MDOT has actively promoted TOD as an approach to help increase transit ridership, support economic development, and maximize the efficient use of transportation infrastructure.

MDOT has provided resources to developers in terms of site planning, which include Maryland TOD Models and Guidelines Resources, some technical assistance, and the Maryland Transit Station Area Profile Tool, an interactive map that compiles key socio-economic, demographic, land-use, and transit-access information for all of Maryland's current and planned fixed rail stations. Providing resources such as these to developers allows for more effective land use and fewer miles traveled in vehicles.

The TOD in Owings Mills is an example of long-range planning which has resulted in the location of high-density commercial and residential development within close proximity of the Baltimore subway system's Owings Mills station and the transit bus stop. Similar developments are planned or underway in other parts of the Baltimore region.

<u>MARC Improvements (Parking, Railcars, Vehicles)</u>

Maryland Area Rail Commuter (MARC) Train Service is the commuter railroad in Maryland connecting passengers into Baltimore and Washington, DC from the Maryland and West Virginia suburbs. The Cornerstone Plans translate MDOT MTA's mission statement into strategic priorities, policies, programs, and initiatives for each transit mode. The MARC Cornerstone Plan is part of MDOT MTA's continuing commitment to achieving its goals while prioritizing the four cornerstones of safety, safety, efficiency, reliability, and world-class customer service.
In the most recent Cornerstone Plan from 2019, the MARC Train investment areas were divided up into vehicles, stations, guideways, facilities, systems, and services. The investments are geared toward improving the overall customer experience and increasing ridership. Recent initiatives have improved the safety and ridership experience including an interactive map where riders can track the train in real-time and improved security at stations by the use of CCTV. In the last decade, MARC has been retired older cars and replace them with newer, safer, and more reliable equipment. MDOT MTA acquired eight new SC-44 "Charger" diesel locomotives in 2018. These locomotives meet the latest TIER IV environmental emissions standards.

<u>Locally Operated Transit Systems (LOTS)</u>

In every county, there are a variety of transit systems throughout the state in smaller jurisdictions and rural areas. The Office of Local Transit Support at MDOT MTA provides a variety of technical assistance services, which include federal and state regulatory compliance, operations, management, planning, and training. Additionally, MDOT MTA manages several funding programs available to transportation operators throughout the state. LOTS help limit the number of vehicles on the road in rural areas and smaller jurisdictions, which helps promote better air quality.

<u>Apps and Smart Card Technologies</u>

Implementation of Smart Card technology and fare collection equipment for the Baltimore Metro, bus, light rail, commuter bus, and lots is being pursued by MTA. Smart card allows for quick and seamless travel between different transit systems. Passengers can pay for travel throughout the state with the swipe of a card. This makes transit and high occupancy vehicle (HOV) travel more convenient for the traveler. Charm*Pass* is a mobile ticketing app for MDOT MTA, allowing users to pay for BaltimoreLink local buses, Light RailLink, Metro SubwayLink, MARC Train, and Commuter Bus services directly from their smartphone. Charm*Flex* is also an option offered through Charm*Pass* that allows the purchase of different pass options to accommodate more flexible schedules and at a discounted rate.

One planned project is the Fare Collection System and Equipment Replacement which plans for a complete replacement of the current fare system including ticket vending machines, fare gates, fareboxes and smart card/mobile app readers, back-office software, and other related components as well as on-going overhaul and replacement of system components as needed.

Electric Vehicles/Electric Vehicle Infrastructure

MDOT and MEA worked collaboratively with partners and stakeholders to develop the *Maryland State Plan for National Electric Vehicle Infrastructure (NEVI) Formula Funding Deployment*, which was submitted to the Joint Office of Energy and Transportation on July 15, 2022. The plan is required by the Bipartisan Infrastructure Law (BIL), enacted as the Infrastructure Investment and Jobs Act (IIJA), to access National Electric Vehicle Infrastructure (NEVI) formula program funding. Funds will be used for the following:

- The acquisition and installation of EV charging infrastructure to serve as a catalyst for the deployment of such infrastructure and to connect it to a network to facilitate data collection, access, and reliability;
- proper operation and maintenance of EV charging infrastructure; and
- data sharing about EV charging infrastructure to ensure the long-term success of investments made under the program.

As the fleet transitions to electric vehicles, emissions from the on-road mobile sector will continue to decrease.

Incentives for Electric Vehicles and Infrastructure

The State of Maryland administers a rebate program to reimburse a portion of costs for installing Electric Vehicle charging outlets in homes and businesses. The State also offers grants for purchase of fleet vehicles and infrastructure under the Clean Fuels Incentive Program (CFIP). A one-time excise tax credit of up to $3,000 was available for Electric Vehicle purchases completed before June 30, 2020. Renewal of the tax credit was considered in the 2021 and 2022 legislative sessions of the Maryland General Assembly and did not pass, but could be funded in the future. Providing incentives to consumers may increase the number of electric vehicles on the road, which will ultimately promote better air quality.

On-Road Technology – Coordinated Highway Action Response Team (CHART) Program (Incident Management)

CHART, operated by MDOT and the Maryland State Police, is a statewide, multidisciplinary program responsible for providing traffic monitoring, 24x7 traffic management, traveler information (MD 511) services, and incident response and management services. Maryland 511 provides travelers with reliable, current traffic, and road closure information, as well as weather-related traffic events and conditions. MD 511 helps motorists reach their destination in the safest and most efficient manner when traveling in Maryland. CHART emergency patrols are available to aid in traffic incident management and motorist assistance. This program promotes streamlined and efficient traffic management, which contributes to motorist safety and better air quality.

Maryland Bicycle and Pedestrian Strategies

Critical components to building efficient, equitable, and sustainable cities are shortening automobile trips and shifting mode choice towards transit and active transportation. In Maryland, there are a variety of avenues that MDOT utilizes to encourage bike and pedestrian modes of transportation. Bicycle commuting can provide an alternate travel mode to shorter car trips which pollute more per mile than longer trips. Both bicycle and pedestrian modes of travel to work, when used alone or in combination with transit, can help to reduce traffic congestion by taking cars off the road.

MDOT administers several discretionary grant programs to fund bicycle and pedestrian infrastructure improvements. The Kim Lamphier Bikeways Network Program, Transportation Alternatives/Safe Routes to School Program, and Recreational Trails Program provide grant support for a wide range of bicycle and pedestrian network development and safety enhancement projects. These programs leverage past investments in bicycle and pedestrian facilities, complement existing state, local, and federal programs, and promote active transportation as a fun, healthy transportation mode.

Outreach is an important component of Maryland's Bicycle and Pedestrian Strategies. MDOT Active Transportation News publication provides information on state pedestrian and bicycle initiatives. The publication is released every couple of months to inform the public about MBPAC meetings, grant opportunities, and awards. In 2020, MDOT SHA launched the Be Street Wise initiative to educate Marylanders on best practices to Drive Safe, Walk Safe, and Bike Safe. For Bike Safe, the reminder to both bicyclists and drivers is that We're On This Road Together. That means that all roadway users must follow the laws of the road and look out for each other.

MDOT utilizes a Level of Traffic Stress (LTS) measurements for assessing the "bikeability" of the State's roadway network . The analysis scores how bikeable a roadway is based on the type of bicycle facility, traffic volumes, and speed. An interactive map is available online that showcases the results. Combined with additional bikeshare stations at 8 rail stations and leveraged bicycle and pedestrian grants state-wide, MDOT is facilitating Marylanders to bike more.

Freight and Freight Rail Programs

Maryland State Freight Plan (2022)

The 2022 Maryland Freight Plan assesses Maryland freight movements, multimodal networks, and related details to supplement and support the overarching vision, goals, and long-range transportation planning initiatives in the 2040 Maryland Transportation Plan (MTP). It also incorporates national freight goals and guidance from federal surface transportation authorizations including the 2015 Fixing America's Surface Transportation (FAST) Act and newer requirements per the 2021 Infrastructure Investment and Jobs Act (IIJA).

Plan goals include enhancing transportation services and communications for users, supporting sustainable freight infrastructure, and supporting alternative transportation choices and delivery options. There are various strategies and sections within the plan that will help improve air quality and reduce Greenhouse Gas (GHG) emissions. One of these strategies is traffic signal optimization which will provide an efficient flow or prioritization of traffic, increasing the efficient operations of a corridor and reducing unwarranted idling at intersections.

Maryland State Rail Plan Update
The 2022 Maryland State Rail Plan is an update of a previous plan completed in 2015. The 2022 plan has been developed in accordance with the federal Passenger Rail Investment and Improvement Act of 2008 (PRIIA) as well as the recently passed federal IIJA. The new 2021 IIJA provides unprecedented funding for rail at $66 billion, with an opportunity to fund “mega projects” on the Northeast Corridor. The project authorizes at least $22.2 billion over five years for projects on the Northeast Corridor. The plan will serve as a guide and resource for federal funds through projects and grant applications.

The goal of the plan is to ensure freight and passenger rail is a well-maintained, sustainable, and intermodal component of the transportation system that supports the equitable, safe, convenient, and efficient movement of people and goods within and through Maryland. Various proposed projects and strategies in the plan are geared toward improving the on-time performance (OTP) of MARC trains and reducing congestion.

Howard Street Tunnel (INFRA Grant Program)
Announced by USDOT in July 2019, Maryland will receive $125 million as part of the federal Infrastructure for Rebuilding America (INFRA) Grant Program. The funding will allow the state, in partnership with CSX, to increase clearance of the Howard Street Tunnel and bridges over the rail to allow for double-stack shipping containers. This will increase the number of containers handled by the Port of Baltimore and generate a significant number of new jobs.

Eastern Transportation Coalition (formerly I-95 Corridor Coalition)
The Eastern Transportation Coalition is a partnership of 17 states and D.C. focused on connecting public agencies across modes of travel to increase safety and efficiency. Formerly the I-95 Corridor Coalition, the organization started as an informal group of transportation professionals working together to manage highway incidents that impacted travel across state lines. The Coalition now includes 200 public agencies working together to address the pressing challenges facing the eastern corridor with a focus on Transportation Systems Management & Operations, Freight, and Innovation.

Public Transportation Initiatives

Transit Priority Initiative
MDOT MTA is working with local jurisdictions to increase bus reliability, speed, and passenger safety throughout the BaltimoreLink system. MDOT MTA has pursued a data-driven approach to identify opportunities in the system, focusing on reliability, bus speeds, and travel delays at bus stops. Potential targeted investments to the roadway that prioritizes transit riders include curb extensions at bus stops, transit signal priority, dedicated bus lanes, queue jumps, and more.

Maryland Transit Administration (MTA) Agency Innovation and Technology Initiatives
Technology initiatives support the deployment of system enhancements throughout the agency, including improved work flows, resource utilization, and data analysis, which also promote alternate methods of service delivery. Promoting enhanced efficiency throughout the agency will allow MDOT MTA to improve safety, reliability, and the overall customer experience. This indirectly supports increased transit utilization.

MTA Transit Plans and Bus Network Improvements
Two significant planning efforts by MDOT MTA - the Central Maryland Regional Transit Plan, and the Statewide Transit Plan - set goals and objectives for improving transit service and infrastructure in Maryland. The plans aim provide a vision of coordinated, local, regional and intercity transit across the state. The plans address strategic themes such as economic opportunity, safety, resiliency, and equity. Specific strategies address expanding dedicated bus lanes, improving bus stops and transit hubs, adding additional wayfinding and customer experience amenities, and improving bike and shared mobility connections. The elements of this planning will improve reliability and on-time performance while simultaneously enhancing the customer wait and transfer experience. Improvements will support use of transit as an alternative to car travel, with resulting air quality improvements.

MTA Transit Bus Fleet Electrification

MDOT MTA is launching a transition plan to move to a zero-emission bus (ZEB) fleet as older, diesel-fueled, and hybrid buses reach the end of their useful life. The incremental approach will include facility updates and is designed to meet the requirements of Maryland's new Zero-Emission Bus Transition Act, which mandates all new buses procured for the state's transit fleet be emission-free beginning in 2023. The agency has committed to converting 50% of its bus fleet to zero-emission by 2030 while seamlessly providing reliable, efficient service throughout the transition and beyond. MDOT MTA's first pilot ZEB program is scheduled for launch in 2023 when seven new battery-electric 40-foot and 60-foot articulated buses will arrive at the agency's Kirk Division. Transitioning to zero-emission buses will improve the region's overall air quality while providing passengers with a comfortable ride.

Pricing Initiatives – Electronic Tolling

All Maryland Transportation Authority (MDTA) facilities are now all-electronic (cashless). Motorists pay all-electronic (cashless) tolls via E-Z Pass® or Video Tolling. MDTA instituted all-electronic tolling at the Intercounty Connector (ICC)/MD 200 in 2011; the I-95 Express Toll Lanes (ETL) in 2014; the Francis Scott Key (I-695) and Thomas J. Hatem Memorial bridges (US 40) in 2019; and the William Preston Lane Jr. Memorial (Bay) Bridge (US 50/301), Baltimore Harbor Tunnel (I-895), Fort McHenry Tunnel (I-95), the John F. Kennedy Memorial Highway (I-95) and Governor Harry W. Nice Memorial/Senator Thomas "Mac" Middleton Bridge (US 301) in 2020. The benefits of AET include toll rate savings for customers, less idling time for better fuel efficiency and reduced emissions, decreased congestion, increased driver safety, and a safer work environment for employees. Each year, Marylanders will save $1 million and 44,000 hours in fuel and time savings just by not stopping at toll booths.

Telework

Telework allows employees to work from a remote location while maintaining communication with managers, colleagues, and customers. Telework strives to reduce both traffic congestion and air pollution by helping employers realize the benefits of a formal telework program. Through its Commuter Choice Maryland program and the Department of Budget & Management, the State of Maryland has made several resources available to the public to support telework options.

Telework reduces the number of commuters on the road, especially during peak travel times. This reduction will reduce congestion and emissions. According to 2022 data from Google Mobility Analytics, mobility trends for places of work are down 33 percent compared to the baseline. Given these results, we can see that COVID-19 has changed the way travel and work, with more and more companies allowing telework and remote work options for employees.

MD House Bill 73

The MD HB73, State and Local Government and Public Institutions of Higher Education – Teleworking Bill was signed and enacted on May 30, 2021. The bill established the Office of Telework Assistance in the Department of Commerce to establish best practices for telework policies; established the Business Telework Assistance Grant Program to assist businesses in implementing telework policies; requires each governing body of a county or municipality to establish telework programs; requires the State Court Administrator, the President of the Senate, the Speaker of the House, and the presidents of public institutions of higher education to establish telework programs and guidelines; etc.

Maryland Relief Act 2021 – County Online Sales / Telework Grants

The Maryland Relief Act of 2021 provided funding for Online Sales and Telework to assist businesses in setting up an online sales framework and offering employee telework opportunities and will be dispersed through the County Economic and Tourism Development Department. Although no single business may receive more than $5,000 of Grant Funds in grant funding under the Program, the money will help businesses impacted by the impacts of COVID-19.

State Vehicle Replacement

The Maryland Greenhouse Gas Reduction Act (GGRA) Plan, completed in 2020, addressed strategies for the State to reduce greenhouse gas emission by 40% by 2030, from 2006 levels. With on-road transportation accounting for over one-third of Greenhouse Gas (GHG) annual emissions in the State, MDOT worked closely with MDE and other key partners to identify strategies within the GGRA Plan that will reduce emissions from the transportation sector. Several strategies focused on the deployment of Zero Emission Vehicles (ZEVs) and ZEV infrastructure in the State.

The State is engaged in transitioning portions of its vehicle fleet to ZEVs. The emissions reduction benefits associated with this transition will assist with meeting the goals laid out in the GGRA Plan. Legislation passed in 2021 and 2022 further clarified funding allocations and reporting and tracking requirements associated with this transition. The Climate Solutions Now Act of 2022 called for 100% of the State's passenger fleet to be ZEVs by 2031, and 100% of other light-duty vehicles to be ZEVs by 2036.

Sustainability and Resilience Programs (at MDOT and at other State Agencies)

MDOT MTA Transit Roots: Sustainability Program
MDOT MTA developed and manages the Transit Roots: Sustainability Program to continuously enhance its world-class transit service and help balance the needs of a community's quality of life, environmental health, and a robust economy. One of the goals of the 2018 Sustainability Plan was to improve air quality by measuring the percentage of renewable energy consumed and the amount of greenhouse gases emitted.

MDOT MPA Sustainability Strategy
The MDOT MPA's Safety, Environment and Risk Management (SERM) office is responsible for compliance related to the landslide movement of cargo at the six public terminals owned by the State of Maryland. SERM is committed to implementing MDOT MPA's fundamental principle that stewardship, environmental and economic sustainability, and protecting its employees and public health are essential components of its mission. The Strategy describes the actions that SERM will take over the next three years in its four primary focus areas: Safety and Risk Management, Air and Energy Management (technologies and practices to reduce GHG and diesel emissions to "near zero"), Water Quality, and Stakeholder Engagement.

MDOT MAA Sustainability Plan – Green Promotion and Reporting Program
The MAA Green Report describes the steps MDOT MAA is taking to promote environmental stewardship and conservation and implement sustainability in their owned and operated facilities. MDOT MAA has an Air Quality Management Plan which identifies and tracks the various sources of air emissions directly and indirectly generated by the airport. MDOT MAA

has worked on a variety of projects within the last few years that improve air quality. These include optimization of preventative maintenance programs for stationary sources; the installation of new high-efficiency boilers that consume less fuel and lowers emissions; electrification of aircraft gates at BWI Airport; installation of EV and DC Fast charging stations at the parking garages and lots; and prepared a White Paper on current fleet and the opportunities to increase the use of alternative fuel vehicles.

