Delaware's Visibility State Implementation Plan (SIP) Revision

DRAFT November 2021

Table of Contents

List of Figures

List of Tables

List of Appendixes

Appendix 8-10	Inter-RPO State/Tribal and FLM Consultation Framework. (MANE-VU, May 2006)
Appendix 8-11	MANE-VU Regional Haze Consultation Plan. (MANE-VU, May 2017)
Appendix 8-12	MANE-VU Regional Haze Consultation Report. (MANE-VU, July 2018)
Appendix 8-13	National Park Service Letters. (April 2018 and October 2018)
Appendix 8-14	Agreement Governing the Acquisition and Operation of Delaware City Refinery (May 2010)
Appendix 9-1	Statement of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Concerning a Course of Action within MANE-VU toward Assuring Reasonable Progress for the Second Regional Haze Implementation Period (2018-2028). (August 2017)
Appendix 9-2	Inter-RPO Consultation Briefing Book. (MANE-VU Resolution for Reasonable Progress) (MANE-VU, May 2006)
Appendix 9-3	Statement of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Concerning a Course of Action in Contributing States Located Upwind of MANE-VU toward Assuring Reasonable Progress for the Second Regional Haze Implementation Period (2018-2028). (August 2017)
Appendix 9-4	Statement of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Concerning a Course of Action by the Environmental Protection Agency and Federal Land Managers Toward Assuring Reasonable Progress for the Second Regional Haze Implementation Period (2018-2028). (August 2017)
Appendix 10-1	Facility Responses to Delaware Department of Natural Resources and Environmental Control Request for Information for MANE-VU "Asks".
Appendix 10-2	Calpine Title V Operating Permits - Christiana Energy Center, Delaware City Energy Center, and West Energy Center. (May 2021)

List of Acronyms

AERR	Air Emissions Reporting Requirements
AMPD	Air Markets Program Data
BART	Best Available Retrofit Technology
BTU	British Thermal Unit
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
CSAPR	Cross-State Air Pollution Rule
DCRC	Delaware City Refining Company, LLC
Department	Delaware Department of Natural Resources and Environmental Control
DNREC	Delaware Department of Natural Resources and Environmental Control
DSI	Dry Sorbent Injection
EEAC	Delaware Energy Efficiency Advisory Council
EGU	Electric Generating Unit
EPA	Environmental Protection Agency
ERTAC	Eastern Regional Technical Advisory Committee
ESP	Electrostatic Precipitator
FCCU	Fluid Catalytic Cracking Unit
FCU	Fluid Coking Unit
FGD	Flue Gas Desulfurization
FLM	Federal Land Managers
HEDD	High Electric Demand Days
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory Model
ICI	Industrial, Commercial, and Institutional
IMPROVE	Interagency Monitoring of Protected Visual Environments
lb	Pound
LNB	Low NOx Burner
LTS	Long-Term Strategy
MACT	Maximum Achievable Control Technology
MANE-VU	Mid-Atlantic/Northeast Visibility Union
MARAMA	Mid-Atlantic Regional Air Management Association
Mm^{-1}	Inverse Megameter
MMBTU	Million British Thermal Units
MW	Megawatt
NAAQS	National Ambient Air Quality Standard
NEI	National Emissions Inventory
NESCAUM	Northeast States for Coordinated Air Use Management
NH_3	Ammonia
NO_x	Nitrogen Oxides

NPS	National Park Service
NSPS	New Source Performance Standards
O_2	Oxygen
OTC	Ozone Transport Commission
PM_{10}	Particulate matter less than 10 microns
$PM_{2.5}$	Fine particles; particulate matter less than 2.5 microns
ppm	Parts per million
ppmvd	Parts per million by volume, dry
PSD	Prevention of Significant Deterioration
Q/d	Emissions Over Distance
RACT	Reasonably Available Control Technology
RGGI	Regional Greenhouse Gas Initiative
RHR	Regional Haze Rule
RICE	Reciprocating Internal Combustion Engines
RPG	Reasonable Progress Goal
RPO	Regional Planning Organization
SB	Senate Bill
S/L/T	State/Local/Tribal
SCC	Source Classification Code
SCR	Selective Catalytic Reduction
SIP	State Implementation Plan
SMP	Smoke Management Program
SNCR	Selective Non-Catalytic Reduction
SO_2	Sulfur Dioxide
tpy	tons per year
TSC	Technical Support Committee
TSD	Technical Support Documents
URP	Uniform Rate of Progress
VOC	Volatile Organic Compounds
WI	Water Injection

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EXECUTIVE SUMMARY

Regional haze is defined as visibility impairment that is produced by a multitude of sources and activities which emit fine particles and their precursors, and which are located across a broad geographic area. These emissions are transported over large regions, and impact areas that include the entire State of Delaware, and national parks and wilderness areas ("Class I" federal areas). The Clean Air Act (CAA) mandates protection of visibility in Class I areas. In 1999, and in various revisions that extend through 2017, the U.S. Environmental Protection Agency (EPA) finalized the Regional Haze Rule (RHR)[1]. The rule calls for state, tribal, and federal agencies to work together to improve visibility in 156 national parks and wilderness areas.

Under the RHR[2], states are required to develop a series of state implementation plans (SIP) to address visibility impairment in Class I areas and make reasonable progress toward achieving natural visibility conditions. On September 25, 2008 Delaware submitted its "Delaware Visibility State Implementation Plan" (Regional Haze SIP) to EPA, which was approved on July 19, 2011. This SIP covered the first implementation period of 2008 – 2018. This SIP was developed based on consultations and work-products of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Regional Planning Organization (RPO).

Section 308(f) of the 1999 RHR[3] also required each state to revise and submit a SIP revision to EPA by July 31, 2018 and every ten years thereafter; therefore, the end date for this second implementation period is 2028. A 2017 RHR[4] revision extended the SIP submittal date to July 31, 2021, but left the end date for the second implementation period at 2028.

This SIP revision must establish emissions reduction strategies and interim goals for 2028, reflecting on those strategies as well as trends from various sources including point, area, and mobile (both onroad and nonroad) source emissions, as well as biogenic, wildfire, and agricultural emissions. It encompasses 1) monitoring strategies for evaluating visibility impacts, 2) baselines and trends, and 3) long-term strategies (LTS).

This SIP also demonstrates that Delaware has met its LTS obligations for 2028 visibility impairment through existing Delaware/Federal regulations and on-the-books federal emission controls. In addition to extensive consultation with the MANE-VU states, Delaware consulted with Federal Land Managers (FLMs) responsible for the Class I areas, and the EPA in the development of the SIP.

1 Protection of Visibility: Amendments to Requirements for State Plans. EPA Final Rule. 82 FR 3078. January 10, 2017.
2 Ibid., 1
3 Regional Haze Regulations. EPA Final Rule. 61 FR 35714. July 1, 1999.
4 Ibid, 1

The Delaware Department of Natural Resources and Environmental Control (DNREC) will submit this SIP revision to the EPA to fulfill its obligation under EPA's RHR[5]. A public hearing will be held for this plan on December 29, 2021, and the proposed plan may be adopted for submittal to EPA.

Delaware will continue to coordinate with other states, FLMs, EPA, MANE-VU, and other RPOs to maintain/improve the visibility in Class I areas. This coordination will include progress reports, SIP revisions, and face-to-face consultation meetings, as necessary.

5 Ibid, 1

Section 1 - Background and Overview

1.1 Introduction

Regional haze is defined as visibility impairment that is produced by a multitude of sources and activities which emit fine particles and their precursors, and which are located across a broad geographic area. These emissions are transported over large regions, including national parks, forests, and wilderness areas ("Class I" federal areas). The Clean Air Act (CAA) mandates protection of visibility in Class I areas.

Fine particles ($PM_{2.5}$) may either be emitted directly or formed from emissions of precursors, the most important of which are sulfur dioxide (SO_2) and nitrogen oxides (NO_x). Particles affect visibility through the scattering and absorption of light, and fine particles - particles similar in size to the wavelength of light - are most efficient, per unit of mass, at reducing visibility. Therefore, reducing fine particles (particles with a diameter less than 2.5 μm), in the atmosphere is generally considered to be an effective method of reducing regional haze, and thus improving visibility. The most important sources of $PM_{2.5}$ and its precursors are coal-fired power plants, industrial boilers, and other combustion sources. Other significant contributors to $PM_{2.5}$ and visibility impairment include mobile source emissions, area sources, fires, and wind-blown dust.

The national goal declared in the CAA Regional Haze Program is to return the visibility condition in our national parks and wilderness areas to their "natural" conditions. The goal of the Regional Haze Program is to make reasonable progress towards natural conditions. Because visibility impairment is caused by the transport of anthropogenically generated emissions, across wide geographic areas which incorporate numerous state and local boundaries, the solution to our visibility problem must be developed on a regional scale and national scale (See Section 1.3 of this State Implementation Plan (SIP)).

1.2 Regulatory Development

In 1977, Congress recognized that our ability to see should be protected, and they adopted provisions in the CAA to improve the visibility "in areas of great scenic importance." These areas have become known as the mandatory Class I Federal Areas (Class I areas) and are located in 35 states and one territory. [40 CFR 81.401-437] The Class I designation applies to national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres that were in existence as of 1977. Class I areas include 156 national parks and wilderness areas (Figure 1-1).

Figure 1-1: Class I Areas

In 1999, the U.S. Environmental Protection Agency (EPA) published the Regional Haze Rule (RHR)[6] to improve air quality in the Nation's national parks and wilderness areas. The RHR required all States to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment found in the 156 Class I areas, in coordination with EPA, the National Park Service (NPS), U.S. Fish and Wildlife Service, the U.S. Forest Service, and other interested parties.

EPA most recently revised the RHR[7] on January 10, 2017. This revision clarified the relationship between the long-term strategies (LTS) and the reasonable progress goals (RPGs), strengthened the Federal Land Managers (FLM) consultation requirements; updated the SIP submittal deadlines for the second planning period to July 31, 2021; adjusted the deadlines for progress report submissions; and removed the requirement for progress reports to take the form of SIP revisions. More details on the history of Regional Haze regulations can be found in Delaware's 2008 Regional Haze SIP, Section 1.2.

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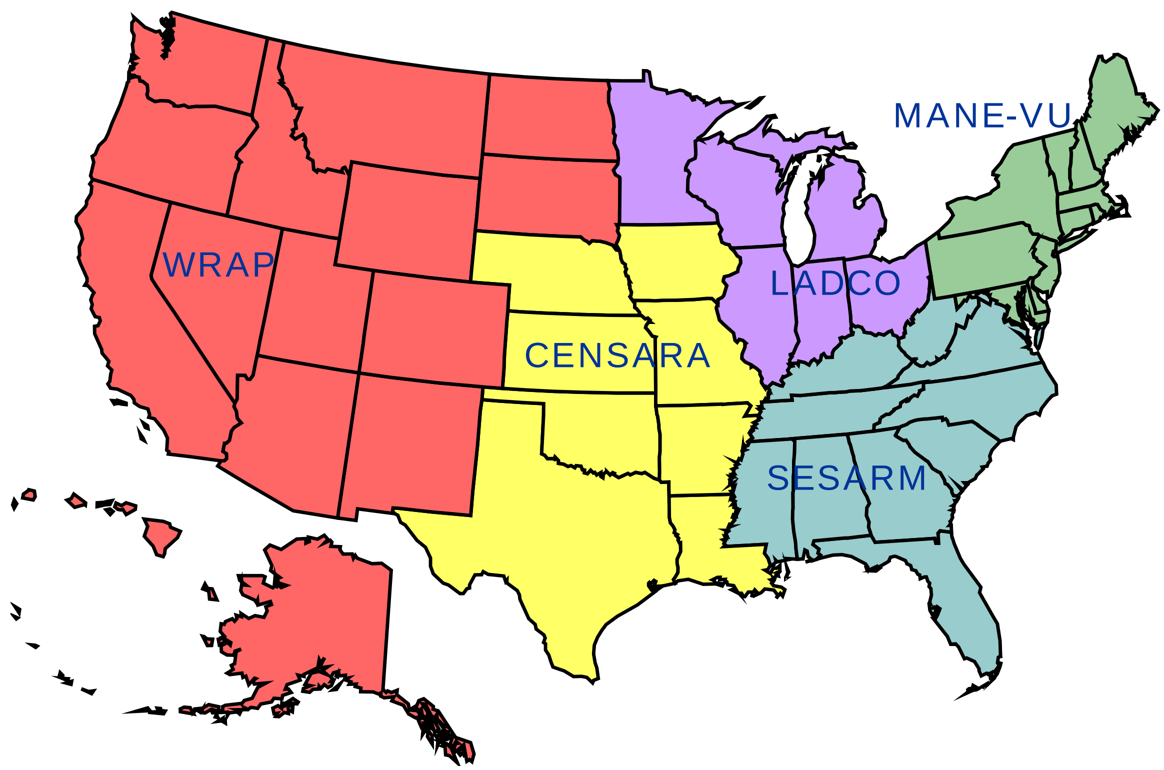
6 Ibid., 3
7 Ibid., 1

1.3 Regional Planning Organizations

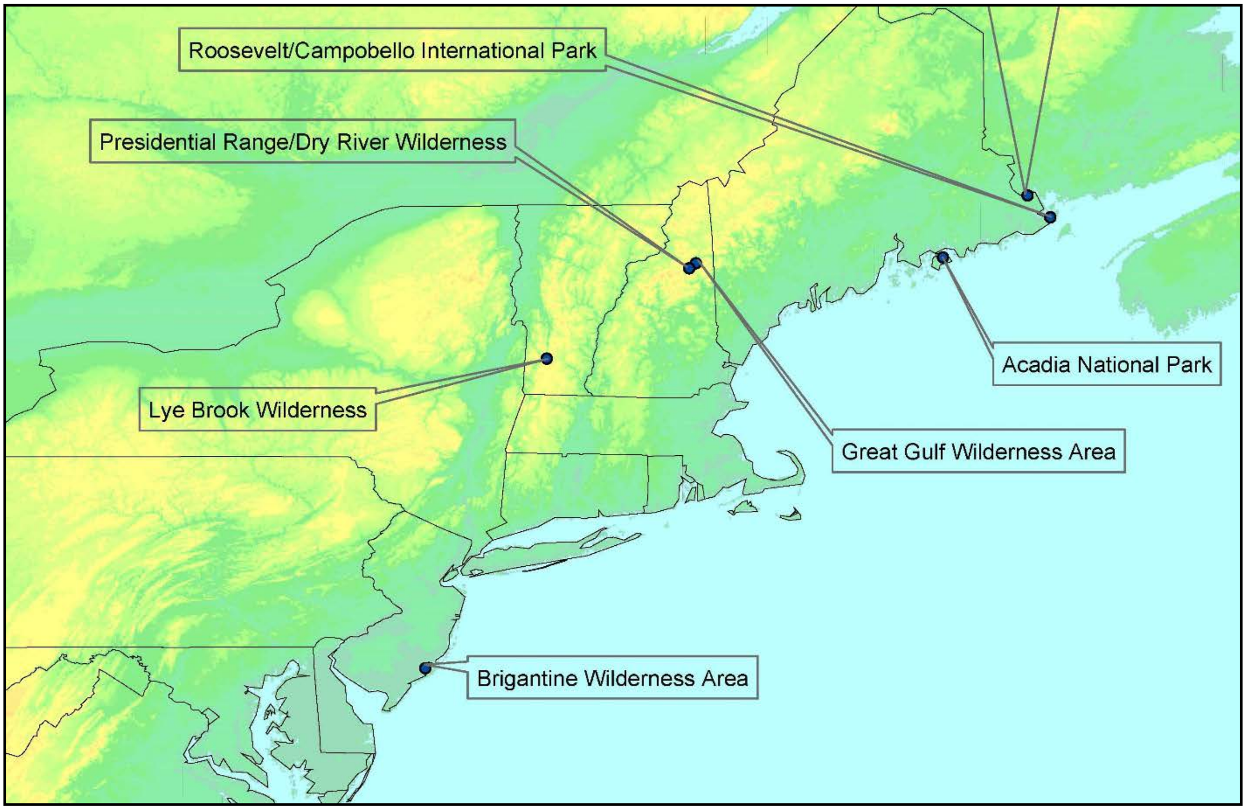
To aid states in their efforts to develop the technical basis for the state's implementation plans, five multi-state regional planning organizations (RPOs) have been established – Western Regional Air Partnership (WRAP), Central States Air Resources Agencies (CENSARA), Lake Michigan Air Directors Consortium (LADCO), Mid-Atlantic/Northeast Visibility Union (MANE-VU), and Southeastern Air Pollution Control Agencies (SESARM) (Figure 1-2). These organizations provide a forum for state air control administrators to develop regional strategies to address regional haze and to coordinate with other regions. Delaware is a member of the MANE-VU.