MDE Maryland Green Schools Award Program (MDGS)

MDGS allows schools and their communities to evaluate their efforts in environmental sustainability. Participating schools empower youth to make changes to reduce environmental impact, encourage sustainability and foster environmental literacy. One of the goals of the program includes responsible transportation which includes carpooling programs, walking field trips, and an annual "Walk to School" day.

DNR Resiliency Through Restoration Initiative

The Resiliency through Restoration Initiative supports restoration targeting, design and construction of nature-based projects, monitoring, adaptive management, community outreach and education – all activities necessary for community-driven restoration and resilience. The initiative is focused on reducing Maryland's vulnerabilities to climate change impacts and enhancing the resiliency of local economies; improving understanding of the community benefits of natural solutions through state and community-led monitoring and ecosystem service evaluation; elevating the use of and understanding of where nature-based practices are feasible and practical; and demonstrating and encourage public-private partnerships to support future private funding investments.

Living Shoreline and Wetland Installation in Anne Arundel County: The Maryland DNR announces resilient shoreline and wetland features are being installed at the West River United Methodist Center, a camp and outdoor recreation facility in southern Anne Arundel County. This innovative restoration project is located on the West River in an area vulnerable to flooding, erosion, and coastal storm impacts. An 885-linear-foot living shoreline with vegetated breakwater and cobble beach components is being constructed to address rising tides, replace a failing bulkhead, enhance wildlife habitat, and help protect infrastructure from storm surge and coastal impacts. These natural features are complemented by 430 linear feet of regenerative stormwater conveyance wetland, designed to safely convey stormwater through the campus and to the shoreline.

DNR Green Infrastructure Resilience Program

The Green Infrastructure Resilience program helps local governments assess their stormwater and riparian flooding hazards and evaluate how green infrastructure practices can improve their resilience. Green infrastructure practices are those that allow water to infiltrate in place, such as rain gardens, bioretention facilities, bioswales, and infiltration trenches.

The Green Infrastructure Resilience program provides funding to help local governments perform the evaluations needed to understand their stormwater and riparian flooding risks and plan to effectively address them. Project examples include performing hydrological assessments, assessing flooding hazards and existing stormwater infrastructure to identify system improvements, evaluating how flood risks may be impacted by projected changes in precipitation patterns, investigating how green infrastructure practices could address flooding scenarios, and developing a prioritized plan for green infrastructure implementation.

6.3.4 Port of Baltimore Initiatives

Baltimore's strategic Mid-Atlantic inland location, 150 miles further inland than any other Mid-Atlantic port, means shorter distances between manufacturer, port and market, making exports a day closer. The Port of Baltimore's Public and Private Marine Terminals are close to I-95, the East Coast major north-south corridor, and I-70, the East-West connection. Cargo will reach 1/3 of the U.S. population and the industrial heartland within an overnight drive from The Port of Baltimore.

Interagency Voluntary Agreement

In 2021, the Maryland Department of the Environment Air and Radiation Administration (MDE ARA), MDOT, MDOT MPA, Maryland Department of the Environment (MDE), and Maryland Energy Administration (MEA) signed an Inter-Agency Air Quality Voluntary Agreement. The agencies have recognized the value of working together and are committed to pursuing mutually agreeable and cooperative efforts that will sustain and advance the economic health of the Port of Baltimore and protect the environment of the State of Maryland.

Since 2008, the Port of Baltimore has received $15 million in EPA grants to upgrade and buy new equipment and vehicles. In addition, the POB Diesel Equipment Replacement Program has achieved over 5,100 tons of pollutant reductions. In 2022, the Port of Baltimore received a $1.8 million grant from EPA to fund its Diesel Equipment Upgrade Program. The funds will go towards replacing diesel-powered equipment with newer and cleaner machinery. By continually upgrading cargo handling equipment and heavy-duty diesel vehicles and adopting state-of-the-art operational technologies, the Port has ensured that emissions have dropped even as the Port's cargo numbers have steadily increased.

Drayage Truck Replacements Program

As part of the MPA's "Green Port of Baltimore" initiative, MDOT MPA is working to reduce emissions from diesel engines serving the Port of Baltimore. Dray trucks are the oldest and often most polluting class 8 vehicles serving the Port. Typically, these vehicles are not replaced until they no longer run. Their long service life delays the introduction of cleaner, newer heavy-duty diesel engines meeting EPA's most stringent engine emission standards. The goal of the "Port of Baltimore Dray Truck Replacement Program" is to reduce air pollution and greenhouse gases from dray trucks transporting goods to and from the Port of Baltimore. The program provides applicants with funding for the purchase of a newer truck with an engine that meets more stringent emissions standards and requires scrappage of the old truck. Replacement trucks are funded with federal, state, and owner funds.

The Port's Dray Truck Replacement Program, initiated in 2012, has replaced more than 250 trucks with cleaner, modern vehicles with the help of federal and state grants such as the U.S. Environmental Protection Agency's Diesel Emissions Reduction Act (DERA). In addition, about 100 pieces of diesel cargo-handling equipment such as forklifts, top loaders, locomotives, and tugs have been replaced or retrofitted.

6.3.5 Regional Forest Canopy Program: Conservation, Restoration, and Expansion

Expanded tree canopy cover is an innovative voluntary measure proposed to improve the air quality in the state. Trees reduce ground-level ozone concentrations by:

1) reducing air temperatures and reducing energy used for cooling, and
2) directly removing ozone and NOx from the air.

Modeling has clearly shown that trees reduce ozone levels. In addition, trees in an urban setting have far-reaching water quality (e.g. decreasing storm water runoff), habit and societal benefits. To achieve a reduction in ground-level ozone under a tree canopy program, it will be necessary to preserve the current canopy and plant and maintain a significant number of new trees.

The current Cecil County tree canopy is composed of mixed native hardwoods and urban plantings. On average these species require 30 years to mature so the short term benefits of a tree program are not substantial yet still significant. To achieve area wide canopy expansion will require long-term commitment by the state and local agencies, volunteer organizations, and private landowners.

While Maryland has over 40 state programs that support, encourage or require the planting of trees five of these tools are of special importance for implementation at the local level:

- Forest Conservation Act
- Critical Areas Act
- Mitigation Requirements
- Comprehensive Plans Requirements
- Urban and Community Forestry Programs

Special attention will be paid to how these programs can be coordinated with new local ordinances and initiatives to enhance their use in tree protection, canopy preservation and expansion to achieve regional air quality goals.

7.0 REASONABLY AVAILABLE CONTROL MEASURE (RACM) ANALYSIS

Section 172(c)(1) of the Clean Air Act (CAA or "the Act") requires State Implementation Plans (SIPs) to include an analysis of Reasonably Available Control Measures (RACM). This analysis is designed to ensure that the Cecil County portion of the Philadelphia 8-hour Ozone Nonattainment Area is implementing all reasonably available control measures in order to demonstrate attainment with the 8-hour ozone standard on the earliest date possible. This chapter presents a summary of analyses conducted to determine whether the SIP includes all Reasonably Available Control Measures. Full details of the analysis are included in Appendix D.

The Maryland Department of the Environment (MDE) has prepared this RACM analysis building off of previously developed lists of potential control measures for the Washington, DC, Baltimore, and Cecil County nonattainment areas, as well as RACM analyses from other states and Clean Air Act Section 108(f) measures. MDE worked very closely with various stakeholders in Maryland area to develop and evaluate potential control measures. Over 100 measures were individually evaluated against established RACM criteria (the criteria are explained below).

Additionally, during the spring and summer of 2022, MDE organized a series of regional calls with transportation stakeholders in Maryland, including Maryland Department of Transportation (MDOT), Baltimore Regional Transportation Board (BRTB), and Baltimore Metropolitan Council (BMC). This analysis yielded 92 transportation-related control measures that were evaluated. As explained below, based on the criteria used for RACM, none of these measures are considered RACM, but these measures shall be kept on a short list of measures if the region needs additional reductions in the future.

At the completion of the RACM analysis, it was determined that no measures met the criteria.

7.1 ANALYSIS OVERVIEW AND CRITERIA

The RACM requirement is rooted in Section 172(c)(1) of the Clean Air Act, which directs states to "provide for implementation of all reasonably available control measures as expeditiously as practicable." In 1992, EPA published general guidance (the "General Preamble") describing how it intended to implement the state implementation plan requirements of Title I of the CAA, including RACM analysis requirements.[34]

In the General Preamble, EPA explains that it interprets Section 172(c)(1) as a requirement that states incorporate in a SIP all reasonably available control measures that would advance a region's attainment date. However, regions are obligated to adopt only those measures that are reasonably available for implementation in light of local circumstances. EPA has noted that

[34] State Implementation Plans; General Preamble for the Implementation of Title 1 of the Clean Air Act Amendments of 1990, 57 Fed. Reg. 13498 (April 16, 1992).

its interpretation of the RACM requirement would not require the adoption of measures if they would not advance the attainment date or would cause adverse economic or other impacts. States should consider "technological feasibility and the cost of control in the area to which the SIP applies" when evaluating measures.[35] Additionally, EPA indicated that it "…does not believe that Congress intended the RACM requirement to compel the adoption of measures that are absurd, unenforceable, or impracticable."[36]

In its opinion on *Sierra Club v. EPA,* decided July 2, 2002, the U.S. Court of Appeals for the DC Circuit upheld EPA's definition of RACM, including the consideration of economic and technological feasibility, ability to cause substantial widespread and long-term adverse impacts, collective ability of the measures to advance a region's attainment date, and whether an intensive or costly effort will be required to implement the measures.[37]

In order to be considered RACM, measures must meet the following criteria:

- Will reduce emissions by the 2022 ozone season
- Enforceable
- Technically feasible
- Economically feasible (proposed as a cost of <u>$1,800</u> per ton or less)
- Will not create substantial or widespread adverse impacts within the region
- Emissions from the source being controlled exceed a *de minimis* threshold, proposed as 0.1 tons per day

An explanation of these criteria is given in succeeding sections.

7.1.1 Implementation Date

EPA has traditionally instructed regions to evaluate RACM measures on their ability to advance the region's attainment date. This means that implementation of a measure or a group of measures must enable the region to reduce ozone levels to the 70 ppb required to attain the eight-hour ozone standard at least one year earlier than expected. As Cecil County currently expects to reduce ozone levels to 70 ppb during the 2023 ozone season, any RACM measures must enable the region to meet the 70 ppb standard by the 2022 ozone season.

7.1.2 Enforceability

When a control measure is added to a SIP, the measure becomes legally binding, as are any specific performance targets associated with the measure. If the state or local government does not have the authority necessary to implement or enforce a measure, the measure is not creditable in the SIP and therefore cannot be declared a RACM. A measure is considered enforceable when all state or local government agencies responsible for funding,

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[35] 57 Fed. Reg. 13498

[36] 57 Fed. Reg. 13498

[37] 294 F.3d 155 (D.C. Cir. 2002)

implementation, and enforcement of the measure have committed in writing to its implementation and enforcement by adopting statutes, regulations, or ordinances and appropriating funding for such implementation and enforcement.

In addition to theoretical enforceability, a measure must also be practically enforceable. If a measure cannot practically be enforced because the sources are unidentifiable or cannot be located, or because it is otherwise impossible to ensure that the sources will implement the control measure, the measure cannot be declared a RACM. One exception is innovative and supplemental measures, such as those measures implemented under EPA's Voluntary Measures Guidance described in Section 6.3.

7.1.3 Technological Feasibility

All technology-based control measures must include technologies that have been verified by EPA. The region cannot take SIP credit for technologies that do not produce EPA-verified reductions.

7.1.4 Economic Feasibility and Cost Effectiveness

EPA guidance states that regions should consider both economic feasibility and cost of control when evaluating potential RACM measures. Therefore, MDE has specified a cost-effectiveness threshold for all possible RACM measures. Measures for which the cost of compliance exceeds this threshold will not be considered RACM.

A subset of RACM is the Reasonably Available Control Technology (RACT) requirements.[38] EPA states:

> *EPA has defined RACT as the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.*[39]

The region examined EPA guidance, as well as state/federal cost-effectiveness thresholds. EPA's Cross-State Air Pollution Rule (CSAPR), CSAPR Update, Revised CSAPR Update (RCU), and Proposed FIP for the 2015 Ozone NAAQS considers reasonable cost effectiveness thresholds between $500-$11,000 per ton of NOx; most recently EPA has settled on a cost of $1,400-$1,800 per ton.[40]

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[38] Connecticut's State Implementation Plan 8-Hour Ozone Attainment Demonstration (for the 1997 NAAQS), Chapter 6: Reasonably Available Control Measures (RACM) Analysis https://portal.ct.gov/-/media/DEEP/air/regulations/proposed_and_reports/Section6pdf.pdf

[39] 44 FR 53762; September 17, 1979

[40] 76 FR 48250, 81 FR 74508, 86 FR 23058, 87 FR 20091

The State of Maryland proposes for Cecil County, a cost threshold of $1,800 per ton for this RACM analysis.

7.1.5 SUBSTANTIAL AND WIDESPREAD ADVERSE IMPACTS

Some candidate RACM measures have the potential to cause substantial and widespread adverse impacts to a particular social group or sector of the economy, including communities with environmental justice concerns. Accordingly, measures that cause substantial or widespread adverse impacts will not be considered RACM.

7.1.6 *DE MINIMIS* THRESHOLD

In the General Preamble, EPA states that "If it can be shown that one or more measures are unreasonable because emissions from the sources affected are insignificant (i.e., de minimis), those measures may be excluded from further consideration as they would not represent RACM for that area."[41]

The smallest major stationary source subject to RACT emits 25 tpy, or approximately 0.1 tpd[42]. Following these requirements and the precedent set by the San Francisco RACM analysis[43], the region will not consider control measures affecting source categories that produce less than 0.1 tpd NOx or VOC emissions.

7.1.7 ADVANCING ACHIEVEMENT OF 70 PPB STANDARD

In order for measures to be collectively declared RACM, implementation of the measures must enable the region to demonstrate attainment of the 70 ppb ozone standard one full ozone season earlier than currently expected. As discussed in this SIP document and the relevant appendices , Cecil County currently expects to demonstrate attainment in 2023. Therefore, any RACM measures would need to enable the region to meet the 70 ppb standard by the 2022 ozone season.

7.1.8 INTENSIVE AND COSTLY EFFORT

EPA has stated in the General Preamble that the RACM evaluation should "consider the impact of the reasonableness of the measures on the municipal or other governmental entity that must bear the responsibility for their implementation."[44] When considered together, the implementation requirements of any RACM measures cannot be so great as to preclude

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[41] 57 Fed. Reg. 13498

[42] 57 Fed. Reg. 13498

[43] SAN FRANCISCO BAY AREA OZONE ATTAINMENT PLAN FOR THE 1-HOUR NATIONAL OZONE STANDARD (OCTOBER 24, 2001), APPENDIX C: REASONABLY AVAILABLE CONTROL MEASURE ANALYSIS https://www.baaqmd.gov/~/media/files/planning-and-research/plans/2001-ozone-attainment-plan/oap_2001.pdf

[44] 57 FR 13498

effective implementation and administration given the budget and staff resources available to Cecil County.

7.2 RACM MEASURE ANALYSIS

7.2.1 ANALYSIS METHODOLOGY

The sources of strategies analyzed for Cecil County include the following:

- Clean Air Act Section 108(f) measures (Transportation Control Measures)
- Measures considered in previous RACM analyses for Baltimore, Washington DC, and Cecil County
- Measures considered in California, Utah, Oregon, New Jersey, Texas, Pennsylvania, Connecticut, Delaware, Indiana, and Massachusetts, as well as the Ozone Transport Committee

These measures were then evaluated against the aforementioned criteria. More details on the analysis methodology are included in Appendix D.

7.2.2 ANALYSIS RESULTS

Appendix D provides lists (in tabular form) organized by source-sector of potential measures evaluated against the RACM criteria. Each RACM criteria was reviewed for each individual measure identified on the lists.

Based on this analysis, none of the measures reviewed were identified as RACM for the Cecil County portion of the Philadelphia 8-hour Ozone Nonattainment Area.

7.3 RACM DETERMINATION

Despite not meeting the criteria for RACM, many of these measures are worthwhile measures that reduce emissions. These measures will be considered potential control measures should the state need further emissions reductions in the future.

8.0 TRANSPORTATION CONFORMITY

Transportation conformity ("conformity") is a provision of the Clean Air Act (CAA) that ensures that federal funding and approval goes to those transportation activities that are consistent with air quality goals. Conformity applies to transportation plans and projects funded or approved by the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA) in areas that do not meet or previously have not met air quality standards for ozone, carbon monoxide, particulate matter, or nitrogen dioxide.

In order to balance growing metropolitan regions and expanding transportation systems with improving air quality, the U.S. Environmental Protection Agency (EPA) established regulations ensuring that enhancements to existing transportation networks will not impair progress towards air quality goals. ***Under the Clean Air Act Conformity Regulations, transportation modifications in a nonattainment area must not impair progress made in air quality improvements.*** These regulations, published in EPA's Transportation Conformity rule on November 24, 1993 in the Federal Register and amended in a final rule signed on July 31, 1997, require that transportation modifications "conform" to air quality planning goals established in air quality SIP documents. The 1997 amendments were followed by further amendments in 2002 and 2004.