Figure 1-2: Map of U.S. Regional Planning Organizations



The Mid-Atlantic Region Air Management Association (MARAMA), the Northeast States for Coordinated Air Use Management (NESCAUM), and the Ozone Transport Commission (OTC) established the MANE-VU RPO to coordinate efforts to address visibility impairment at seven Class I areas located in the Mid-Atlantic and Northeast corridor: Acadia National Park, ME; Brigantine Wilderness, NJ; Great Gulf Wilderness, NH; Lye Brook Wilderness, VT; Moosehorn Wilderness, ME; Presidential Range – Dry River Wilderness, NH; and Roosevelt Campobello International Park, New Brunswick (Figure 1-3). Section 3 of this SIP provides additional information on MANE-VU and how Delaware fits into the regional planning process.

Figure 1-3: MANE-VU Class I Areas



1.4 Required Elements for State Implementation Plan Revisions

The RHR[8] requires each State, as well as the District of Columbia and the Virgin Islands, to develop a SIP for reducing regional haze. The plan must include goals aimed at improving visibility, and a long-term plan for reducing pollutant emissions that contribute to visibility degradation.

The RHR[9] gives States the flexibility to determine what measures are necessary to make reasonable progress and encourages States to coordinate with each other through regional planning efforts. The core areas to be addressed in this SIP revision are codified at 40 CFR 51.308(f), (g), and (i). The core elements in this SIP revision are addressed as follows:

8 Ibid., 1
9 Ibid., 1

Regional Haze Implementation Plan SIP Revision Elements - 40 CFR 51.308		
Source:	**Required Element:**	**Location in SIP:**
(f)	*Requirements for comprehensive periodic revisions of implementation plans for regional haze.*	Section 11 - Comprehensive Periodic Implementation Plan Revisions
(f)(1)	*Calculations of baseline, current, and natural visibility conditions, and the uniform rate of progress.*	Section 5 - Assessment of Baseline, Natural and Current Conditions (Not required for non-Class I states, but provided for reference).
(f)(2)	*Long-term strategy for regional haze.*	Section 8 - Delaware's Long-Term Strategy
(f)(3)	*Reasonable progress goals.*	Sections 9 and 10 (Not required for non-Class I states, but provided for reference).
(f)(4)	*…additional monitoring to assess reasonably attributable visibility impairment at the mandatory Class I Federal area in addition to the monitoring currently being conducted*	Not required for non-Class I states
(f)(5)	*So that the plan revision will serve also as a progress report, the State must address in the plan revision the requirements of paragraphs (g)(1) through (5) of this section.*	See (g)(1) through (5) below
(f)(6)	*Monitoring strategy and other implementation plan requirements.*	Section 6 - Monitoring Strategy and Section 7 - Emissions Trends
(g)	*Requirements for periodic reports describing progress towards the reasonable progress goals.*	Section 11 - Comprehensive Periodic Implementation Plan Revisions
(g)(1)	*Status of implementation of SIP measures.*	Section 10.7
(g)(2)	*Summary of emissions reductions through implementation of measures for achieving reasonable progress goals.*	Section 10.7
(g)(3)	*Visibility changes and conditions.*	Section 5 - Assessment of Baseline, Natural and Current Conditions (Not required for non-Class I states, but provided for reference).
(g)(4)	*Trends in emissions of visibility impairing pollutants.*	Section 7 – Emission Trends
(g)(5)	*Significant changes in anthropogenic emissions.*	Section 7 – Emission Trends
(i)	*State and Federal Land Manager coordination*	Section 4 - Federal Land Manager Coordination

1.5 Area of Influence for MANE-VU Class I Areas

The key difference between SIPs from States with Class I areas and States without Class I areas is the calculation of the baseline and natural visibility for their Class I areas, and the determination of RPGs. Class I States calculate baseline visibility conditions for the period between 2000 and 2004. The average impairment for the most and least impaired days are determined for each calendar year and compiled into the average of the five annual averages (40 CFR 51.308 (f)(1)(i)). The natural visibility conditions for the most and least impaired days is calculated by estimating the average deciview index based on available monitoring data and appropriate data analysis technique (40 CFR 51.308 (f)(1)(ii)).

While there are several requirements that are solely placed on States with Class I areas all states are responsible for establishing an LTS so that the Class I areas affected by emissions from the state can make reasonable progress towards natural conditions.

There are seven Class I areas located in the Mid-Atlantic and Northeast. Delaware does not have a Class I area located within its borders. As a result, the RHR[10] requires Delaware, in consultation with MANE-VU and others, to identify where its emissions are most likely to influence visibility in Class I areas. For the second implementation period, in order to identify states whose emissions are most likely to influence visibility in MANE-VU Class I areas, MANE-VU prepared the *Selection of States for MANE-VU Regional Haze Consultation (2018)* (Appendix 1-1) [Selection of States]. As detailed within the report, MANE-VU initiated a process of screening states and sectors for contribution using two tools, emissions over distance (Q/d) and the CALPUFF model.

During the first implementation period, MANE-VU used a 2% cutoff for contribution of the sulfate ion, for determining which states it would recommend participate in the consultation process with Class I states. The only Class I area that Delaware had a least a 2% contribution for was Brigantine National Wildlife Refuge (Brigantine) in New Jersey (located within the Edwin B. Forsythe National Wildlife Refuge). Modeling indicated that Delaware contributed at least 2% in Brigantine in 2002.

For the second implementation period, MANE-VU is again using the same 2% cutoff threshold for determining which states would need to participate in the consultation process, but considered both sulfate and nitrate in the modeling. MANE-VU's analysis estimated contribution from Delaware sources of less than 2% of visibility impairment for all seven MANE-VU Class I areas (see Section 8.3 and Table 8-1 of this SIP for modeling results). Two of the MANE-VU Class I areas, Roosevelt Campobello International Park and Presidential Range-Dry Wilderness, do not have Interagency Monitoring of Protected Visual Environments (IMPROVE) monitors. The visibility monitors at Moosehorn Wilderness and Great Gulf are considered representative for these Class I areas, respectively. Therefore, results of the contribution assessment for these Class I areas are representative of Roosevelt and Presidential-Dry Range.

Even with a contribution level below 2%, Delaware agreed to participate in the consultation process, as part of the MANE-VU RPO. This technical work is discussed further in Sections 8 and 9 of this SIP. A full discussion of the process and outcome of consultations between Delaware and other states is contained in Section 9.1 of this SIP. MANE-VU "Asks" or emission reduction measures identified as necessary to make reasonable progress in MANE-VU Class I areas, are discussed in Section 9. The details for how Delaware met or will meet each MANE-VU "Ask" is provided in Section 10.

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10 Ibid., 1

1.6 What are Long-term Strategies?

A core component of the SIP is to develop a Long-Term Strategy (LTS) that includes enforceable emissions limitations, compliance schedules, and other measures necessary to make reasonable progress in affected Class I areas. States without Class I areas but with sources identified to cause or contribute to another State’s Class I area must consult with that State in order to develop coordinated emission management strategies containing the emission reductions necessary to make reasonable progress (40 CFR 51.308 (f)(2)(ii)). The consultation process and Delaware’s Long-Term Strategy are discussed in Sections 9 and 8, respectively.

1.7 What are Reasonable Progress Goals?

Reasonable Progress Goals (RPGs) are visibility goals for each planning period. RPGs must be set based on LTS that consider certain statutory factors established by Congress[11] that include - the costs of compliance, time needed for compliance, and energy and non-air quality environmental impacts along with the remaining useful life of any potentially affected sources. For each Class I area located within a State, the Class I State must establish goals (expressed in deciviews) that reflect the visibility conditions projected to be achieved as a result of the State’s own LTS, other States’ LTS, and other emission reduction programs (40 CFR 51.308 (f)(3)(i)). These requirements only apply to states containing Class I areas. Therefore, Delaware will not address these requirements in this SIP.

While Delaware is not a Class I state, it is still required to take steps to help meet the Reasonable progress goals set by the Class I states (40 CFR 51.308 (f)(3)(ii)(b)). MANE-VU states worked together to develop emission management strategies to meet the RPGs in MANE-VU Class I areas. Each MANE-VU state was asked to address these strategies in their SIP. These strategies are referred to as “Asks”. These Asks are discussed in Section 9.4.

1.8 Periodic Updates and Revisions to SIPs

Other details to be discussed in this SIP include the process to submit periodic plan revisions to EPA, with the next revision due by 2028. In addition to submitting plan revisions every ten years, Delaware will discuss how we intend to evaluate and report our progress towards the RPGs established for each Class I area located outside the State, which may be affected by emissions from within the State. These progress reports were to be submitted every five years to EPA, but in the 2017 RHR[12], EPA limited the requirement for separate progress reports to the one due mid-way between periodic comprehensive SIP revisions. In accordance with the 2017 RHR, the next progress report will be due January 31, 2025. Depending on the findings of the progress report, the State commits to taking one of the actions listed in 40 CFR 51.308(h) (see Section 12 of this SIP).

11 Clean Air Act. Section 169A. Visibility Protection for Federal Class I Areas. August 7, 1977.
12 Ibid., 1

Section 2 - General Planning Provisions & Future Submissions

The RHR[13] gives the States the flexibility to develop cost-effective strategies for pollution reductions, and encourages States to coordinate with each other through regional planning efforts. The core areas to be addressed in the SIP are (1) calculation of Baseline and Natural Visibility Conditions – Class I States only; (2) LTS; (3) RPGs; (4) Monitoring Strategy and Other Implementation Plan Requirements; and (5) Progress Report requirements.

- Pursuant to the requirements of 51.308(a) and (b), Delaware submits this SIP to meet the requirements of EPA's RHR[14] that were adopted to comply with requirements set forth in the CAA. This SIP addresses Regional Planning, State, and FLM coordination. In addition, it contains an update on Best Available Retrofit Technology (BART), as part of the status of implementation of all measures included in the previous implementation plan, a commitment to provide Plan revisions, and adequacy determinations.

- Section 51.308(f) requires the States to submit their SIP revision by July 31, 2021, July 31, 2028, and every ten years thereafter.

- Section 51.308(g) requires states to submit a progress report to EPA by January 31, 2025; July 31, 2033; and every 10 years thereafter evaluating progress towards the RPG for each Class I area located within the State and in each Class I area located outside the State that may be affected by emission from within the State.

- In accordance with Section 51.308(h), at the time the progress report is submitted, Delaware will also submit a determination of the adequacy of its existing SIP revision.

- Administrative Requirements from Appendix V to CFR Part 51 require Delaware to demonstrate it has legal authority to adopt and implement this Plan. Legislative authority for the Delaware air quality program relating to the responsibilities in the CAA is codified in Title 7 "Conservation" of the Delaware Code, Chapter 60[15] – Delaware's comprehensive water and air resources conservation law, which gives the Delaware Department of Natural Resources and Environmental Control (DNREC) the power and duty to implement the provisions of the CAA in the State of Delaware.

13 Ibid., 1
14 Ibid., 1
15 Title 7 "Conservation" of the Delaware Code, Chapter 60.
https://delcode.delaware.gov/title7/c060/sc02/index.html

Section 3 - Regional Planning

Because visibility impairment occurs across wide geographic areas which incorporate numerous state and local boundaries, the solution to visibility impairment is to address it on a regional scale with the primary goal of making reasonable progress toward returning the visibility condition in our national parks and wilderness areas to their "natural" conditions. As mentioned previously, in 1999, EPA and affected States/Tribes established five RPOs to facilitate interstate coordination on their SIPs. The State of Delaware is a member of the MANE-VU RPO. Members of MANE-VU are listed in Table 3-1.

Table 3-1: MANE-VU Members

Connecticut	Pennsylvania
Delaware	Penobscot Nation
District of Columbia	Rhode Island
Maine	St. Regis Mohawk Tribe
Maryland	Vermont
Massachusetts	U.S. Environmental Protection Agency*
New Hampshire	U.S. National Park Service*
New Jersey	U.S. Fish and Wildlife Service*
New York	U.S. Forest Service*

*Non-voting members

MANE-VU's work is managed by the OTC and carried out by OTC, MARAMA, and NESCAUM. The states along with federal agencies and professional staff from OTC, MARAMA, and NESCAUM are members of the various committees and workgroups.

Since its inception on July 24, 2001, MANE-VU established an active committee structure to address both technical and non-technical issues related to regional haze. The primary committee is the Technical Support Committee (TSC). The TSC is charged with assessing the nature and magnitude of the regional haze problem within MANE-VU, interpreting the results of technical work, and reporting on such work to the MANE-VU.

Further details on MANE-VU's background, purpose, roles, responsibilities, and organizational structure can be found in MANE-VU's *Final Interim Principles for Regional Planning* (Appendix 3-1).

This proposed SIP utilizes data analysis, modeling results and other technical support documents (TSD) prepared for and by MANE-VU TSC members. Information and a description of the processes used to consult regarding baseline determinations, natural background levels, and RPG development is available in Sections 8 and 9 of this SIP.

Section 4 - Federal Land Manager Coordination (40 CFR 51.308 (i))

The RHR[16] requires the states, in coordination with EPA, NPS, U.S. Fish and Wildlife Service, the U.S. Forest Service, and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment. Section 51.308(i) requires coordination between States/Tribes and the FLMs. Opportunities have been provided by MANE-VU for FLMs to review and comment on each of the technical documents developed by MANE-VU and included in this SIP. In the development of this Plan, the FLMs were consulted in accordance with the provisions of 51.308(i)(2). Delaware has provided the FLMs an opportunity for consultation, in person at least 120 days prior to holding any public hearing on this SIP (Appendix 4-1). This draft SIP was received by FLMs on February 11, 2021 for their review and comment.

Section 51.308(i)(4) requires procedures for continuing consultation between States and FLMs on the implementation of the visibility protection program, which are discussed in detail in Appendix 8-11 of this plan. Delaware consults with the FLMs on the status of the following implementation items:

1. Implementation of emissions strategies identified in the SIP as contributing to achieving improvement in the worst-day visibility;
2. Summary of major new source permits issued;
3. Status of State/Tribe actions to meet commitments for completing any future assessments or rulemakings on sources identified as likely contributors to visibility impairment, but not directly addressed in the most recent SIP revision;
4. Any changes to the monitoring strategy or monitoring stations status that may affect tracking of reasonable progress;
5. Work underway for preparing the 5-year reviews and / or 10-year revisions;
6. Items for FLMs to consider or provide support for, in preparation for any visibility protection SIP revisions (based on a 5-year review or the 10-year revision schedule under EPA's RHR[17]); and
7. Summary of topics discussion (meetings, emails, other records) covered in ongoing communications between the State/Tribe and FLMs regarding implementation of the visibility program.