This SIP submission includes Mobile Vehicle Emissions Budgets (MVEB or “mobile budgets” or “budgets”) for Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC). These mobile budgets, once found adequate by EPA, shall be used in all conformity documents for Cecil County. In order for a transportation plan to “conform,” the estimated emissions from the transportation plan cannot exceed the mobile budgets set via this SIP submission. If the estimated emissions are shown to exceed the budget, then mitigation measures must be taken to ensure emissions will not exceed the budgets.

The MVEB, therefore, provides a limit or ceiling on the amount of emissions transportation sources can produce in a given area that is consistent with attainment, Reasonable Further Progress (RFP), or maintenance. The MVEB acts as the federally enforceable cap/control measure on the on-road mobile transportation source sector.

Responsibility for Making a Conformity Determination

The policy board of a Metropolitan Planning Organization (MPO), in consultation with the Maryland Department of Transportation (MDOT) and Maryland Department of the Environment (MDE), is responsible to formally make a conformity determination on its transportation plans and Transportation Improvement Programs (TIPs) prior to submittal to the FHWA and FTA for review. EPA also may review and comment on proposed conformity determinations.

If a particular transportation plan’s projected emissions exceed the MVEB, the MPO has a variety of mitigation options to reduce emissions. These may include, but are not limited to, specific transportation emission reduction measures, such as High Occupancy Vehicle (HOV) lanes, transit enhancements, bicycle lanes, diesel retrofits, and idling reductions. Thus, the mobile budgets are the only federally enforceable emission limits placed on the source sector.

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) was enacted on August 10, 2005. Under this act, amendments were made to the transportation conformity rules (Section 6011 of the Act), which required states that have nonattainment areas like Maryland to revise their existing transportation conformity SIPs. Maryland submitted a revised transportation conformity SIP to EPA in February of 2007. Because of changes mandated by SAFETEA-LU, conformity determinations have to be done at least every four years instead of the previous three years.

When a positive conformity determination is not made according to the required frequency, or in the event that emission mitigation can't be agreed upon, a nonattainment area is in conformity "lapse." This means that federal transportation funds allocated to the state, which contains the lapsed nonattainment area, can only be used for the following kinds of projects:

1. Transportation Control Measures (TCM) in Approved SIPs;
2. Non-Regionally Significant Non-federal Projects;
3. Regionally Significant Non-federal Projects - only if the project was approved by all necessary non-federal entities before the lapse. (See Approval of a Regionally Significant Non-Federal Project by a Non-Federal Entity later in this Chapter.)
4. Project phases (i.e., design, right-of-way acquisition, or construction) that received funding commitments or an equivalent approval or authorization prior to the conformity lapse.
5. Exempt Projects - identified under 40 CFR §93.126and 40 CFR §93.127; and,
6. Traffic Synchronization Projects - however, these projects must be included in subsequent regional conformity analysis of MPO's transportation plan/TIP under 40 CFR §93.128.

The amount of federal funding a state receives is not reduced, but such funds are restricted until the area can again demonstrate conformity. Federal funding is then tied to the MVEB, acting as a compliance mechanism for the control measure.

8.1 CECIL COUNTY, MD MOBILE EMISSIONS BUDGET & THE WILMAPCO TRANSPORTATION CONFORMITY PROCESS

Mobile source emissions in the Long Range Transportation Plan (LRTP) and the shorter term Transportation Improvement Program (TIP) cannot exceed the mobile emissions budget. The transportation plans are required to conform to the mobile budget established in the SIP for the short-term TIP years, as well as for the forecast period of the long-range plan, which must be at least twenty years.

In Cecil County, modifications to the existing transportation network are advanced through the Wilmington Area Planning Council (WILMAPCO) by state, regional, and local transportation agencies through periodic updates to the LRTP and TIP. The TIP is updated annually for the

Wilmington, Delaware region, which includes Cecil County, and includes transportation modifications and improvements on a four-year program cycle. Pursuant to the conformity regulations, the LRTP and TIP must contain analyses of the motor vehicle emissions estimates for the region resulting from the transportation improvements. These analyses must show that the transportation improvements in the TIP and the LRTP do not result in a deterioration of (conform to) the air quality goals established in the SIP.

8.2 BUDGET LEVEL FOR ON-ROAD MOBILE SOURCE EMISSIONS

As part of the development of the SIP, MDE, in consultation with the Wilmington Area Planning Council (WILMAPCO), establishes a mobile source emissions budget. This budget will be the benchmark used to determine if the region's long-range transportation plan (LRTP) and four-year transportation improvements program (TIP) conform to the SIP. Under EPA regulations, the projected mobile source emissions for 2023 (for purposes of meeting the CAA requirements related to reasonable further progress) become the mobile emissions budgets for the region unless MDE takes actions to set other budget levels.

Modeling and Data
The 2017 and 2023 mobile emissions inventories are calculated using the following models and tools: EPA's MOVES3 and the Highway Performance Monitoring System (HPMS) model. A detailed explanation of the model and the emission estimating methodology can be found in Appendix E.

Attainment Year Mobile Budgets
The 2023 Mobile Vehicle Emissions Budgets are based on the projected 2017 mobile source emissions accounting for all mobile control measures plus a safety margin. Federal regulations provide for establishing a "buffer"/"safety margin" in mobile emissions budgets. The emissions resulting from the output of the 2023 MOVES3 model are the lowest values that a MVEB could be set at for the source sector under the conditions inputted into the MOVES3 model. Buffers or safety margins are necessary to ensure future transportation projects can meet the MVEB. Regardless of whether the MVEBs are established with a safety margin or not, the MVEBs are the only federally enforceable limit placed on the source category.

The MVEBs shown in table 8-1 contain buffers of approximately 25% for VOC emissions and 25% for NOx emissions.

Table 8-1: 2023 Attainment Year Mobile Vehicle Emission Budgets for the Cecil County portion of the Philadelphia Nonattainment Area

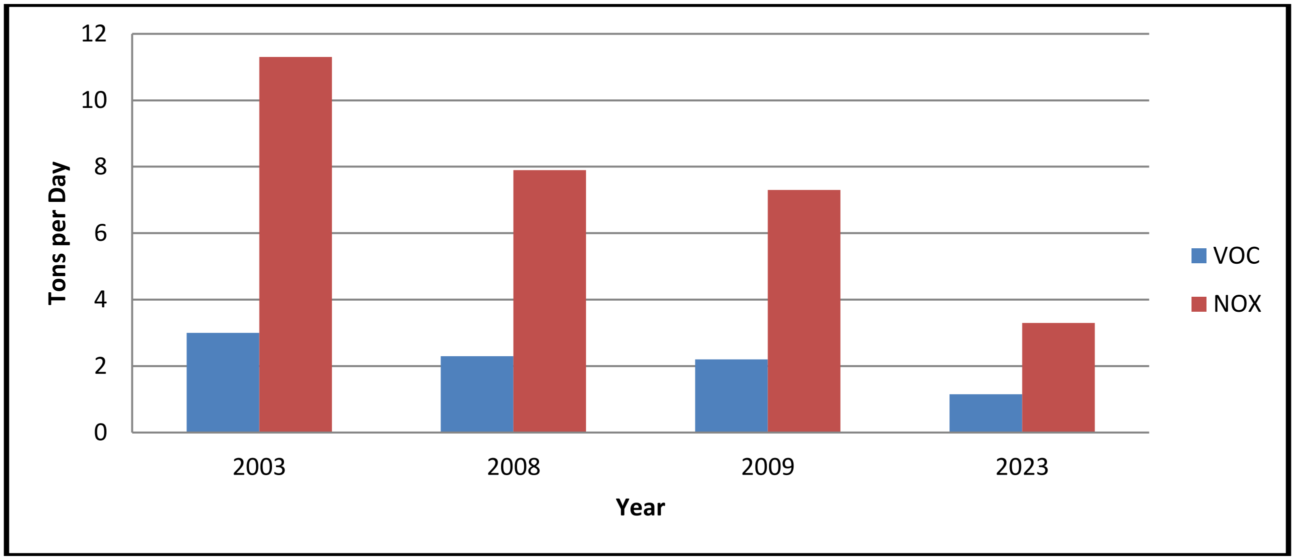
Pollutant	Mobile Source Emission Budget
VOC (TPD)	1.15
NOx (TPD)	3.30

Mobile source emissions in the Long Range Transportation Plan (LRTP) and the shorter term Transportation Improvement Program (TIP) cannot exceed the mobile emissions budget. These plans are required to conform to the budgets for VOC and NOx listed in table 8-1.

8.3 TRENDS IN MOBILE EMISSIONS

The mobile emissions budgets for 2023 for VOCs and NOx reflect a continuation of a downward trend in mobile emissions over time. The VOC and NOx emission levels for mobile sources provided in Section 8.2 are lower than the most recently approved mobile budgets for Cecil County.

Figure 8-1: Historic and Current Mobile Emissions Budgets for NOx – Cecil County



The steady reductions in mobile emissions in Maryland are attributable largely to a series of increasingly stringent federal regulations requiring cleaner vehicles and fuels, including the federal Tier II regulations for motor vehicles and Maryland's adoption of California's low emissions vehicle program. Trends toward reduced mobile emissions are occurring despite the negative effects of a shift toward the use of higher-emitting, less fuel-efficient sport utility vehicles instead of passenger cars and a steady increase in population, employment, and Vehicle Miles Traveled (VMT) in Cecil County.

The trends of increasing population and VMT are expected to remain strong well beyond 2023. As stated in WILMAPCO's 2050 Long Range Transportation Plan,[45] the region's population is expected to increase 11% by 2050. This net population growth will stress the area's transportation system. If no improvements are made, highway congestion can be expected to

[45] "2050 Regional Transportation Plan", Key Successes and Challenges. Wilmington Area Planning Council. http://www.wilmapco.org/Rtp/2050/2050RTP.pdf

increase by 77%. Some of that congestion will be created by additional truck traffic, which is forecasted to grow by 80%.

These trends, however, will not reverse the expected decline in regional mobile emissions resulting from cleaner fuels and improved vehicle technology. The recent Tier II passenger vehicle standards and regulations on emissions from heavy-duty diesel vehicles and fuels are expected to produce further dramatic reductions in VOC and NOx emissions as vehicles are replaced and retrofitted over the next 20 years. Nevertheless, it is important to keep in mind that despite cleaner fuels and improved vehicle technology, the relationship between land use planning, transportation, and air quality is important for long-term air quality goals.

9.0 CONTINGENCY MEASURES

9.1 PURPOSE OF SECTION

This section demonstrates that the Cecil County portion of the Philadelphia Nonattainment Area meets the requirements for State Implementation Plan (SIP) contingency measures related to both Reasonable Further Progress (RFP) and to the attainment of the ozone standard. If implemented, the contingency measures discussed in this section would result in reductions in addition to those required to demonstrate RFP (discussed in Section 5) and in addition to those that are accounted for in the attainment demonstration (discussed in Sections 5-7). Contingency measures ensure that if the Philadelphia Nonattainment Area fails to achieve the required RFP reductions by the RFP milestone year or fails to attain the ozone standard by attainment year, additional reductions will occur without further state or federal action.

9.2 CONTINGENCY REQUIREMENTS OVERVIEW

Section 172(c)(9) of the CAA and EPA's Phase 2 Rule require that nonattainment areas include contingency measures in their RFP and attainment SIPs. If a state receives a notification from the Environmental Protection Agency (EPA) that a nonattainment area within its borders has failed to achieve the level of reductions demonstrated in the RFP SIP by the milestone year or has failed to attain the standard by the attainment date, the area must be able to implement contingency measures within one year after EPA's notice.

Several recent court cases impact the construction and implementation of contingency measures in an attainment SIP. Since EPA has not provided any guidance to the States that reflects the ramifications to contingency requirements from these court decisions, but will hold the SIPs accountable nevertheless, a short summary of each court is necessitated.

On Friday Jan. 29, 2021, the United States Court of Appeals for the D.C. Circuit in *Sierra Club v. EPA*, Case No. 15-1465, 2021 WL 7210058, struck down several provisions in EPA's 2018 rule implementing the 2008 National Ambient Air Quality Standards (NAAQS) for ozone (the 2018 Implementation Rule) under the Clean Air Act (CAA). The court vacated three provisions of this rule, including (1) the ozone precursor inter-pollutant trading (IPT) program; (2) an option for states to demonstrate reasonable further progress of NAAQS attainment through compliance with control measure requirements, rather than models based on actual emissions data; and (3) a provision allowing states to include already implemented measures as contingency measures in their state implementation plans (SIP). The court's opinion vacating these three provisions has important implications for Maryland as it continues to confront ozone nonattainment.

Vacating the provision allowing states to include already implemented measures as contingency measures has the foremost implication in that a *separate* control program/measure/regulation/ restriction must be developed that is "triggered" by a failure to meet the standard by the attainment date or failure to achieve the required RFP reductions.

On Aug. 26, 2021, the Ninth Circuit issued its decision in *Association of Irritated Residents v. EPA*, 10 F.4th 937 (9th Cir. 2021)reversing EPA's approval of California's non-attainment ozone SIP in the San Joaquin Valley, finding defects with the contingency measures.[46] In the past, EPA required contingency measures to be approximately equal to the emissions reductions necessary to demonstrate reasonable further progress for one year, which for ozone, amounts to reductions of 3% of the baseline emissions inventory for the non-attainment area. Nevertheless, EPA approved California's SIP, which contained a single contingency measure that would reduce ozone emissions by one ton per day when one year's worth of reasonable further progress emissions was approximately 11.4 tons per day. EPA argued the CAA does not specify the quantity of emission reductions a contingency measure must achieve, and therefore, does not guide nor bind EPA in approving contingency measures. The court concluded "EPA still must give a reasoned explanation for departing from agency practice or policy" and "[b]ecause the agency did not provide a reasoned explanation for approving the state plan, the rule is arbitrary and capricious." As a result, states will need to include contingency measures that provide a sufficient quantity of emission reductions in its SIP or better justify a lesser quantity of emission reductions.

A related, but separate question from *Irritated Residents* that arose before the Ninth Circuit in *Bahr v. Regan*, 6 F.4th 1059 (9th Cir. 2021), was if EPA properly applied its 2016 Exceptional Events Rule in determining the Phoenix-Mesa area was in attainment with the applicable ozone NAAQS. In submitting its ozone SIP, the Arizona Department of Environmental Quality (ADEQ) sought to exclude exceedances caused by the 2015 Lake Fire in southeastern California through an exceptional events demonstration. EPA agreed with ADEQ's request. Petitioners challenged EPA's decision, arguing ADEQ had not established a clear causal connection between the 2015 Lake Fire and the subsequent ozone exceedances.

In *Bahr,* the ADEQ submitted to EPA (1) trajectory analyses, (2) satellite photos of the area revealing visible smoke plumes, (3) National Oceanic and Atmospheric Administration (NOAA) smoke contour maps, and (4) other evidence to demonstrate a clear causal connection between the wildfires and the NAAQS exceedances. The court concluded the petitioners failed to produce evidence sufficient to demonstrate a lack of causal connection, deferring to ADEQ and EPA's technical determinations.

The cases carry important implications for any state confronting a NAAQS non-attainment area. Following *Sierra Club v EPA* and *Irritated Residents v. EPA*, EPA will likely scrutinize contingency measures more carefully, which could result in states looking for additional contingency measure reductions from regulated industries. Meanwhile, the *Bahr* decision is an important marker for judicial deference to EPA in making exceptional events demonstrations, which is likely to be an important consideration in non-attainment demonstrations given recent wildfire activity. The more an area gets out of attainment, even from biogenic sources, such as wildfires, the more difficult it becomes to find reduction measures.

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[46]Association of Irritated Residents v. United States Environmental Protection Agency, No. 19-71223 (9th Cir. 2021)

In contrast to the *Irritated Residents* case, Maryland is submitting a SIP containing contingency measures representing one year's worth of progress, amounting to 3% of the 2023 VOC emission inventory for the non-attainment area. The contingency reductions are in addition to the reductions required to demonstrate RFP and in addition to the reductions considered in the attainment demonstration.

9.3 CONTINGENCY

9.3.1 RFP CONTINGENCY

As discussed in Sections 5 through 7, Maryland Department of the Environment (MDE) is meeting the RFP requirement to reduce emissions by 15 percent between the years 2017 to 2023 through a combination of reductions of NOx and VOCs.

Should these measures fail to achieve the required RFP reductions, contingency measures are required to be implemented without further state or federal action that provide additional reductions from control measures that satisfy the court's orders and provisions.

9.3.2 ATTAINMENT CONTINGENCY

EPA will assess whether the Philadelphia Nonattainment Area has attained the standard, presumably based on measured ozone readings from the region's air quality monitors for the 2021 – 2023 time period. If the area is not meeting the standard based on design values for the 3-year period, EPA may issue a notification of failure to attain. The notification will trigger a requirement for MDE to implement contingency reductions. For purposes of this contingency analysis, MDE is assuming that EPA would issue the notice in June 2024 and that the contingency measures would need to be in place at that time (June 2024). Therefore, to meet the attainment contingency requirement, MDE must identify a control measure(s) that will achieve additional reductions in emissions and will be effective without any further state or federal action.

9.3.3 CONTINGENCY REDUCTION AMOUNT

The recommended amount of additional reductions that must be achieved in order to meet the attainment contingency requirement without further justification is 3% of the 2017 VOC Adjusted Base Year Inventory Calculated Relative to 2023. The amount of reductions is shown below.