The formal 120-day consultation was coordinated with the designated visibility protection program coordinators for the NPS, U.S. Fish and Wildlife Service, and the U.S. Forest Service. In accordance with 40 CFR 51.308(i)(3), this draft was revised as necessary following that formal consultation and prior to the publication of the proposed RH SIP for the public hearing. The comments and responses are included in Appendix 4-1 of this plan.

16 Ibid., 1
17 Ibid., 1

Delaware will provide FLMs with an opportunity to provide comments on future SIP revisions as required by Section 51.308(f). Section 51.308(g) requires Delaware to submit reports to the EPA evaluating progress towards the RPG for each Class I area that may be affected by emissions from within the State. The next progress report is due January 31, 2025. In accordance with Section 51.308(h), at the time of the report submission, Delaware will also submit a determination of the adequacy of its existing Regional Haze SIP revision.

Section 5 - Assessment of Baseline, Natural and Current Conditions (40 CFR 51.308 (f)(1) and (g)(3))

The requirement for this Section applies only to states containing Class I areas. Therefore, as Delaware does not have any Class I areas, it will not address these requirements in this SIP. Information regarding the progress being made toward improving visibility in the MANE-VU Region can be found in *Tracking Visibility Progress 2004-2018 (1st RH SIP Metrics)* (May 1, 2020 revision) and *Mid-Atlantic/Northeast U.S. Visibility Data 2004-2019 (2nd RH SIP Metrics)* (May 1, 2020 revisions) (January 21, 2021 revision)[18].

18 Tracking Visibility Progress 2004-2018 (1st RH SIP Metrics) (May 1, 2020 revision) and Mid-Atlantic/Northeast U.S. Visibility Data 2004-2019 (2nd RH SIP Metrics) (May 1, 2020 revisions) (January 21, 2021 revision) https://otcair.org/manevu/Document.asp?fview=Reports

Section 6 - Monitoring Strategy (40 CFR 51.308 (f)(6))

In the mid-1980's, the IMPROVE program was established to measure visibility impairment in mandatory Class I areas throughout the United States. The monitoring sites are operated and maintained through a formal cooperative relationship between the U.S. EPA, NPS, U.S. Fish and Wildlife Service, Bureau of Land Management, and U.S. Forest Service. In 1991, several additional organizations joined the effort: State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials, (which now goes by the name National Association of Clean Air Agencies), Western States Air Resources Council, MARAMA, and NESCAUM.

6.1 IMPROVE Program Objectives

Data collected at Class I area IMPROVE sites[19] are used by land managers, industry planners, scientists, public interest groups, and air quality regulators to understand and protect the visual air quality resource in Class I areas. Most importantly, the IMPROVE program scientifically documents for American citizens the visual air quality of their wilderness areas and national parks.

Program objectives include:

- Establishing current visibility and aerosol conditions in mandatory Class I areas,
- Identifying chemical species and emission sources responsible for existing anthropogenic visibility impairment,
- Documenting long-term trends for assessing progress towards the national visibility goals, and
- Providing regional haze monitoring representing all visibility-protected Class I areas where practical, as required by EPA's RHR[20].

Section 51.308(f)(6)(iii) of EPA's RHR[21] requires the inclusion of procedures by which monitoring data and other information are used in determining the contribution of emissions from within the State to visibility impairment at mandatory Class I areas.

Both Sussex and New Castle counties in Delaware were in non-attainment for the 2008 ozone National Ambient Air Quality Standard (NAAQS). EPA determined on May 4, 2016 that Sussex County attained the 2008 NAAQS by the July 20, 2015 attainment date. On November 2, 2017, EPA determined that New Castle County attained the 2008 ozone NAAQS by the July 20, 2016 attainment date – as part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE nonattainment area.

19 Delaware does not contain any Class I areas, and therefore does not have IMPROVE monitors.
20 Ibid., 1
21 Ibid., 1

On April 30, 2018 EPA finalized the designation of New Castle County as nonattainment under the 2015 NAAQS, as part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area. The area was classified as a Marginal nonattainment area, meaning it will have 3 years from the effective date of the designations to attain the standard. Accordingly, Delaware is required to maintain its current monitoring network, and to develop emission inventories once a year for major sources, and every three (3) years for all sources.

As mentioned above, the RHR[22] requires procedures by which other information is used in determining the contribution of emissions from within the State to visibility impairment at mandatory Class I areas. Delaware has conducted receptor modeling and emissions inventory analysis to determine source contributions to within the state, and the proportional impacts of those sources to areas outside the state.

Delaware accepts the Contribution Assessment analysis completed by NESCAUM entitled, *Contributions to Regional Haze in the Northeast and Mid-Atlantic States* (Appendix 8-2). Delaware agrees that NESCAUM is providing quality technical information by using the IMPROVE program data and the Visibility Information Exchange Web System (VIEWS) site. Delaware does not contain a Class I area; therefore, a monitoring plan is not required for this SIP.

22 Ibid., 1

Section 7 - Emissions Trends (40 CFR 51.308, (f)(6), (g)(4), and (g)(5))

40 CFR Section 51.308(f)(5) states that this periodic regional haze SIP must meet the requirement of 51.308(g)(4), which requires analysis of trends in emissions of visibility impairing pollutants.

7.1 Trends in Emissions of Visibility Impairing Pollutants

This section is intended to satisfy paragraph 40 CFR 51.308(g)(4) of the Regional Haze Program Requirements. Paragraph 51.308(g)(4) requires:

> *"An analysis tracking the change over the period since the period addressed in the most recent plan required under paragraph (f) of this section in emissions of pollutants contributing to visibility impairment from all sources and activities within the State. Emissions changes should be identified by type of source or activity. With respect to all sources and activities, the analysis must extend at least through the most recent year for which the state has submitted emission inventory information to the Administrator in compliance with the triennial reporting requirements of subpart A of this part as of a date 6 months preceding the required date of the progress report…The State is not required to backcast previously reported emissions to be consistent with more recent emissions estimation procedures, and may draw attention to actual or possible inconsistencies created by changes in estimation procedures."*

Delaware summarized emissions of visibility impairing pollutants from all sources and activities within the state from 2002 to 2017. The most recent year for which Delaware has submitted emission estimates to fulfill the requirements of 40 CFR 51 Subpart A (also known as the Air Emissions Reporting Requirements, or AERR) is 2017. In Sections 7.1.1 – 7.1.6 below, Delaware has provided estimates for NOx, particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), SO_2, volatile organic compounds (VOC), and ammonia (NH_3), all of which have the potential to contribute to regional haze formation. The data were obtained from EPA's National Emissions Inventory (NEI).[23] NEI data categories include point sources, nonpoint sources, non-road mobile sources, and on-road mobile sources and are described below:

- NEI Point sources are stationary facilities that generally report their emissions directly via state and/or Federal permitting and reporting programs. Point sources represent larger facilities such as electric generating units (EGUs), manufacturing facilities, and heating units for large schools and universities. As of 2008, mobile source nonroad emissions from airports, and railroad switch yards are inventoried as point sources in the NEI. In the tables and charts included in this section, point source NOx and SO_2 are further broken down into EPA Air Markets Program Data (AMPD) sources and non-AMPD sources. The majority of sources that report to EPA's AMPD are EGUs. Therefore, the AMPD point category is a reasonable representation of emissions from EGUs.

23 2017 National Emissions Inventory. https://www.epa.gov/air-emissions-inventories/emissions-inventory-system-eis-gateway

- NEI Nonpoint sources include stationary area sources and some mobile sources. Area sources are those emissions categories that are too small, widespread, or numerous to be inventoried individually. Therefore, emissions are estimated for these categories using aggregate activity data such as population, employment, and statewide fuel use (after accounting for the fuel used by point sources). There is a wide range of nonpoint categories, but examples include residential fuel combustion and commercial & consumer solvent use.

- NEI Non-road mobile sources represent vehicles and equipment that are not designed to operate on roadways. Examples include aircraft, ships, locomotives, construction equipment, recreational vehicles, and lawn & garden equipment (Note, however, that beginning in 2008, emissions from airports and some large rail yards are inventoried as point sources since these emissions occur at discrete locations. In addition, emissions from other locomotive activities and commercial marine vessels are inventoried as nonpoint sources.)