Table 9-1: Recommended Reductions for Contingency without Further Justification

	Target Levels 2023 (TPD)		3% of 2023 VOCs = Recommended Contingency Reduction Without Further Justification
	VOC	NOx	
Cecil County	6.16	7.81	0.18

The contingency measures to address failure to achieve RFP must be for VOC, while the contingency measures for failure to attain may be for VOC or NOx. While the total recommended reductions (3%) are calculated as a percentage of the 2023 VOC emissions, NOx reductions can be used as a direct substitute for VOC reductions if the area fails to attain the standard.[47]

EPA's Office of General Counsel determined that States must adopt a minimum of 0.3 percent in VOC measures of the 3 percent contingency measure requirement to be legally defensible. Therefore, in an area that has demonstrated that NOx controls are needed for attainment, 2.7 percent of the required 3 percent could be NOx contingency measures. Therefore, only 10% (0.3/3 = 0.1 or 10%) of the reductions achieved by the contingency measures must be VOCs; this equates to 0.06 TPD in Cecil County. Correspondingly 90% (2.7/3 = 0.9 or 90%) of the reductions could be NOx.

Maryland opted to exceed the 10% minimum for VOC and is using 30% of the contingency tonnage on VOC reductions and 70% for NOx.

Table 9-2: Minimum and Actual VOC Reductions Required for Attainment Contingency

Pollutant	Total Reductions Recommended for Contingency without Further Justification	Minimum Pollutant Percentage / Tonnage	Actual Pollutant Percentage Taken	Contingency Amount per Pollutant (tpd)
VOC	0.185	10% - .0185	30%	0.055
NOx	0.185	90% - 0.166	70%	0.129

9.3.4 Maryland Contingency Demonstration

MDE will meet this attainment contingency requirement by lowering the motor vehicle emissions conformity budget should the area fail to attain the standard.

[47] Guidance on Issues Related to 15 Percent Rate-of-Progress Plans https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19930823_shapiro_15pct_rop_guidance.pdf

The State air quality agency is responsible for the development of the entire SIP. The air quality agency identifies how pollution from all sources will be reduced sufficiently to meet the federal air quality standards. As part of this process, the motor vehicle emissions budget is developed. Transportation agencies, including state DOTs and MPOs, consult with the air quality agency on the development of the SIP and motor vehicle emissions budget.

The SIP accounts for emissions of each pollutant for each source type. There are three types of sources: mobile (on-road and non-road), stationary (ex: refineries), and area (ex: dry cleaners). Required emission reductions are calculated, and control measures are adopted to achieve needed reductions. This reduced level of emissions is used to set a limit for motor vehicle emissions, which are called "budgets."

In order to balance growing metropolitan regions and expanding transportation systems with improving air quality, EPA established regulations ensuring that enhancements to existing transportation networks will not impair progress towards air quality goals. ***Under the Clean Air Act Conformity Regulations, transportation modifications in a nonattainment area must not impair progress made in air quality improvements.*** These regulations, published in EPA's Transportation Conformity rule on November 24, 1993 in the Federal Register and amended in a final rule signed on July 31, 1997, require that transportation modifications "conform" to air quality planning goals established in air quality SIP documents. The 1997 amendments were followed by further amendments in 2002 and 2004.

A budget provides a limit or ceiling on the amount of emissions transportation sources can produce in a given area that is consistent with attainment, RFP, or maintenance.

The transportation conformity rule (40 CFR parts 51 and 93), requires areas to demonstrate that projected emissions from the planned transportation system do not exceed the budgets established in the applicable SIP. If on-road motor vehicle emissions of one or more pollutant precursors are determined through the SIP development process to be significant contributors to an area's nonattainment problem, an emissions budget for each significant precursor must be established in the SIP.

The motor vehicle emission budgets, therefore, are developed in the SIP in consultation with transportation officials and are the federally enforceable limit on the onroad motor vehicle source category through the conformity process. A conformity determination is a demonstration that the emissions from travel on an area's transportation system are consistent with goals for air quality found in the SIP. All conformity demonstrations are evaluated against the emissions budget with the budget as the ceiling.

The MVEBs with a buffer, established in this SIP, meet the Clean Air Act Conformity Regulations that transportation modifications in a nonattainment area must not impair progress made in air quality improvements.

A new MVEB, presented in the table below, has been established that lowers the mobile emission budget and will be “triggered” by a failure to attain the standard. The regulation meets the courts requirements for contingency measures.

- The regulation is a new measure not included in the SIP and therefore is not an already implemented enforceable measure.
- The regulation provides a new federally enforceable emission limit/budget on a source category.
- The new regulation has a “trigger” mechanism consistent with contingency requirements.

Table 9-3: Mobile Budgets for Cecil County

Pollutant	MVEB*	Contingency MVEB**	Difference
VOC (TPD)	1.15	1.09	0.06
NOx (TPD)	3.30	3.17	0.13
TOTAL			**0.19**
Reductions Needed for Contingency			**0.18**

* Established in this SIP revision – Table 8.1
** Should EPA determine that the area fails to attain the 2015 standard

9.4 CONCLUSIONS

On and after 60 days following the effective date of the U.S. Environmental Protection Agency’s (EPA) final determination that one or both of the conditions described in Clean Air Act Sections 172(c)(9) or 182(c)(9) have occurred in the Philadelphia Ozone Nonattainment Area regarding the 2015 8-hour Ozone National Ambient Air Quality Standard, the Motor Vehicle Emissions Budget will be lowered to the Contingency MVEB level, shown in Table 9-3, requiring future transportation projects to be subject to the lower budgets.

The following tables demonstrate that the Cecil County portion of the Philadelphia Nonattainment Area has met the RFP contingency requirements. The tables show Cecil County meets the 3% conformity reduction in emissions using the Contingency MVEB in Table 8-1. As the 2023 controlled emissions are even lower the overall controlled emission level is farther below the 15% 2023 target level emissions required by RFP.

Table 9-4: Contingency Measure Calculations

	VOC Target Level for 2023 Milestone Cecil County Maryland Emissions in Tons per Day		
		Formula	
A	2017 Base Year Inventory		26.88
B	Biogenic Emissions		20.10
C	2017 Rate-of Progress Base Year Inventory	A - B	6.77
D	FMVCP/RVP Reductions Between 2017 and 2023		0.00
E	2017 Adjusted Base Year Inventory Calculated Relative to 2023	C - D	6.77
F	Ratio		0.090 0
G	Emissions Reductions Required Between 2017 and 2023	E * F	0.61
H	Target Level for 2023 [$TL_{(2023)}$]	C - D - G	6.16
	Emission Level Obtained 2023 - Enforceable MVEB 1		6.06
	Emission Level Obtained 2023 - Enforceable MVEB 2 CM Applied		6.00

	NOx Target Level for 2023 Milestone Cecil County Maryland Emissions in Tons per Day		
		Formula	
A	2017 Base Year Inventory		9.31
B	Biogenic Emissions		0.82
C	2017 Rate-of Progress Base Year Inventory	A - B	8.48
D	FMVCP/RVP Reductions Between 2017 and 2023		0.00
E	2011 Adjusted Base Year Inventory Calculated Relative to 2018	C - D	8.48
F	Ratio		0.060 0
G	Emissions Reductions Required Between 2017and 2023	E * F	0.51
H	Target Level for 2023 [$TL_{(2023)}$]	C - D - G	7.98
	Emission Level Obtained 2023 - Enforceable MVEB 1		7.81
	Emission Level Obtained 2023 - Enforceable MVEB 2 CM Applied		7.68

10.0 ATTAINMENT DEMONSTRATION MODELING

The Cecil County portion of the Philadelphia-Wilmington-Atlantic City Nonattainment area (Philadelphia NAA) must demonstrate attainment of the 2015 ozone NAAQS by August 2024. The 8-hour Ozone Standard Attainment Demonstration analyzes the potential of the Philadelphia NAA to achieve attainment of the 8-hour ozone standard by the attainment date. The attainment demonstration is comprised of the following sections:

- 10.1 - Modeling Study Overview
- 10.2 - Model Platform Description
- 10.3 - Model Performance Evaluation
- 10.4 - Attainment Demonstration
- 10.5 - Procedural Requirements.

10.1 MODELING STUDY OVERVIEW

10.1.1 BACKGROUND AND OBJECTIVES

In 1997, the Environmental Protection Agency (EPA) reviewed the National Ambient Air Quality Standard (NAAQS) for ozone and recommended that the ozone standard be changed from 0.12 parts per million (ppm) of ozone measured over one hour, to a standard of 0.08 ppm measured over eight hours, with the average fourth highest concentration over a three-year period determining whether or not an area is in compliance. The one-hour standard was consequently revoked in June 2005. In 2008, EPA issued a revised and stricter ozone standard of 0.075 ppm, measured over an eight-hour period. In 2015, EPA again revised the ozone standard to a more protective level of 0.070 ppm or 70 parts per billion (ppb), measured over an eight-hour period.

In 2018, EPA designated the Philadelphia-Wilmington-Atlantic City area as a “marginal” nonattainment area for the 0.70 ppm 8-hour ozone standard under Subpart 2 of part D, Title I (Effective Date August 3, 2018)[48]. In 2022, EPA finalized an action that reclassified the Philadelphia Nonattainment area to “moderate” for the 0.70 ppm 8-hour ozone standard.[49]

As a result, the Philadelphia NAA is required to demonstrate attainment of the 8-hour ozone standard by the end of the 2023 ozone season using photochemical modeling.[50]

The objective of the photochemical modeling study is to enable the Maryland Department of the Environment (MDE) to analyze the efficacy of various control strategies and to demonstrate

[48] 83 FR 25776

[49] EPA-HQ-OAR-2021-0742

[50] The Philadelphia NAA is required to attain the 0.070 ppm ozone standard by August 2024. However, the region is required to demonstrate compliance of the standard by the end of the last *full* ozone season prior to the listed attainment date.

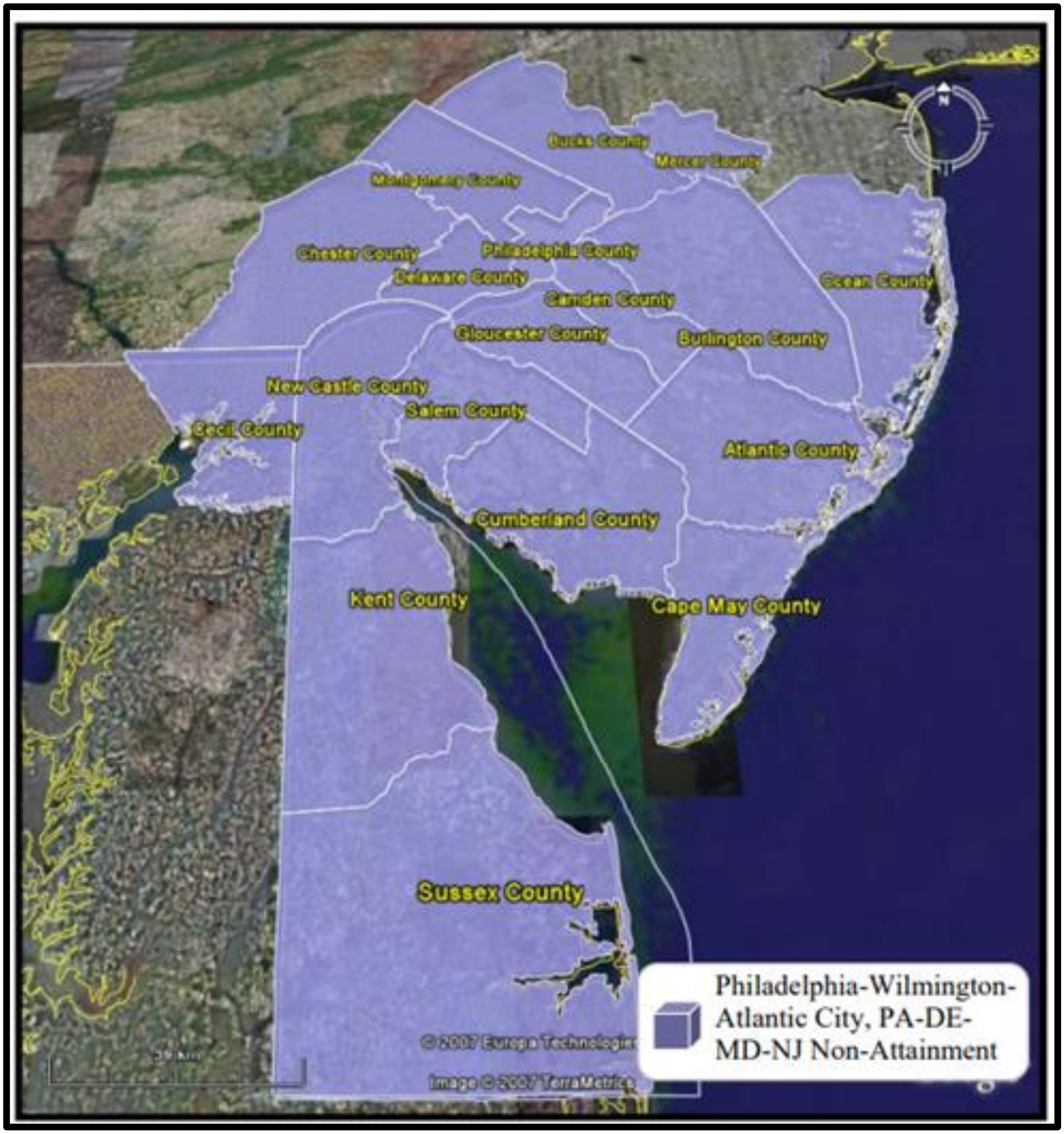
that the measures adopted by the states will result in attainment of the 8-hour ozone standard by the end of the 2023 ozone season. The modeling exercise predicts future year 2023 air quality conditions based on the worst episodes in the 2016 base year and applies control measures to demonstrate the effectiveness of new control measures in reducing air pollution.

Table 10-1 identifies all jurisdictions within the 8-hour ozone Philadelphia NAA, and Figure 10-1 provides a graphical representation of the 8-hour ozone Philadelphia NAA.

Table 10-1: Jurisdictions within the 8-Hour Ozone Philadelphia NAA

Area	State	Jurisdictions	Classification	Attainment Date
Philadelphia Non-Attainment Area	Maryland	Cecil County	Moderate	August 2024 (End of 2023 Ozone Season)
	Delaware	Kent County New Castle County Sussex County		
	New Jersey	Atlantic County Burlington County Camden County Cape May County Cumberland County Gloucester County Mercer County Ocean County Salem County		
	Pennsylvania	Bucks County Chester County Delaware County Montgomery County Philadelphia County		

Figure 10-1: 8-Hour Ozone Philadelphia NAA



The University of Maryland, College Park (UMD) performed air quality simulations for a 2016 baseline year ozone monitoring season (April 1 – October 31) and a 2023 future attainment year. The objective of the photochemical modeling performed is to enable MDE to determine if additional measures, as part of a SIP, are needed to attain the federal 8-hour ozone standard of 70 ppb. The modeling exercise predicted future year 2023 air quality conditions based on expected control measures to demonstrate the effectiveness of new control measures in reducing air pollution. Regions that experienced the worst air quality episodes in the 2016 base year were identified and evaluated to determine if these areas would attain the federal standard.

For this analysis, UMD used EPA's Community Multiscale Air Quality (CMAQ) version 5.3.3. CMAQ is a numerical atmospheric chemistry/air quality model that simulates the physics and chemistry of the atmosphere at relatively high spatial and temporal resolution. CMAQ has been used extensively for SIP modeling since its initial release in 1998 and allows regulatory agencies to better understand current air quality issues and test air quality attainment strategies. An overview of the CMAQ model can be found on an EPA website, including the model's purpose, capabilities, components, history, overview of science processes, and peer reviews.[51]

10.1.2 Modeling Protocol

In April 2022, EPA proposed three actions related to the attainment date for 31 areas classified as "Marginal" nonattainment for the 2015 ozone NAAQS. EPA proposed to determine that six areas attained the standard by the attainment date, proposed to grant a 1-year extension for one nonattainment area, and proposed to determine that 24 areas failed to attain the standard by the applicable attainment date and should be reclassified to "Moderate" upon the effective date of the final reclassification notice. EPA further proposed that SIP revisions associated with these reclassifications (i.e., the bump-up SIP) would be due January 1, 2023.[52] MDE immediately began developing an Attainment Demonstration SIP in anticipation of a final rulemaking, assuming that the due date for the SIP would not change. EPA finalized the proposed action in October 2022, retaining the January 1, 2023 SIP due date. [53]

MDE was faced with developing a modeled attainment demonstration in under 10 months. Photochemical modeling attainment demonstrations typically take between 18 and 30 months to develop and fine-tune. MDE determined that it would not be possible to develop its own photochemical modeling platform that could be used to assess future attainment in the time required to meet the SIP submission deadline. As such, MDE chose to adopt, in whole, without modifications (save the domain size) EPA's 2016v2 modeling platform for both the 2016 base year and the 2023 projection year. The EPA model platform has undergone numerous technical peer reviews and has recently been used in a proposed federal action addressing interstate ozone pollution transport.[54] The modeling study was conducted by UMD and was overseen by MDE Air and Radiation Administration staff. The model inputs were obtained from the New York State Department of Environmental Conservation (NYSDEC), the agency within the Ozone Transport Commission (OTC) who processed EPA's 2016v2 modeling inputs into the smaller 12OTC2 domain for use by OTC member states. The model results were benchmarked against baseline modeling conducted by NYSDEC.

[51] https://www.epa.gov/cmaq/cmaq-models-0
[52] 87 FR 21842
[53] 87 FR 60897
[54] Good Neighbor Plan for the 2015 Ozone NAAQS (EPA-HQ-OAR-2021-0668)

Given that MDE adopted EPA's modeling platform, the development of a Modeling Protocol as the initial step in a photochemical model attainment demonstration is unnecessary. Moreover, many of the recommended protocol elements are covered in other sections of this chapter and are therefore duplicative. An extended discussion on MDEs approach to the modeling protocol is provided in Appendix F-2.

10.1.3 Conceptual Description

EPA recommends that a conceptual description of an area's ozone problem be developed prior to the initiation of any air quality modeling study. A "conceptual description" is a qualitative way of characterizing the nature of an area's non-attainment problem.

The conceptual description for this study is provided in Appendix F-1.

10.2 MODEL PLATFORM DESCRIPTION

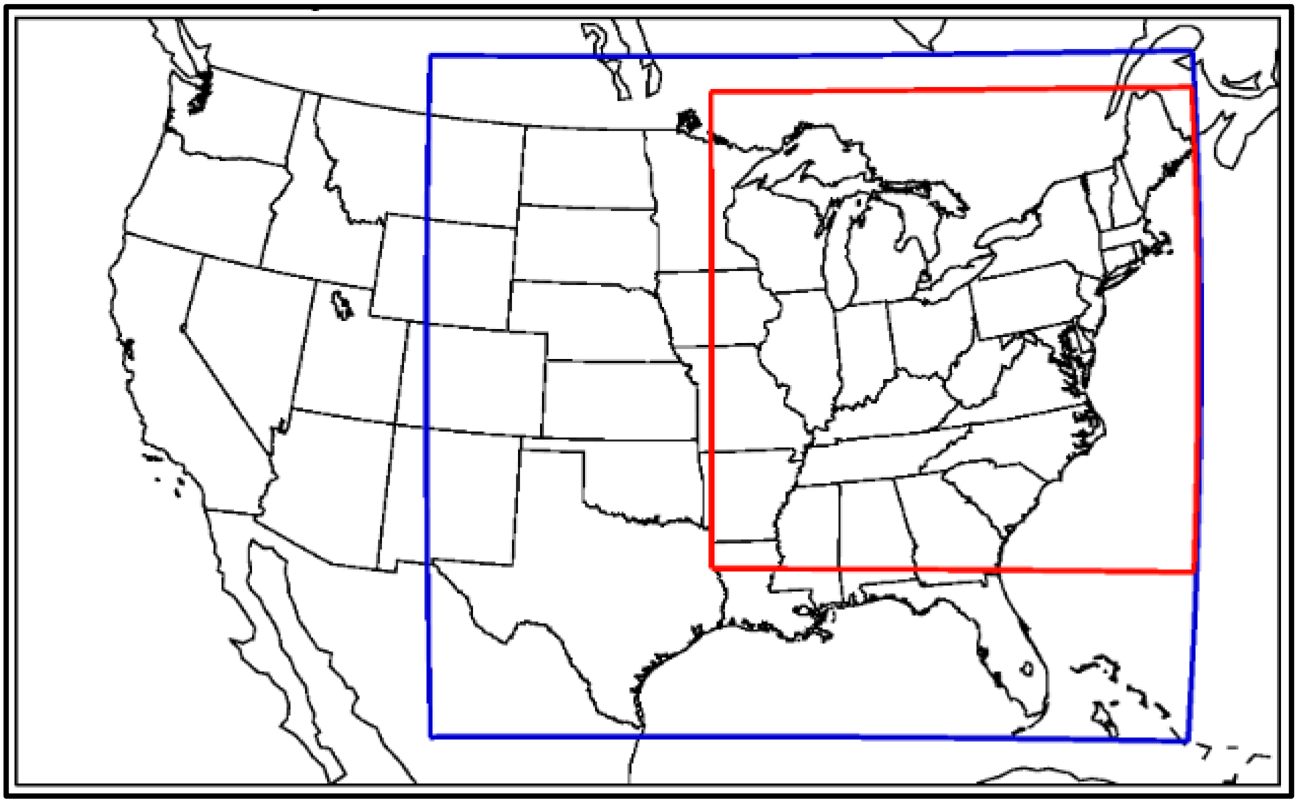
10.2.1 Model Description

UMD performed the simulations using emissions inventories, meteorology, and boundary and initial conditions for a 2016 baseline year and 2023 future year. UMD is using the 2016v2 modeling platform recently developed by EPA for the continental United States (CONUS) and includes neighboring portions of Mexico and Canada.[55]

To reduce model run times, the CONUS domain was scaled to a smaller domain as part of a collaboration between EPA and state agencies within the OTC. The new, 12km horizontal grid domain is called 12OTC2 (Figure 10-2). UMD received the 12OTC2 model platform from the NYSDEC. Previous modeling was performed using a smaller, OTC12 domain (Figure 10-2). The OTC12 domain led to faster model run times, but it was realized through source apportionment modeling that the long-range transport of ozone and ozone precursors from outside of the OTC12 region were impacting local ozone.

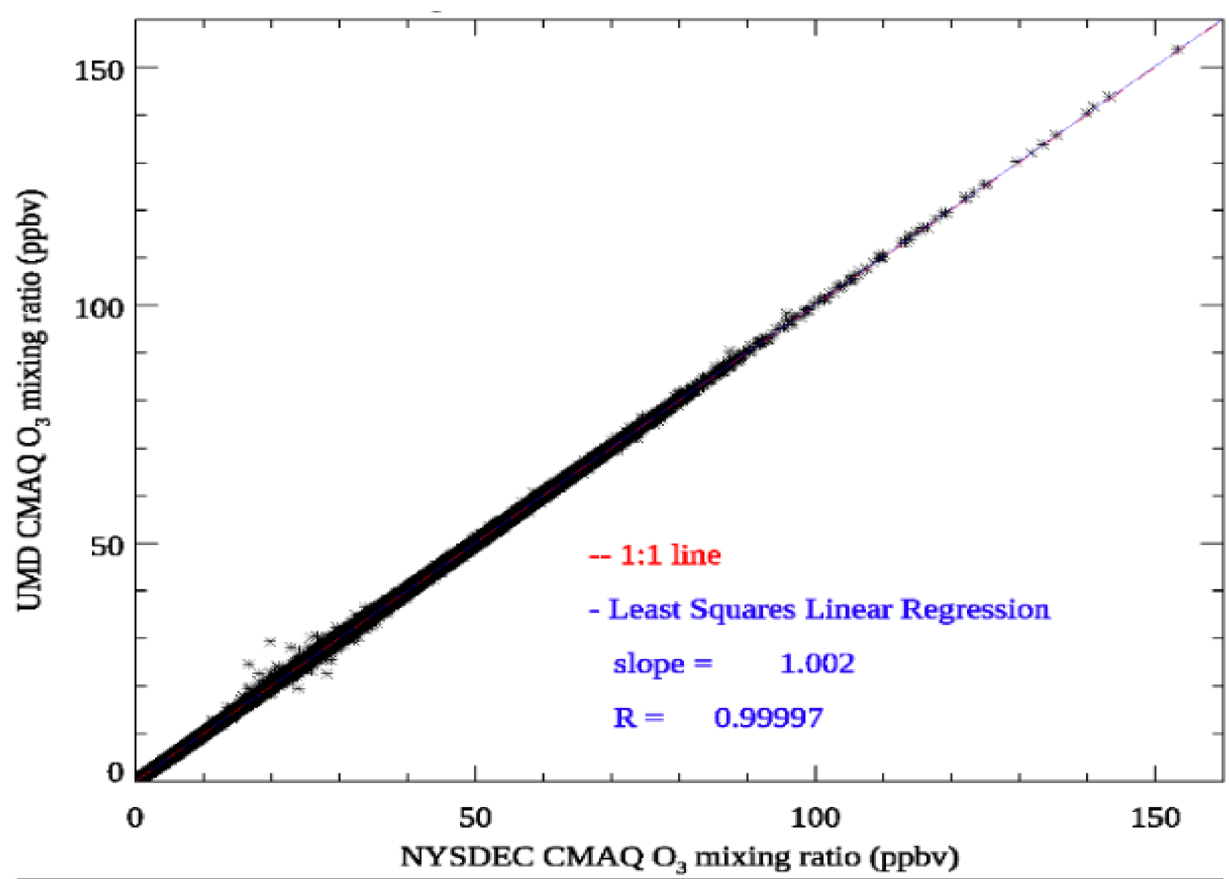
[55] https://www.epa.gov/air-emissions-modeling/2016v2-platform

Figure 10-2: 12OTC2 (Blue Box) vs OTC12 (Red Box) Model Domains



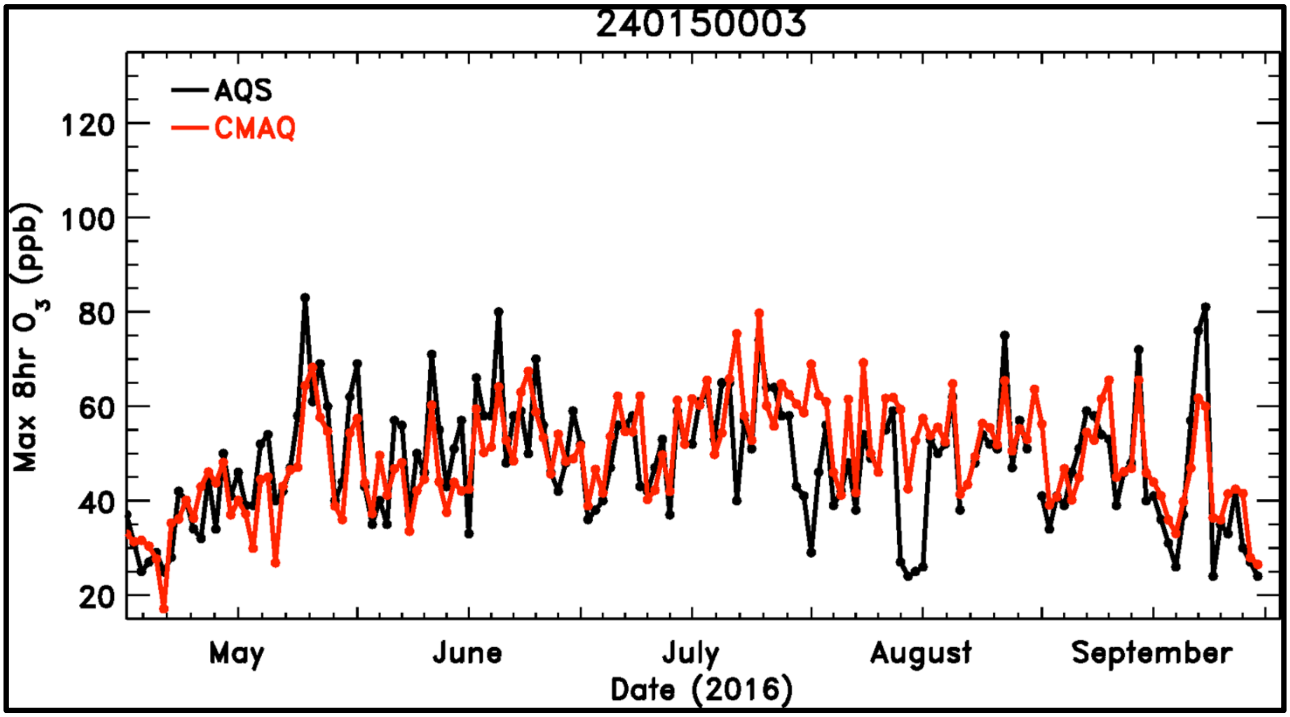
UMD benchmarked CMAQ model output against a simulation performed by the NYSDEC and found that differences in surface ozone were less than 0.2% (Figure 10-3) which satisfies the EPA benchmark criteria where species should agree within 1%. The small disagreement between the model results is most likely due to differences between the computers and compilers used by each group to perform the simulations.

Figure 10-3: Simulated O3 from models run by UMD (y-axis) and NYSDEC (x-axis) for 05/26/2016 on the 12OTC2 domain



A comparison of the CMAQ model output to surface observations from the Fair Hill, MD air quality system (AQS) monitor is shown in Figure 10-4. While the model captures much of the day-to-day variability, it does not always reproduce the highest ozone events observed in 2016.

Figure 10-4: Observed averaged 8-hour ozone from the Fair Hill, MD surface AQS site (black) and CMAQ model output for the same area (blue)



The full CMAQ model configuration that UMD used for SIP modeling is summarized in Table 10-2. UMD used the model inputs as received from NYSDEC and model configuration as downloaded from the CMAQ website[56], colloquially known as the "off-the-shelf" framework. No changes were made to the emissions inventories, photochemistry represented by the carbon bond chemical mechanism (CB6r3), meteorology, etc.

Table 10-2: OTC CMAQ Air Quality Model Configuration

Science Options	Configuration	Details/Comments
Model and Domain Design		
Horizontal Grid Mesh	12OTC2	12-km 12OTC2 domain
Grid cells	273 × 246	
Vertical Grid Mesh	35 Layers	
Meteorology Model	WRF Version 3.8	Generated by EPA and resized for 12OTC2
Chemical Transport Model	CMAQ Version 5.3.3	
Boundary Conditions	EPA 36-km CMAQ	Downscaled from 36-km Simulations
Meteorological Processor	MCIP Version 3.4.1	
Emissions Processing		

56 https://www.cmascenter.org/cmaq/

Science Options	Configuration	Details/Comments
Anthropogenic Emissions Processing	SMOKE Version 4.8.1	
Biogenic Emissions Processing	BEIS Version 3.7	Off-line simulations for SIP modeling
Chemistry and Dynamic Options		
Gas Phase Chemistry	CB6r3	
Aerosol Chemistry	AE7_AQ	
Secondary Organic Aerosols	AE7_AQ	
Deposition Scheme	M3dry	Directly linked to Pleim-Xiu Land Surface
Model Parameters		
3D Advection Scheme	wrf_cons	
Horizontal Diffusion Module	Multiscale	
Vertical Diffusion Module	ACM2_M3dry	
Cloud Chemistry	ACM_AE7	
In-line Biogenic Emissions	BEIS Version 3.7	Not activated for SIP modeling
Land Surface Model	Pleim-Xiu LSM	
Ocean Halogen Chemistry	Activated	
Lighting NOx Emissions	Activated	
Diffusivity Lower Limit	Kzmin	Activated
Photolysis Calculation	Inline	
Bi-directional NH_3 flux	In-line deposition	Activated
Gas Phase Chemistry Solver	Euler Backward Iterative (EBI) solver	
Numerical Experiment		
Simulation Periods	2016	Ozone season (Apr to Oct)
Platform	Linux Server	UMD Zaratan Supercomputer

10.2.2 Episode Selection

The procedures for selecting 8-hour ozone modeling episodes seek to achieve a balance between the possible science and regulatory needs and constraints. Modeling episodes, once selected, influence technical and policy decisions for many years. Clearly, both the direct and implicit procedures used in selecting episodes warrant full consideration.

The modeling platform was developed through a Federal-State collaborative process.[57] A Base Year Selection Workgroup examined several candidate base years, and ultimately recommended that 2016 was the ideal base year due to its representative ozone formation and meteorological conditions, as well as time and data constraints. The year selected for modeling attainment is 2023. The future year selection was dictated by the required attainment date, which is August 2024. Because attainment is based on the most recent complete ozone season, attainment is actually based on 2023 design values. Therefore, the attainment demonstration model year of 2023 was selected to best meet the attainment planning needs of the jurisdiction. The rationale for the selection of 2016 meteorology and 2023 projection year as input to the air quality simulations are provided in Appendix F-2, Chapter 3 (Episode Selection).

Recent research has shown that model performance evaluations and the response to emissions controls need to consider modeling results over long time periods, in particular full synoptic cycles or even full ozone seasons.[58] Based on this factor, the entire ozone monitoring season was simulated for the SIP modeling runs (April 1 to October 30). As a result, the total number of days examined for the complete ozone season far exceeds EPA recommendations, and provides for better assessment of the simulated pollutant fields.

10.2.3 SIZE OF THE MODELING DOMAIN

In defining the modeling domain, one must consider the location of the local urban area, the downwind extent of the elevated ozone levels, the location of large emission sources, and the availability of meteorological and air quality data. The domain or spatial extent to be modeled includes, as its core, the NAA. Beyond this, the domain includes enough of the surrounding area such that major upwind sources fall within the domain and emissions produced in the NAA remain within the domain throughout the day.

The modeling domain represents a subset of EPA's larger continental modeling domain that covers the contiguous U.S. This domain covers the United States from the western border of Texas to the Atlantic Ocean. The domain reaches from southern Canada to the southernmost Florida border and includes portions of northern Mexico. The final SIP modeling analysis utilized this modeling domain. The boundaries of the 12OTC2 modeling domain are provided in Appendix F-2, Chapter 4 (Modeling Domain).