- NEI On-road mobile sources represent vehicles that operate on roadways, including cars, trucks, buses, and motorcycles.

The data used to create the tables in Sections 7.1.1 – 7.1.6, were taken from EPA's NEI. Under the AERR, states are required to submit estimates for all emissions categories to EPA on a three-year cycle. The state submittals are combined with EPA's own estimates to form the NEI. Note that 2005 was a limited effort NEI, so that year is not shown. A brief discussion of the trends in emissions is provided in the section for each pollutant. Inconsistencies due to changes in estimation procedures are also pointed out, where applicable.

Paragraph 51.308(g)(4) also states, "With respect to sources that report directly to a centralized emissions data system operated by the Administrator, the analysis must extend through the most recent year for which the Administrator has provided a State-level summary of such reported data or an internet-based tool by which the State may obtain such a summary as of a date 6 months preceding the required date of the progress report." Therefore, Delaware has also provided a summary of NOx and SO_2 emissions for AMPD sources for the years 2016 and 2017.

In addition to the Delaware-specific data, 2002 – 2017 summaries of emissions from all sectors, as well as summaries of 2016 and 2017 NOx and SO_2 emissions for AMPD sources are provided for all the MANE-VU states. Similar summaries are also shown for the states listed in the MANE-VU Inter-RPO "Ask" as having the potential to contribute to visibility impairment in MANE-VU Class I areas. These states include Alabama (AL), Florida (FL), Illinois (IL), Indiana (IN), Kentucky (KY), Louisiana (LA), Michigan (MI), Missouri (MO), Ohio (OH), Tennessee (TN), Texas (TX), Virginia (VA), and West Virginia (WV). This group of states is referred to hereinafter as the "Ask states".

MANE-VU also developed a list of major regulations affecting Regional Haze emissions inventories from 2002-2017: *MANE-VU Emissions Inventory Regulation List* (April 25, 2018).[24] Delaware has some of the lowest levels of visibility impairment pollutants in the Region. Most significantly, Delaware has had major reductions for AMPD sources (mostly EGUs) from 2002 – 2019 for SO2 – 99% and NOx. – 96% (Tables 7-19 and 7-5 respectively). Given Delaware's low actual and projected emissions (Section 7.1 and Tables 7-32 respectively); Delaware believes that its existing regulations and retirements, as detailed in Sections 8.6 and 8.8, are sufficient to make reasonable progress.

7.1.1 Nitrogen Oxides

Table 7-1 shows a summary of NOx emissions from all data categories – point, nonpoint, non-road, and on-road – for the period from 2002 to 2017 in Delaware. This summary is also shown graphically in Figure 7-1.

NOx emissions have shown a steady decline in Delaware over the period from 2002 to 2017, particularly in the AMPD, non-road and on-road mobile sectors. Reductions in AMPD emissions are due to source retirements, fuel switching to lower emitting fuels, and promulgation of 7 DE Admin Code 1146 - Electric Generating Unit (EGU) Multi-Pollutant Regulation. More information regarding 7 DE Admin Code 1146 can be found in Section 10.7.1.1.

Reductions in non-road emissions are due to a wide range of Federal rules to reduce emissions from non-road vehicles and equipment. A few examples of regulatory programs that have reduced, and/or will continue to reduce, emissions from non-road vehicles and equipment include Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel[25], Control of Emissions from Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters Per Cylinder[26], and Control of Emissions from Nonroad Spark-Ignition Engines and Equipment[27].

On-road mobile emissions reductions are due in part to Federal requirements for on-road vehicles such as the Tier 2 motor vehicle emissions standards[28]. It should also be noted that Federal requirements for on-road mobile sources and fuels are being strengthened even further with the

24 MANE-VU Emissions Inventory Regulation List. MANE-VU. April 25, 2018. https://otcair.org/manevu/document.asp?fview=Reports

25 Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel; EPA Final Rule. 69 FR 38958. June 24, 2004. https://www.gpo.gov/fdsys/pkg/FR-2004-06-29/pdf/04-11293.pdf

26 Control of Emissions of Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder; Republication; EPA Final Rule. June 30, 2008. 73 FR 37096. https://www.gpo.gov/fdsys/pkg/FR-2008-06-30/pdf/R8-7999.pdf

27 Control of Emissions From Nonroad Spark-Ignition Engines and Equipment. EPA Final Rule. 73 FR 59034. October 8, 2008. https://www.gpo.gov/fdsys/pkg/FR-2008-10-08/pdf/E8-21093.pdf

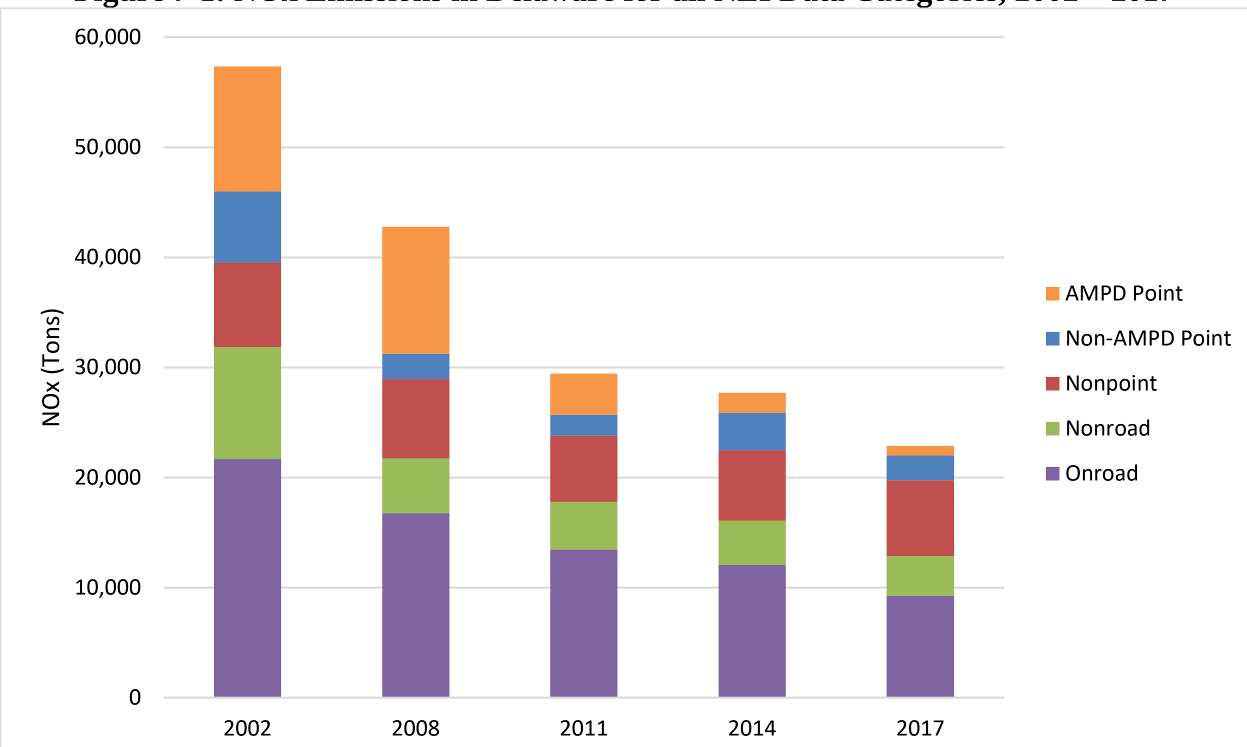
28 Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements. EPA Final Rule. 65 FR 6698. February 10, 2000. https://www.gpo.gov/fdsys/pkg/FR-2000-02-10/pdf/00-19.pdf

Tier 3 requirements[29]. More information on programs to control emissions from mobile sources can be found on EPA's Transportation, Air Pollution, and Climate Change website[30]. For both non-road and on-road mobile sources, NOx emissions are expected to continue to decrease as fleets turn over and older more polluting vehicles and equipment are replaced by newer, cleaner ones.