10.2.4 HORIZONTAL GRID SIZE

The modeling platform utilizes a coarse grid continental United States (US) domain with a 12 km horizontal grid resolution. The 12km by 12km domain includes 38 full states (including DC) and four partial stats (MT, WY, CO and NM) from 110.17°W to 65.0931°W and 23.0019°N to

[57] http://views.cira.colostate.edu/wiki/wiki/9169#Workgroup-Wikis

[58] Hogrefe, C., S.T. Rao, I.G. Zurbenko, and P.S. Porter, (2000*), Interpreting the information in time series of ozone observations and model predictions relevant to regulatory policies in the eastern United States*, Bull. Amer. Met. Soc., 81, 2083-2106. Vizuete, W., Jeffries, H.E., Tesche, T.W., Olaguer, E.P., Couzo, E., (2011), *Issues with Ozone Attainment Methodology for Houston, TX*. J. Air Waste Manage. Assoc. 61, 238-253

51.8794°N, which includes some portions of southern Canada and northern Mexico. The domain is 273 columns by 246 rows in the horizontal. Appendix F-2, Chapter 4 (Modeling Domain) contains the horizontal grid definitions for the WRF and CMAQ modeling domains.

10.2.5 Vertical Resolution

The vertical grid used in the CMAQ modeling was primarily defined by the WRF vertical structure. The atmosphere is resolved with 35 vertical layers up to 50 millibars, with the thinnest layers being near the surface to better resolve the planetary boundary layer. This is consistent with the EPA guidance.

Appendix F-2, Chapters 4 (Modeling Domain) and 6 (Weather Research Forecasting (WRF) Meteorological Model) contain the vertical layer definitions for the WRF and CMAQ modeling domains.

10.2.6 Initial and Boundary Conditions

The objective of a photochemical grid model is to estimate the air quality given a set of meteorological and emissions conditions. When initializing a modeling simulation, the exact concentration fields are not known in every grid cell for the start time. Therefore, typically photochemical grid models are started with clean conditions within the domain and allowed to stabilize before the period of interest is simulated. In practice, this is accomplished by starting the model several days, called spin-up time, prior to the period of interest.

The winds move pollutants into, out of, and within the domain. The model handles the movement of pollutants within the domain and out of the domain. An estimate of the concentration of pollutants at the edge of the domain and therefore the quantity of pollutants moving into the domain is needed. These are called boundary conditions.

The 3-D boundary conditions for the 12OTC2 12 km grid were created by NYSDEC running CMAQ v5.3.1 at the 36US3 domain. Boundary conditions for the 36US3 domain were obtained from EPA's hemispheric 108km CMAQ (H-CMAQ) platform downloaded from the Intermountain West Data Warehouse.[59] The CMAQ simulations used a multi-day ramp-up period to wash out the effect of the initial fields. Additional information on the extraction of boundary conditions is provided in Appendix F-2, Chapter 4 (Modeling Domain).

10.2.7 Meteorological Model Selection and Configuration

The gridded meteorological model used to provide input data for the emissions modeling was developed using the Weather Research and Forecasting Model (WRF)[60] version 3.8, Advanced

[59] http://views.cira.colostate.edu/iwdw/

[60] https://ral.ucar.edu/solutions/products/weather-research-and-forecasting-model-wrf

Research WRF Core (Skamarock, et al., 2008). The WRF Model is a mesoscale numerical weather prediction system developed for both operational forecasting and atmospheric research applications. The WRF was run for 2016 over a domain covering the continental U.S. at a 12km resolution with 35 vertical layers. The run for this platform included high resolution sea surface temperature data from the Group for High Resolution Sea Surface Temperature (GHRSST)[61] and is given the EPA meteorological case label "16j."

Based on model validation and sensitivity testing, the WRF configurations provided in Appendix F-2, Chapter 6 (Weather Research Forecasting (WRF) Meteorological Modeling) were selected. A more detailed description and performance evaluation of the WRF modeling results are provided in Appendix F-2, Chapter 6 (Weather Research Forecasting (WRF) Meteorological Modeling).

10.2.8 Emissions Model Selection and Configuration

The Sparse Matrix Operator Kernel Emissions (SMOKE) Emissions Processing System was selected for the modeling analysis. SMOKE is principally an emissions processing system, and not a true emissions inventory preparation system in which emissions estimates are simulated from 'first principles'. This means that, with the exception of mobile and biogenic sources, its purpose is to provide an efficient, modern tool for converting emissions inventory data into the formatted, hourly, mapped emissions files required for a photochemical air quality model.

The primary emissions modeling tool used to create the air quality model-ready emissions was the SMOKE modeling system, version 4.8.1 (SMOKE 4.8.1)[62] with some updates. Emissions files were created for a 36-km national grid and for a 12-km national grid, both of which include the contiguous states and parts of Canada and Mexico. Emissions at 36-km were only created for the inventory years 2016 and 2023

The emissions inventories prepared for the modeling analyses were developed through a coordinated effort between the EPA and states through a collaborative process.[63] The original starting point for the emission inventories was the 2016v1 platform. The 2016v1 data were updated with information and methods from the 2017 National Emissions Inventory (NEI)[64], MOtor Vehicle Emission Simulator version 3 (MOVES3) model, and updated inventory methodologies. Documentation for each 2016v1 emissions sector in the form of specification sheets is available on the 2016v1 page of Inventory Collaborative Wiki.[65] The Wiki provides additional details of data provided for the 2016v1 process. In addition to the NEI-based data for the broad categories of point, nonpoint, onroad, nonroad, and events (i.e., fires), emissions

[61] https://www.ghrsst.org/

[62] http://www.smoke-model.org/

[63] http://views.cira.colostate.edu/wiki/wiki/9169#Workgroup-Wikis

[64] Data and documentation for the 2017NEI, including a TSD, are available at: https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data

[65] http://views.cira.colostate.edu/wiki/wiki/10202

from the Canadian and Mexican inventories and several other non-NEI data sources are included in the 2016 platform. The Canadian and Mexican inventories were updated in 2016v2.

In 2016v2, emissions for nonpoint source sectors started with 2017 NEI emissions and were adjusted to better represent the year 2016, as opposed to 2016v1 where these sectors were based on 2014 NEI data. Fertilizer emissions, nonpoint oil and gas emissions, and onroad and nonroad mobile source emissions represent the year 2016 and were updated from 2016v1. Commercial Marine Vessel (CMV) emissions are consistent with 2016v1 and were developed based on 2017 NEI CMV emissions and the sulfur dioxide (SO2) emissions reflect rules that reduced sulfur emissions for CMV that took effect in the year 2015. Locomotive emissions in the rail and ptnonipm sectors are consistent with those in 2016v1. Nonpoint oil and gas emissions were developed using 2016-specific data for oil and gas wells and their 2016 production levels.

Onroad and nonroad mobile source emissions were developed using MOVES3 and were updated from 2016v1. Onroad emissions for the platform were developed based on emissions factors output from MOVES3 for the year 2016, run with inputs derived from the 2017NEI along with activity data (e.g., vehicle miles traveled and vehicle populations) provided by state and local agencies for 2016v1 or otherwise backcast to the year 2016. MOVES3 was also used to generate nonroad emissions using spatial allocation factors updated for the 2016v1 platform.

In addition to the NEI-based sectors, emissions for Canada and Mexico are included. In 2016v2, these emissions are based on updated data that represent the base year of 2016 for Canada from Environment and Climate Change Canada (ECCC) and for Mexico from Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT)[66].

These emissions were then processed using the SMOKE Version 4.8.1 processor to provide inputs for the photochemical model. The emission sectors are processed independently except for the final merge. The final merge program combines the sector-specific, gridded, speciated hourly emissions together to create CMAQ-ready emission inputs.

The emissions inventories included a base case (2016), which serves as the "parent" inventory off which all future year inventories (i.e., 2023) are based. The future year emissions inventories include emissions growth due to projected increases in economic activity as well as the emissions reductions due to implementation of control measures.

A detailed description of all SMOKE input files such as area, mobile, fire, point and biogenic emissions files and the SMOKE model configuration are provided in Appendix F-2, Chapter 5 (Emissions Inputs).

10.2.9 Air Quality Model Selection and Configuration

[66] Secretariat of Environment and Natural Resources

EPA's CMAQ modeling system was selected for the attainment demonstration primarily because it is a "one-atmosphere" photochemical grid model capable of addressing ozone on a regional scale. CMAQ has been used extensively for SIP modeling since its initial release in 1998 and is considered one of the preferred models for regulatory modeling applications. The model is also recommended by the *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze* (Draft 3.2-September 2006).

The CMAQ configuration is provided in Appendix F-2, Chapter 2 (Air Quality Model Selection and Configuration Summary).

10.2.10 Quality Assurance

All air quality, emissions, and meteorological data were reviewed to ensure completeness, accuracy, and consistency before proceeding with modeling. Any errors, missing data or inconsistencies, were addressed using appropriate methods that are consistent with standard practices. All modeling was benchmarked through the duplication of a set of standard modeling.

The WRF meteorological model and CMAQ air quality model inputs and outputs were plotted and examined to ensure sufficiently accurate representation of the observed data in the model-ready fields, and temporal and spatial consistency and reasonableness. Both WRF and CMAQ underwent operational and scientific evaluations in order to facilitate the quality assurance review of the meteorological and air quality modeling procedures and are discussed in greater detail throughout this document and the related appendices.

10.3 MODEL PERFORMANCE EVALUATION

10.3.1 Overview

There are many aspects of model performance. This section will focus primarily on the methods and techniques recommended by EPA for evaluating the performance of the air quality model. It should be noted that other parts of the modeling process, the emissions and meteorology, also undergo an evaluation.

The first step in the modeling process is to verify the model's performance in terms of its ability to predict ozone in the right locations and at the right levels. To do this, model predictions for the base year simulation are compared to the ambient data observed in the historical episode. This verification is a combination of statistical and graphical evaluations. If the model appears to be predicting ozone in the right locations for the right reasons, then the model can be used as a predictive tool to evaluate various control strategies and their effects on ozone. The purpose of the model performance evaluation is to assess how accurately the model predicts ozone levels observed in the historical episode and to use the knowledge of CMAQ's performance to put CMAQ's predictions of future year air quality in the appropriate context so that future policy decisions are informed by CMAQ's predictions and its performance.

The results of a model performance evaluation were examined prior to using CMAQ's results to support the attainment demonstration. The performance of CMAQ was evaluated using both operational and diagnostic methods. Operational evaluation refers to the model's ability to replicate observed concentrations of ozone and/or precursors (surface and aloft), whereas diagnostic evaluation assesses the model's accuracy with respect to characterizing the sensitivity of ozone to changes in emissions (i.e., relative response factors).

Appendix F-2, Chapter 7 (2016 Base Year Modeling and Model Performance Evaluation) provides comprehensive operational and diagnostic evaluation results, including spreadsheets containing the assumptions made to compute statistics. Highlights of this evaluation are provided in the following sections.

10.3.2 Diagnostic and Operational Evaluation

To evaluate model performance, EPA recommends that several statistical metrics be calculated for air quality modeling. Two of the common metrics that are most often used to assess performance are the normalized mean gross error and the normalized mean bias. The normalized mean gross error parameter provides an overall assessment of model performance and can be interpreted as precision, and the normalized mean bias parameter measures a model's ability to reproduce observed spatial and temporal patterns and can be interpreted as accuracy. EPA suggests the following criteria: a normalized mean gross error (MNGE) of < 35%, and a normalized mean bias (MNB) of < ±15% above a threshold of 40-60 ppb. The results are presented in Tables 10-3 and 10-4 on a monitor-by-monitor basis averaged over all days for the 40 ppb and 60 ppb thresholds.

Table 10-3: Individual Site Statistics for 8-Hour Ozone Using 40 ppb Cutoff

State	SITE ID	Site Name	County	MNGE (%)	MNB (%)
Maryland	240150003	Fair Hill	Cecil	12.294	-1.2271
Delaware	100010002	Killens Pond	Kent	14.0575	1.2297
	100031007	Lums Pond	New Castle	12.2768	3.9966
	100031010	BCSP	New Castle	13.4464	-1.499
	100031013	Bellevue Park	New Castle	11.1544	-0.2409
	100032004	MLK	New Castle	10.7273	1.5597
New Jersey	340010006	Brigantine	Atlantic	13.8744	1.2297
	340070002	Camden Spruce Street	Camden	11.096	7.218
	340071001	Ancora State Hospital	Camden	12.7585	0.992
	340110007	Millville	Cumberland	12.0393	7.3572
	340150002	Clarksboro	Gloucester	10.7119	1.003

State	SITE ID	Site Name	County	MNGE (%)	MNB (%)
	340210005	Rider University	Mercer	12.0509	0.5296
	340219991	Wash. Crossing	Mercer	12.3244	2.559
	340290006	Colliers Mills	Ocean	11.6235	-0.0382
Pennsylvania	420110006	Kutztown	Berks	11.205	-1.4765
	420110011	Reading Airport	Berks	11.5926	3.5243
	420170012		Bucks	14.385	0.8165
	420290100	Chester	Chester	11.9268	4.3132
	420450002		Delaware	10.8615	-1.1846
	420910013		Montgomery	11.7869	0.4525
	421010004	Air Mgmt. Serv. Lab	Philadelphia	17.1089	3.3226
	421010024	North East Airport	Philadelphia	11.6843	14.8122
	421010048	North East Waste	Philadelphia	10.839	-0.8608

Table 10-4: Individual Site Statistics for 8-Hour Ozone Using 60 ppb Cutoff

State	SITE ID	Site Name	County	MNGE (%)	MNB (%)
Maryland	240150003	Fair Hill	Cecil	12.7772	-10.394
Delaware	100010002	Killens Pond	Kent	14.1528	-8.9232
	100031007	Lums Pond	New Castle	7.9128	-4.6264
	100031010	BCSP	New Castle	13.0663	-11.322
	100031013	Bellevue Park	New Castle	9.2796	-6.9132
	100032004	MLK	New Castle	9.0022	-5.1725
New Jersey	340010006	Brigantine	Atlantic	14.1528	-8.9232
	340070002	Camden Spruce Street	Camden	14.5502	5.4742
	340071001	Ancora State Hospital	Camden	9.0293	-4.5268
	340110007	Millville	Cumberland	8.5787	-3.0853
	340150002	Clarksboro	Gloucester	11.9555	-9.8445
	340210005	Rider University	Mercer	8.502	-5.1401
	340219991	Wash. Crossing	Mercer	10.0697	-5.4126
	340290006	Colliers Mills	Ocean	11.5161	-7.5472
Pennsylvania	420110006	Kutztown	Berks	10.6978	-6.2123
	420110011	Reading Airport	Berks	10.5476	-9.7277
	420170012		Bucks	10.9918	-10.659
	420290100	Chester	Chester	12.3617	-5.4479
	420450002		Delaware	12.167	-10.808
	420910013		Montgomery	8.479	-6.812
	421010004	Air Mgmt. Serv. Lab	Philadelphia	10.2559	-6.1242
	421010024	North East Airport	Philadelphia	7.6135	0.7975

State	SITE ID	Site Name	County	MNGE (%)	MNB (%)
	421010048	North East Waste	Philadelphia	10.6731	-6.7546

The model performance evaluation been provided in Appendix F-2, Chapter 7 (2016 Base Year Modeling and Model Performance Evaluation).

10.3.3 Summary of Model Performance

The CMAQ model was employed to simulate ozone for the 2016 monitoring season (April through October). A comparison of the temporal and spatial distributions of ozone and its precursors was conducted for the study domain, with additional focus placed on performance in the Philadelphia NAA.

The CMAQ model performance for surface ozone is quite good with low bias and error. Model performance is generally consistent from day to day. The results of the 2016 ozone season show that the modeling system tends to over-predict minimum concentrations and slightly under-predict peak concentrations. The over-prediction of minimum concentrations is not of great regulatory concern since attainment tests are based on the application of relative response factors to daily peak concentrations. Prediction of minimum concentrations is still important to appropriately model regional transport and nighttime ozone removal processes in order to accurately estimate peak concentrations.

The model performance for the Philadelphia NAA averaged over all stations and all days meets the guidelines[67] suggested by EPA. Applying those criteria to individual days is a much more stringent test that is not required by EPA. If those long-term average standards are applied to daily performance, those criteria for acceptable model performance are met on most individual days as well.

No significant differences in model performance for ozone and its precursors were encountered across different areas of the domain. While there are some differences in the spatial data among sub-regions, there is nothing to suggest a tendency for the model to respond in a systematically different manner between regions. Examination of the statistical metrics by sub-region confirms the absence of significant performance problems arising in one area but not in another, building confidence that the CMAQ modeling system is operating consistently across the full domain.

The evaluations discussed above show that the modeling system is doing a good job of appropriately estimating 8-hour average surface ozone throughout the domain and in the Philadelphia NAA. This confidence in the modeling results allows the modeling system to be

[67] https://www.epa.gov/scram/state-implementation-plan-sip-attainment-demonstration-guidance

used to support the development of emissions control scenarios and the SIP to meet the 8-hour ozone NAAQS.

10.4 ATTAINMENT DEMONSTRATION

10.4.1 OVERVIEW

The 8-hour ozone standard attainment demonstration analyzes the potential of the Philadelphia NAA to achieve attainment of the 8-hour ozone standard. The demonstration of achieving the 8-hour ozone standard is based on the CMAQ modeling results. The modeling simulation demonstrates that the Philadelphia NAA will attain the 2015 ozone standard by the August 3, 2024 attainment date. Details of the CMAQ modeling results are provided in the following section.

10.4.2 MODELED ATTAINMENT TEST

The modeled attainment test demonstrates attainment of the 8-hour ozone standard by utilizing air quality models to simulate future year concentrations. Future year design values for each monitor are projected by multiplying base year design values by the relative response factors.