Table 7-1: NOx Emissions in Delaware for all NEI Data Categories, 2002 – 2017 (Tons)

Category	2002	2008	2011	2014	2017	Reduction 2002 - 2017	Percent Reduction 2002 - 2017
AMPD Point	11,363	11,545	3,748	1,791	889	-10,474	-92%
Non-AMPD Point	6,450	2,304	1,876	3,424	2,246	-4,204	-65%
Nonpoint	7,673	7,204	6,024	6,383	6,881	-792	-10%
Nonroad	10,180	4,972	4,347	4,020	3,623	-6,557	-64%
Onroad	21,679	16,765	13,441	12,066	9,243	-12,435	-57%
Total	**57,345**	**42,790**	**29,436**	**27,684**	**22,882**	**-34,462**	**-60%**

Figure 7-1: NOx Emissions in Delaware for all NEI Data Categories, 2002 – 2017



29 Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards Tier 3 Motor Vehicle Emission and Fuel Standards. EPA Final Rule. 79 FR 23414. April 28, 2014. https://www.gpo.gov/fdsys/pkg/FR-2014-04-28/pdf/2014-06954.pdf

30 EPA. Transportation, Air Pollution, and Climate Change. https://www.epa.gov/air-pollution-transportation

Delaware has also provided a summary of 2016 to 2019 NOx emissions for sources that report to one or more EPA's AMPD programs. This is shown in Table 7-2 below, and it can be seen that NOx emissions from AMPD sources in Delaware have declined 62% since 2016.

Table 7-2: NOx Emissions from AMPD Sources in Delaware, 2016 – 2019 (Tons)

2016	2017	2018	2019
1,308	889	948	496

Table 7-3 and Figure 7-2 show total NOx emissions from all source categories for the MANE-VU states for the period from 2002 to 2017. Table 7-4 and Figure 7-3 show the same data for the "Ask states".

Similar to Delaware, Tables 7-3 and 7-4 and Figures 7-2 and 7-3 show a steady decline in NOx emissions from 2002 to 2017 for almost all of the MANE-VU states and the "Ask states". Much of this decline in NOx emissions is due to the Federal control programs for non-road and on-road mobile sources described earlier. Other sources of NOx emissions reductions include individual states' rules for Reasonably Available Control Technology for NOx (NOx RACT).

Table 7-3: Total NOx Emissions in the MANE-VU States from all NEI Data Categories, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	NO_x Reduction (2002 – 2017)	Percent NO_x Reduction (2002 – 2017)
CT	115,012	93,080	72,828	63,003	46,575	-68,438	-60%
DE	57,345	42,790	29,436	27,684	22,882	-34,462	-60%
DC	15,169	13,189	9,403	8,566	4,780	-10,390	-68%
ME	85,995	71,606	59,785	52,346	49,890	-36,104	-42%
MD	291,299	205,239	165,185	138,496	96,310	-194,989	-67%
MA	287,077	168,599	136,892	127,304	105,860	-181,216	-63%
NH	69,036	66,595	47,947	49,880	28,533	-40,503	-59%
NJ	330,369	244,552	168,297	154,655	136,961	-193,408	-59%
NY	537,513	442,093	387,262	330,782	240,411	-297,101	-55%
PA	718,261	616,320	561,928	492,755	321,900	-396,361	-55%
RI	29,917	18,963	22,489	24,716	14,865	-15,052	-50%
VT	28,764	20,903	19,635	15,697	15,311	-13,453	-47%
Total	**2,565,756**	**2,003,930**	**1,681,086**	**1,485,883**	**1,084,279**	**-1,481,477**	**-58%**

Figure 7-2: Total NOx Emissions in the MANE-VU States from all NEI Data Categories, 2002–2017

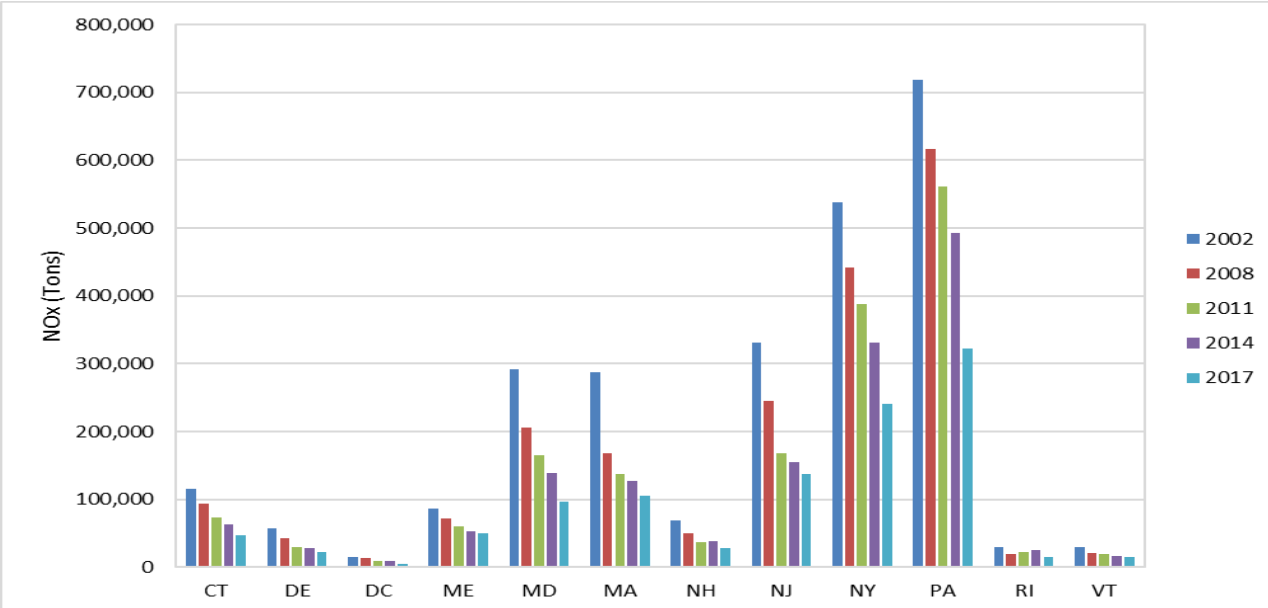


Table 7-4: Total NOx Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	NO_x Reduction (2002 – 2017)	Percent NO_x Reduction (2002 – 2017)
AL	494,699	369,943	345,285	314,187	213,135	-281,564	-57%
FL	1,092,044	853,858	609,704	558,725	406,291	-685,753	-63%
IL	847,488	638,926	507,075	453,108	317,164	-530,325	-63%
IN	723,294	545,953	443,116	395,719	280,409	-442,886	-61%
KY	484,708	378,216	324,803	281,468	196,104	-288,604	-60%
LA	723,164	496,880	519,018	361,543	306,028	-417,136	-58%
MI	684,627	628,254	444,088	382,946	279,503	-405,124	-59%
MO	542,019	425,645	365,593	357,946	259,367	-282,652	-52%
NC	596,536	434,596	366,131	305,674	231,534	-365,002	-61%
OH	948,927	740,029	583,802	429,038	328,246	-620,682	-65%
TN	557,649	416,702	320,085	265,631	199,380	-358,269	-64%
TX	1,894,041	1,515,796	1,268,310	1,225,152	1,017,177	-876,865	-46%
VA	511,048	373,229	310,821	273,733	209,669	-301,379	-59%
WV	381,774	213,495	171,715	184,782	126,645	-255,129	-67%
Total	**10,482,018**	**8,031,522**	**6,579,546**	**5,789,652**	**4,370,653**	**-6,111,367**	**-58%**

Figure 7-3: Total NOx Emissions in the Non-MANE-VU Ask States from all Data Categories, 2002–2017