10.4.2.1 Base Design Values

A design value for monitored data is the 4th-highest daily maximum 8-hour average concentration, averaged over a 3-year period for each air quality monitoring site. For the modeled attainment test, EPA recommends calculating base design values by averaging three consecutive design values, starting with the design values of the base year. As a result, for this study, design values for 2014-2016, 2015-2017, and 2016-2018 were averaged to generate the 2016 observed design values. The observed design values for 2016 for all monitoring sites in Maryland are shown in Table 10-6.

10.4.2.2 Relative Response Factors

Relative response factors (RRF) are used to project future year design values and are calculated through a series of steps recommended by EPA with model output values for base year and future year.

UMD performed a full Ozone season (Apr 1 – Oct 31) simulation for 2016. Maximum daily 8-hr ozone was calculated from CMAQ output following the EPA guidance for determining relative response factors. At each grid point, the 3×3 grid cell array surrounding the center grid point was used to determine which of the 9 cells had the highest value for 8-hr ozone. This was the daily maximum 8-hr ozone concentration attributed to the center grid point. All model days above a threshold value of 70 ppb were identified for each grid cell. If there were at minimum

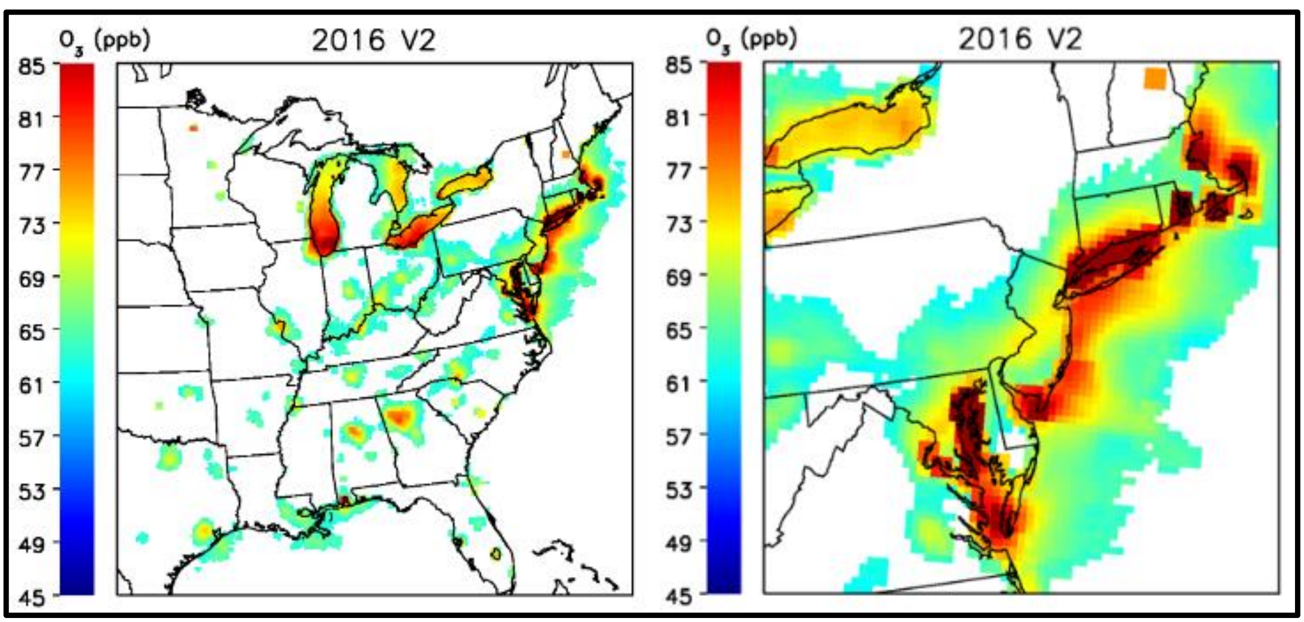
10 days above the threshold, the 10 days with the highest concentrations of 8-hr ozone were averaged. If there were not 10 days above 70 ppb then the threshold was decreased by 1ppb. If 10 days were still not above the threshold, then the minimum daily limit was reduced by 1. This procedure was followed until a minimum ozone threshold of 60 ppb was reached and a minimum of 6 days. If there were not enough days above the minimum limit where ozone was not above threshold value, then no average was calculated.

For this study, the RRFs are the ratios of 2023 to 2016 average maximum daily 8-hr ozone. The air quality community recognizes that models are not perfect and are best used to determine relative changes from year to year. RRFs are multiplied by the observed design values to determine the future year (2023) model design value.

10.4.2.3 Future Design Values

Figure 10-5 shows the modeled ozone concentration for 2016 over the 12OTC2 model domain and the I-95 corridor from Virginia to Massachusetts. Regions are only shown where average ozone satisfied the EPA criteria for calculating RRFs. Results for the 12OTC2 domain are shown on the left. The right panel highlights the I-95 corridor region. Densely populated regions and areas with a lot of electrical generating units (e.g., the Ohio River Valley) have the highest ozone concentrations. Areas over the Great Lakes, Chesapeake Bay, and coastal waters generally have higher ozone concentrations most likely due to a shallower marine boundary layer.[68]

Figure 10-5: Average Maximum Daily Modeled Ozone for the 2016 Ozone Season



[68] Dreessen J, Orozco D, Boyle J, Szymborski J, Lee P, Flores A, Sakai RK. *Observed ozone over the Chesapeake Bay land-water interface: The Hart-Miller Island Pilot Project*. Air Waste Manag Assoc. 2019 Nov;69(11):1312-1330. doi: 10.1080/10962247.2019.1668497. Epub 2019 Oct 15. PMID: 31526247.

The same grid cells and days used to calculate the ozone values shown in Figure 10-5 were used to calculate ozone for 2023. These results are shown in Figure 10-6 and, together with the results for 2016, were used to calculate the RRFs.

Figure 10-6: Average Maximum Daily Modeled Ozone for the 2023 Ozone Season

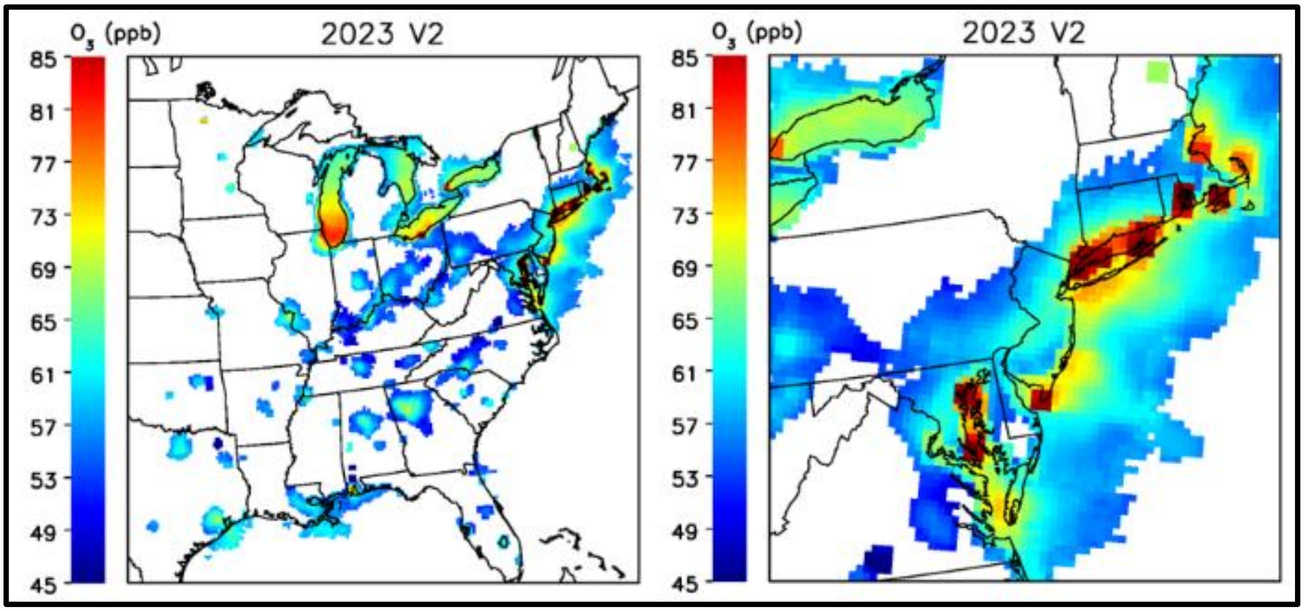


Table 10-5 shows the observed design values for 2016 and the model design values for 2023. In Table 10-5, N/A indicates either not enough data to determine the observed design value or the calculation of average ozone concentration did not satisfy the EPA criteria. There were sixteen monitors in the Philadelphia NAA above the 70 ppb federal standard in 2016. Based on the UMD modeling, none of these monitors are expected to be in non-attainment by 2023. The modeling simulation demonstrates that the Philadelphia NAA will attain the 2015 ozone standard by the August 3, 2024 attainment date.

Table 10-5: Observed and Modeled Design Values

State	Site	Site ID	DV 2016	DV 2023
Maryland	Davidsonville	240030014	N/A	N/A
	Glen Burnie	240031003	74	65
	Padonia	240051007	72	61
	Essex	240053001	73	64
	Calvert	240090011	68	58
	South Carroll	240130001	68	57
	Fair Hill*	240150003	74	63
	S. Maryland	240170010	69	59
	Horn Point	240190004	65	57

State	Site	Site ID	DV 2016	DV 2023
	Blackwater	240199991	66	58
	Frederick Airport	240210037	68	58
	Piney Run	240230002	65	56
	Edgewood	240251001	74	65
	Aldino	240259001	73	62
	Millington	240290002	69	59
	Rockville	240313001	68	58
	HU-Beltsville	240330030	69	58
	PG Equest.	240338003	71	61
	Beltsville	240339991	69	58
	Hagerstown	240430009	67	58
	Furley	245100054	68	60
Delaware	Killens Pond*	100010002	66	57
	Lums Pond*	100031007	68	58
	BCSP*	100031010	74	65
	Bellevue Park*	100031013	71	62
	MLK*	100032004	71	62
New Jersey	Brigantine*	340010006	64	58
	Camden Spruce St*	340070002	75	66
	Ancora St. Hosp.*	340071001	67	59
	Millville*	340110007	66	58
	Clarksboro*	340150002	74	66
	Rider University*	340210005	71	62
	Wash. Crossing*	340219991	73	65
	Colliers Mills*	340290006	73	64
Pennsylvania	Kutztown*	420110006	66	58
	Reading Airport*	420110011	70	61
	Bucks*	420170012	79	69
	Chester*	420290100	73	63
	Delaware*	420450002	71	62
	Montgomery*	420910013	71	63
	Air Mgmt Svc Lab*	421010004	61	N/A
	North East Airport*	421010024	78	68
	North East Waste*	421010048	75	66

*Monitors for the Philadelphia NAA

Appendix F-2, Chapter 8 (Assessing Modeled Attainment for Ozone) provides additional information on the RRF and the modeled attainment test.

10.5 PROCEDURAL REQUIREMENTS

10.5.1 REPORTING

Documents, technical memorandums, and databases developed in this study are available for distribution as appropriate. This report contains the essential methods and results of the conceptual model, episode selection, modeling protocol, base case model development and performance testing, future year and control strategy modeling, quality assurance, and calculation of 8-hr ozone attainment via EPA's relative response factor (RRF) methodology.

10.5.2 DATA ARCHIVAL AND TRANSFER OF MODELING FILES

All relevant data sets, model codes, scripts, and related software required by any project participant necessary to corroborate the study findings (e.g., performance evaluations, control strategy runs) will be provided in an electronic format. The UMD has archived all modeling data relevant to this project. Transfer of data may be facilitated through the combination of a project website and the transfer of large databases via mail. Database transfers will be accomplished using an ftp protocol for smaller datasets, and the use of IDE and Firewire disk drives for larger data sets.

11.0 WEIGHT OF EVIDENCE ATTAINMENT DEMONSTRATION

The Weight of Evidence (WOE), derived from a performance comparison between the Community Multiscale Air Quality (CMAQ) and the Comprehensive Air Quality Model with Extensions (CAMx) modeling systems, as well as EPA's guidance, supports the conclusion that Cecil County will attain the 2015 8-hour ozone National Ambient Air Quality Standard (NAAQS). The approach to Maryland's WOE is to provide supplemental information and analysis, which further support the conclusion of attainment of the 8-hour ozone NAAQS.

11.1 EPA 2016V2 MODELING USING CAMX

The Environmental Protection Agency (EPA) developed the 2016v2 emissions modeling platform as an update to the 2016v1 platform because new data, model versions, and methods have become available following the release of 2016v1. The 2016v2 platform incorporates emissions based on: MOVES3, the 2017 NEI nonpoint inventory (both anthropogenic and biogenic), the Western Regional Air Partnership oil and gas inventory, and updated inventories for Canada and Mexico. In addition, 2016v2 makes use of a new inventory method for solvents, includes minor corrections to the wildfire inventory, and corrects for double counting of the airport emissions. The commercial marine vessel and rail inventories are consistent with the 2016v1 inventories.

The 2016v2 platform includes emissions for the years 2016, 2023, 2026, and 2032. Factors used to perform projections to future years have been updated where new data have become available. For example, where factors based on the Annual Energy Outlook (AEO) are used to develop future year emissions, most of those factors have been updated to use AEO 2021. Future year EGU emissions include impacts from the Revised Cross-state Air Pollution Rule Update (RCU) along with other updated data.

EPA's photochemical model simulation used the Comprehensive Air Quality Model with Extensions (CAMx version 7.10).[69] CAMx is a three-dimensional grid-based Eulerian air quality model designed to simulate the formation and fate of oxidant precursors, primary and secondary particulate matter concentrations, and deposition over regional and urban spatial scales.

The 2016v2 platform technical support documents (TSD) are linked below, along with SMOKE[70] input data files and summaries and premerged SMOKE outputs. The Air Quality Modeling TSD is also presented in Appendix G-1.

[69] https://www.camx.com/

[70] Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system

2016v2 Technical Support Document: Preparation of Emissions Inventories[71]
2016v2 SMOKE Input Data Files and Summaries[72]
2016v2 Premerged SMOKE Outputs[73]
2016v2 Technical Support Document: Air Quality Modeling[74]

The TSDs describe EPA's air quality modeling performed using emissions from the 2016v2. The focus of the air quality modeling is to project ozone design values[75] at individual monitoring sites to 2023, 2026, and 2032 and to estimate state-by-state contributions to ozone design values at individual monitoring sites in 2023 and 2026.

In brief, EPA performed air quality modeling for a 2016 base year and 2023, 2026, and 2032 future years to project 2016-centered base period design values to each of these future years. Ozone source apportionment modeling was performed using emissions in 2023 and 2026 to determine the contributions of total anthropogenic emissions in each state to projected ozone design values at individual monitoring sites nationwide for each of these years.

The photochemical model 2023 future design values[76] from the EPA modeling demonstrate attainment of the NAAQS the Philadelphia Nonattainment Area. Table 11-1 shows the 2023 EPA model design values for all monitors in the Philadelphia Nonattainment Area.[77]

Table 11-1: 2023_2026_2032_DVs_3x3

State	SITE ID	Site Name	County	2016-Centered Avg	2016-Centered Max	2023fj Avg 3x3	2023fj Max 3x3
MD	240150003	Fair Hill	Cecil	74.0	74	63.4	63.4
DE	100010002	Killens Pond	Kent	66.3	67	56.9	57.5
	100031007	Lums Pond	New Castle	68.0	69	58.8	59.7

71 https://www.epa.gov/air-emissions-modeling/2016-version-2-technical-support-document

72 https://gaftp.epa.gov/Air/emismod/2016/v2/

73 https://dataverse.unc.edu/dataset.xhtml?persistentId=doi:10.15139/S3/SAXVSF

74 https://gaftp.epa.gov/Air/aqmg/2016v2_Platform_Modeling_Data/AQ%20Modeling%20TSD_2016v2%20Platform_rev_2022_0119a.pdf

75 The ozone design value for a monitoring site is the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations at the site.

76 https://gaftp.epa.gov/Air/aqmg/2016v2_Platform_Modeling_Data/2016v2_DVs_state_contributions.xlsx

77 EPA conducted this exercise a second time but excluding data influenced by the land-water interface. The 2023 average and maximum design values only changed for two monitors (Killens Pond in Kent County, DE and Brigantine in Atlantic County NJ). The effect of removing the water-cells lowered the average and maximum design values 0.1 ppb for Killens Pond and 0.4 ppb for Brigantine. Neither scenario influenced the determination of attainment for this monitor as the 2023 projected design values are well under 70 ppb both with and without water cells.

State	SITE ID	Site Name	County	2016-Centered Avg	2016-Centered Max	2023fj Avg 3x3	2023fj Max 3x3
	100031010	BCSP	New Castle	73.7	74	64.4	64.7
	100031013	Bellevue	New Castle	71.0	72	61.8	62.7
	100032004	MLK	New Castle	71.3	72	62.1	62.7
NJ	340010006	Brigantine	Atlantic	63.7	64	56.8	57.1
	340070002	Cam. Spr. St.	Camden	75.3	77	67.4	68.9
	340071001	Ancora	Camden	67.3	68	59.2	59.8
	340110007	Millville	Cumberland	65.7	67	57.9	59.0
	340150002	Clarksboro	Gloucester	73.7	74	65.3	65.6
	340210005	Rider Univ.	Mercer	71.3	72	63.5	64.2
	340219991	Wash. Cross.	Mercer	73.3	74	65.2	65.8
	340290006	Colliers Mills	Ocean	72.7	73	64.6	64.8
PA	420110006	Kutztown	Berks	65.5	66	57.9	58.3
	420110011	Reading Apt.	Berks	70.0	70	61.8	61.8
	420170012		Bucks	79.3	81	70.7	72.2
	420290100	Chester	Chester	72.7	73	63.9	64.1
	420450002		Delaware	71.3	72	62.6	63.2
	420910013		Montgomery	71.3	72	63.9	64.5
	421010004	Air Mgmt. Lb	Philadelphia	61.0	61	54.4	54.4
	421010024	NE Airport	Philadelphia	77.7	78	69.5	69.8
	421010048	NE Waste	Philadelphia	75.3	76	67.2	67.8

Per Appendix U to Part 50 of the Interpretation of the Primary and Secondary National Ambient Air Quality Standards for Ozone, monitoring site design values are calculated to three decimal places, with additional digits to the right of the third decimal place truncated.[78] Per EPA's 2018 Modeling Guidance, the same rounding/truncation procedures should be applied to the modeled attainment test. EPA explains, by way of example, that a monitor with a 70.9 ppb design value is considered attainment and 71.0 is considered nonattainment.[79] In short, projected design values that are greater than or equal to 71 ppb are considered to be violating the 2015 ozone NAAQS. Following this guidance, all monitors in the Philadelphia nonattainment area are projected to attain the 2015 ozone NAAQS.

The 2023 design value data EPA reports for the Bucks County monitor in Philadelphia has a modeled average design value of 70.7 ppb and a modeled maximum design value of 72.2 ppb. Following the attainment test guidance that EPA has established, the modeled average design

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[78] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50/appendix-Appendix%20U%20to%20Part%2050

[79] Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM2.5 and Regional Haze. November 2018. Pg. 104.

value is below 71 ppb (70.7) and therefore the monitor has attained the standard. The modeling conducted by EPA was primarily prepared for use in ozone transport modeling. Ozone transport modeling identifies nonattainment areas as well as maintenance areas – which are areas that are either (1) currently attaining the standard or (2) are projected to attain the standard, but may have difficulty maintaining ozone attainment under conditions that are maximally favorable to modeled ozone formation. In summary, EPA's 2023 modeling results demonstrate attainment of the standard for all monitors in the Philadelphia ozone nonattainment area using EPA's attainment modeling guidance and definitions.

Support for this conclusion can be found in EPA's own modeling guidance. EPA's modeling presents average design values (the 2014-2018 average design value multiplied by the Relative Response Factor) and maximum design values (the 2014-2018 maximum design value multiplied by the Relative Response Factor). However, the guidance for design value calculations, as summarized below, clearly indicates that the average value is the one that is used to determine modeled attainment:[80]

> The modeling guidance recommends using 5-year weighted average ambient design values centered on the base modeling years as the starting point for projecting *average* design values for the future. The 5-year weighted average ambient design value at each site is projected to the attainment year using Relative Response Factors (RRF). The basic equation is as follows:

Future Year Design Value (DVF)	=	Relative Response Factor (RRF)	x	Base Period Design Value (DVB)

> The RRF is the fractional change in MDA8 ozone between the base year and the future year. The RRF is based on the *average* ozone on model-predicted high ozone days in grid cells in the vicinity of the monitoring site. The guidance recommends calculating RRFs based on the highest 10 modeled ozone days in in the base year simulation at each monitoring sites. Specifically, the RRF for an individual monitoring is the ratio of the *average* MDA8 ozone concentration in the future year to the *average* MDA8 concentration in the base year. Note that for cases where the base year model simulation does not have 10 days with ozone values >= 60, ppb, EPA recommends using all days >=60 ppb, as long as there are at least 5 days that meet the criteria. If there are less than 5 days, EPA recommends that agencies do not calculate a DVF for the site. The guidance recommends calculating the RRF using base year and future year model predictions from the grid cells immediately surrounding the monitoring site using a 3X3 array centered on the location of the grid cell containing the monitor. The grid cell with the highest base year MDA8 ozone concentration on each day in the applicable array of

[80] Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM2.5 and Regional Haze. November 2018. Ch 4.

grid cells surrounding the location of the monitoring site is used for both the base and future components of the RRF calculation.

EPA's guidance indicates that the average design value is the metric considered for the attainment test. Projected average design values that are greater than or equal to 71 ppb are considered to be violating the 2015 ozone NAAQS. EPA's modeling results show all monitors In the Philadelphia Nonattainment Area below 71 ppb and therefore the area is considered in attainment of the standard. EPA's photochemical modeling results are presented in Appendix G-2.

In summary, EPA's modeling results provide additional support for Maryland's modeling conclusions of attainment for the area.

11.2 CMAQ VS. CAMX

EPA's modeling guidance indicates that the most commonly used chemical transport models for attainment demonstrations are CMAQ and CAMx. EPA supports the use of either photochemical model in demonstrating attainment of an ozone standard. EPA makes careful note that the mention of CMAQ and CAMx is not intended to be a comprehensive list of available models, nor does it imply that a model is "preferred" for a particular type of application.[81] EPA does however require that the model should meet the general criteria as outlined in 40 CFR Part 51 Appendix W.

Per EPA's guidance, there is no preferred model – only the requirement that the model meet the criteria in Appendix W. For this attainment demonstration, UMD used EPA's Community Multiscale Air Quality (CMAQ) version 5.3.3. CMAQ has been used extensively for SIP modeling since its initial release in 1998 and allows regulatory agencies to better understand current air quality issues and test air quality attainment strategies; it meets all of the general criteria as outline in Appendix W. See Appendix F-2, Chapter 2 for additional information on the air quality model selection.

Both modeling platforms demonstrate the Philadelphia area will attain the standard. The fact that EPA's CAMx modeling produced a slightly higher design value (while still demonstrating attainment) does not indicate an error. In fact, it is expected. Given identical inputs, multiple studies have shown that CAMx typically predicts higher ozone than CMAQ:

- CAMx is uniformly higher than CMAQ and shows less agreement with observations of ozone, which we can attribute to difference in vertical mixing.[82]
- CAMx tends to predict more ozone than the CMAQ modeling system.[83]

[81] Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM2.5 and Regional Haze. November 2018. Pg. 24.

[82] Goldberg et. al., 2014. https://www2.atmos.umd.edu/~dgoldb/Goldberg_CAMx_poster.pdf

[83] Baker et. al., 2008. https://www.regulations.gov/document/EPA-HQ-OAR-2018-0225-0412

- The predicted ozone concentrations in CAMx were significantly higher than those predicted by CMAQ.[84]
- The domain-averaged surface ozone is higher in CAMx than CMAQ at all hours except between 8-10 am PST.[85]

In this case, CMAQ and CAMx were given identical inputs (save the modeling domain size), and predictably produced similar 2023 design value model results. Both models predicted attainment for the Philadelphia Nonattainment Area.

The fact that two distinct modeling platforms produced by two separate modeling centers agree that the area models attainment provides a significant weight of evidence supporting the conclusions of both models: photochemical modeling demonstrates the area will attain the 2015 ozone NAAQS.

11.3 INTERAGENCY CONSULTATION SHOWING AGREEMENT IN PHOTOCHEMICAL MODELING BETWEEN ALL STATES IN THE PHILADELPHIA NONATTAINMENT AREA

The Philadelphia Nonattainment Area (NAA) comprises four states: Pennsylvania, New Jersey, Maryland, and Delaware. Maryland is responsible for the Cecil County portion of the NAA. Being a multi-jurisdictional NAA, each state of the Philadelphia NAA is required to submit its own State Implementation Plan (SIP).

Section 182(j)(1) of the Clean Air Act (CAA) states:

> Each State in which there is located a portion of a single ozone nonattainment areas which covers more than one State (hereinafter in this section referred to as a "multi-state ozone nonattainment area") shall - (A) take all reasonable steps to coordinate, substantively and procedurally, the revisions and implementation of State implementation plans applicable to the nonattainment area concerned; and (B) use photochemical grid modeling or any other analytical method determined by the Administrator, in his discretion, to be at least as effective. The Administrator may not approve any revision of a State implementation plan submitted under this part for a State in which part of a multi-State ozone nonattainment area is located if the plan revision for that State fails to comply with the requirements of this subsection.[86]

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[84] Timin et. al., 2007. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=926a69457a9fbe2f4c864a9c1573464ab8b7b889

[85] Liang et. al., 2004. file:///C:/Users/Emily%20Bull/Downloads/80097.pdf

[86] 42 U.S. Code § 7511a - Plan Submissions and Requirements

MDE consulted with EPA Region 3 to determine if all states in a multi-state ozone nonattainment area have to use the same model and attainment demonstration in a SIP. EPA responded:

> EPA believes it is acceptable for each jurisdiction, in a multi-jurisdictional nonattainment area, to submit its' own unique modeled attainment demonstration if each modeling demonstration follows EPA modeling guidance. Additionally, each jurisdiction must work together to ensure that the modeling inventories used in each demonstration are consistent with each other in both the base and future year used in the modeling. The future year emission controls assumed in each demonstration should be the same or very similar. It is acceptable for the predicted future year design values to be slightly different, as long as each modeling demonstration shows that all monitors within the multi-state nonattainment area are in attainment.
>
> Each state's SIP should describe in detail how their modeling was performed and document that the emission inventories used in all modeling demonstrations for the nonattainment area lead to consistent results. Each state's SIP could also reference the other attainment modeling demonstrations for their area as weight-of-evidence that the area will attain the NAAQS.
>
> In conclusion, states that share nonattainment areas should work together to ensure that their attainment demonstrations complement each other and do not create incompatible results and conclusions. If states decide to use different modeling demonstrations, they need to show how the inventories used in each demonstration are similar. Each state needs to describe in detail the modeling they used to demonstrate attainment and should cite results from the other modeling as part of the weight-of-evidence section in their SIPs.[87]

On February 21, 2023, the state air agencies for Pennsylvania, Delaware, New Jersey, and Maryland met to discuss the modeling efforts for the 2015 Ozone NAAQS attainment demonstration. In particular, the group compared Maryland Department of the Environment's (MDE) modeling that was conducted by University of Maryland College Park (UMD) to the Ozone Transport Commission's (OTC) modeling which will be used by the other states in the nonattainment area. Table 11-2 gives an overview of the comparison between the modeling efforts of the two groups, and Table 11-3 provides the design values calculated for each modeling platform for 2023.

As shown in Table 11-2, the key elements in the inventory and photochemical modeling are identical except for:

- The Biogenic Emissions Model land use database
    - The UMD modeling used the EPA's 2016v2 "off the shelf emissions inventory. This includes only v2 emissions as generated by the EPA and the National Emissions Inventory Collaborative. It was determined post-release of the

[87] Email from Keila Panan-Incle: [*External] Philadelphia Area - Modeling Efforts.* January 25, 2023

inventory and modeling platform that the biogenic emissions model contained an error which resulted in an underestimation of biogenic Volatile Organic Compounds (VOCs) in the Southeast U.S. It was determined that the 2016v2 modeling platform results were still reasonable for use because the region encompassing the Philadelphia NAA is NOx limited - and thus a correction to VOC's would unlikely significantly impact modeled ozone projections.
    - The OTC modeling used a corrected version of the biogenic emissions model land use database which corrected the underestimation of biogenic VOCs.
- The Emissions Inventory
    - The UMD modeling used the EPA's 2016v2_fj "off the shelf emissions inventory. This includes only v2 emissions as generated by the EPA and the National Emissions Inventory Collaborative.
    - The OTC modeling used a v2/v3_fj hybrid approach which used 2016v2 for all sectors except for Solvents and Commercial Marine Vessels. For these two sectors, the OTC modeling used EPA's 2016v3 emissions inventory. The v3 solvents included emissions inventory updates submitted by the states - mostly based on comments from New Jersey. The v3 commercial marine vessels included updates and corrections affecting the location of emissions around New Jersey and New York; it only included corrections regarding the location of the emissions and did not effect the overall total.
- The Electric Generating Unit (EGU) model
    - UMD modeling used the EPA's 2016v2 "off the shelf" emissions inventory. For EGU's, this inventory was generated using the Integrated Planning Model (IPM). IPM is a linear programming model that accounts for variables and information such as energy demand, planned unit retirements, and planned rules to forecast-unit level energy production and configurations.
    - OTC modeling used the Eastern Technical Advisory Committee on Electric Generating Units (ERTAC EGU) model version 2016.2 for EGUs. ERTAC EGU is a pattern-matching model. The model imports base year Continuous Emissions Monitoring data from the U.S. EPA and sorts the data from the peak to the lowest generation. It applies regional projections of electric generation growth using the Annual Energy Outlook and North American Reliability Council growth rates. It accounts for known shutdowns, new units, emissions controls and fuel switches.

Table 11-2: Comparison of UMD and OTC Attainment Demonstration Modeling

	OTC Modeling - Philadelphia NAA for SIPs Submitted by DE, NJ, and PA	UMD Modeling - Philadelphia NAA for SIP Submitted by MD
Photochemical Grid Model	CMAQ 5.3.3	CMAQ 5.3.3
Horizontal Grid Mesh	12OTC2	12OTC2
Grid Cells	273x246	273x246
Vertical Grid Mesh	35 Layers	35 Layers
Meteorological Model	WRF Version 3.8	WRF Version 3.8
Biogenic Model	BEIS Version 3.7 with Updated BELD5	BEIS Version 3.7 with BELD5
Boundary Conditions	36-km CMAQ using EPA V2 emissions	36-km CMAQ using EPA V2 emissions
Gas Phase Chemistry	CB6r3	CB6r3
Emissions Inventory	2016V2V3_fj	2016v2_fj
Includes Water Cell Adjustment?	No	No
EGU Model	ERTAC EGU	IPM
Includes Revised CSAPR Update?	Yes	Yes

As shown in table 11-3, despite slight differences in the model inputs, the model outputs produced similar design values for all monitors in the Philadelphia NAA.

Table 11-3: Comparison of Design Values Between UMD and OTC Attainment Demonstration Modeling

Site ID	State	County	Site name	2014-2018 Design Value	OTC Modeling - Philadelphia NAA Results for SIPs Submitted by DE, NJ and PA	UMD Modeling - Philadelphia NAA Results for SIP Submitted by MD
100010002	Delaware	Kent	KILLENS POND STATE PARK	66.3	58	57
100031007	Delaware	New Castle	Lums Pond	68	58.9	58
100031010	Delaware	New Castle	BCSP	73.7	65.5	65
100031013	Delaware	New Castle	BELLEVUE STATE PARK	71	62.8	62
100032004	Delaware	New Castle	MLK	71.3	63.1	62
240150003	Maryland	Cecil	Fair Hill	74	64.4	63
340010006	New Jersey	Atlantic	Brigantine	63.7	58.4	58
340070002	New Jersey	Camden	Camden Spruce Street	75.3	67.2	66
340071001	New Jersey	Camden	Ancora State Hospital	67.3	59.2	59
340110007	New Jersey	Cumberland	Millville	65.7	58.1	58
340150002	New Jersey	Gloucester	Clarksboro	73.7	65.8	66
340210005	New Jersey	Mercer	Rider University	71.3	63.3	62
340219991	New Jersey	Mercer	Wash. Crossing	73.3	65.5	65
340290006	New Jersey	Ocean	Colliers Mills	72.7	64.6	64
420110006	Pennsylvania	Berks	Kutztown	65.7	57.8	58
420110011	Pennsylvania	Berks	Reading Airport	70	61.2	61
420170012	Pennsylvania	Bucks	Bucks	79.3	70.2	69
420290100	Pennsylvania	Chester	CHESTER	72.7	63.8	63
420450002	Pennsylvania	Delaware	Delaware	71.3	63.4	62
420910013	Pennsylvania	Montgomery	Montgomery	71.3	64	63
421010004	Pennsylvania	Philadelphia	Air Management Services Laboratory	61	54.2	N/A
421010024	Pennsylvania	Philadelphia	North East Airport (NEA)	77.7	69	68
421010048	Pennsylvania	Philadelphia	North East Waste (NEW)	75.3	66.9	66

The consensus amongst the group was that there was no significant difference in the emissions inventory, including in control measures. Additionally, the architecture and models used are similar if not identical. The group determined that the design value conclusions are the same: projected attainment of the 2015 Ozone NAAQS for the Philadelphia NAA.

Appendices

Appendix A – *(Chapter 3 & 4)* Emission Inventories (Base Year/Projection Year)

- Appendix A-1: Projection Year Emission Inventory Methodologies
- Appendix A-2: Point Source Base Year Inventory
- Appendix A-3: Quasi-Point Source Base Year Inventory
- Appendix A-4: Area Source Base Year Inventory
- Appendix A-5: Mobile Source Base Year Inventory
- Appendix A-6: Nonroad Source Base Year Inventory

Appendix B – *(Chapters 4 & 5)* Reasonable Further Progress Calculations

Appendix C – *(Chapter 6.2)* Regulatory Support Information

Appendix D – *(Chapter 7)* RACM Measures List

Appendix E – *(Chapter 8)* Mobile Source Documentation

- Overview
- Data Sources
- Analysis Methodology
- Emission Estimates
- Sample Input/Output Files

Appendix F – *(Chapter 10)* Attainment Demonstration

Appendix F-1: Conceptual Description

Appendix F-2: Attainment Photochemical Modeling Protocol

Appendix G – *(Chapter 11)* Weight of Evidence Supporting Documentation

Appendix G-1 – EPA Technical Support Documentation: Air Quality Modeling

Appendix G-2 – EPA Photochemical Modeling Results

Appendix H – Public Hearing Notices, Comments, and Responses