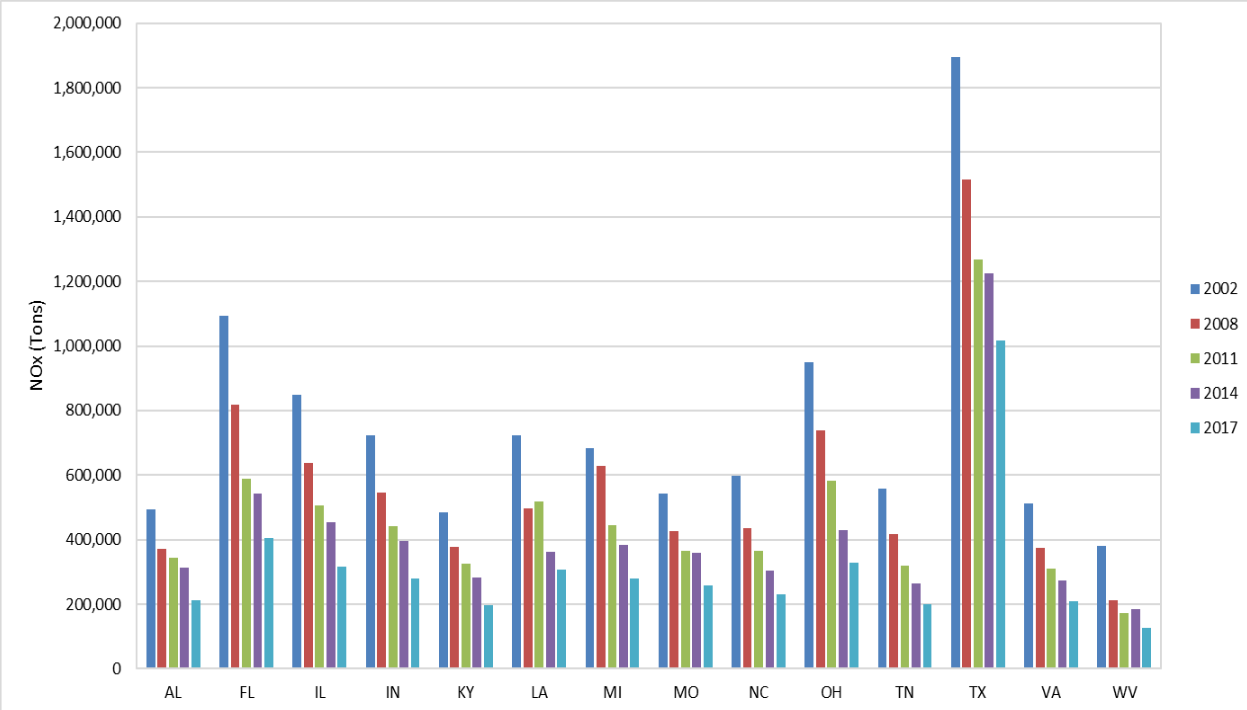


Table 7-5 and Figure 7-4 show AMPD NOx data for the MANE-VU states for 2016 and 2017, and Table 7-6 and Figure 7-5 show AMPD NOx data for the "Ask states" for 2016 and 2017.

Tables 7-5 and 7-6 and Figures 7-4 and 7-5 show decreases in NOx emissions for the AMPD sources between 2016 and 2019 for almost all states in MANE-VU as well as all of the "Ask states". For applicable states, some of the reduction in AMPD NOx since 2002 is attributable to the NOx Budget Trading Program under the NOx SIP Call and the Clean Air Interstate Rule (note that the Clean Air Interstate Rule, or CAIR, was replaced by the Cross-State Air Pollution Rule, also known as CSAPR). Other reductions are attributable to source retirements and fuel switching due to the availability of less expensive natural gas in recent years.

Table 7-5: NOx Emissions from AMPD Sources in the MANE-VU States, 2002–2019 (Tons)

State	2002	2008	2011	2014	2016	2017	2018	2019	NOx Redux 2002-2019	Percent NOx Redux 2002-2019
CT	6,329	4,133	1,667	1,955	1,058	1,052	1,492	801	-5,528	-87%
DC	798	291	320	108	68	67	96	76	-722	-90%
DE	11,363	11,545	3,748	1,791	1,308	889	948	496	-11,797	-96%
MA	32,940	10,002	5,111	4,108	2,883	2,372	1,646	1,007	-31,933	-97%
MD	76,519	40,327	22,536	15,053	9,405	6,127	8,431	4,019	-72,500	-95%
ME	1,154	680	575	539	288	263	327	138	-1,016	-88%
NH	6,873	4,650	3,951	2,753	1,326	1,070	1,695	1,018	-5,855	-85%
NJ	36,163	15,147	7,040	7,096	4,382	3,443	3,408	2,949	-33,213	-92%
NY	85,917	47,556	31,062	22,214	16,222	11,253	11,702	7,844	-78,145	-91%
PA	218,268	187,771	149,620	125,612	79,450	37,148	34,928	33,132	-185,579	-85%
RI	640	462	630	518	448	470	513	453	-187	-29%
VT	230	296	117	161	167	139	142	133	-97	-42%
Total	**477,195**	**322,858**	**226,377**	**181,908**	**117,014**	**64,292**	**65,326**	**52,066**	**-426,574**	**-89%**

Figure 7-4: NOx Emissions from AMPD Sources in the MANE-VU States, 2002–2019

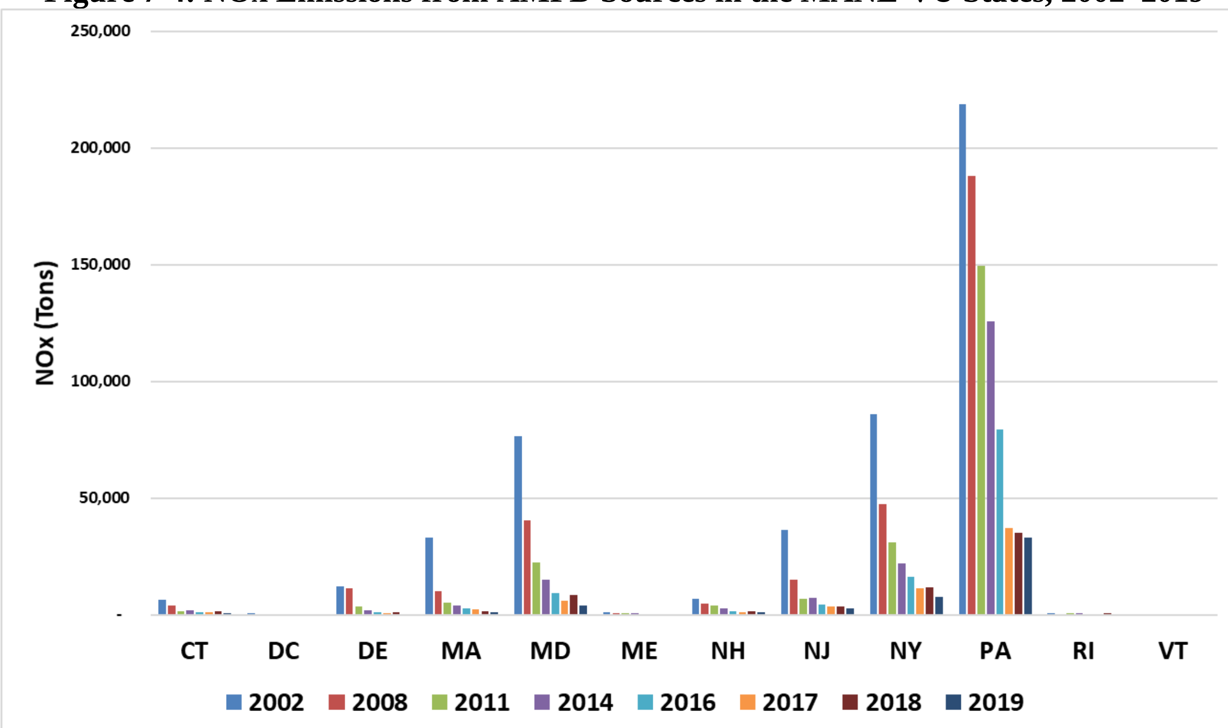
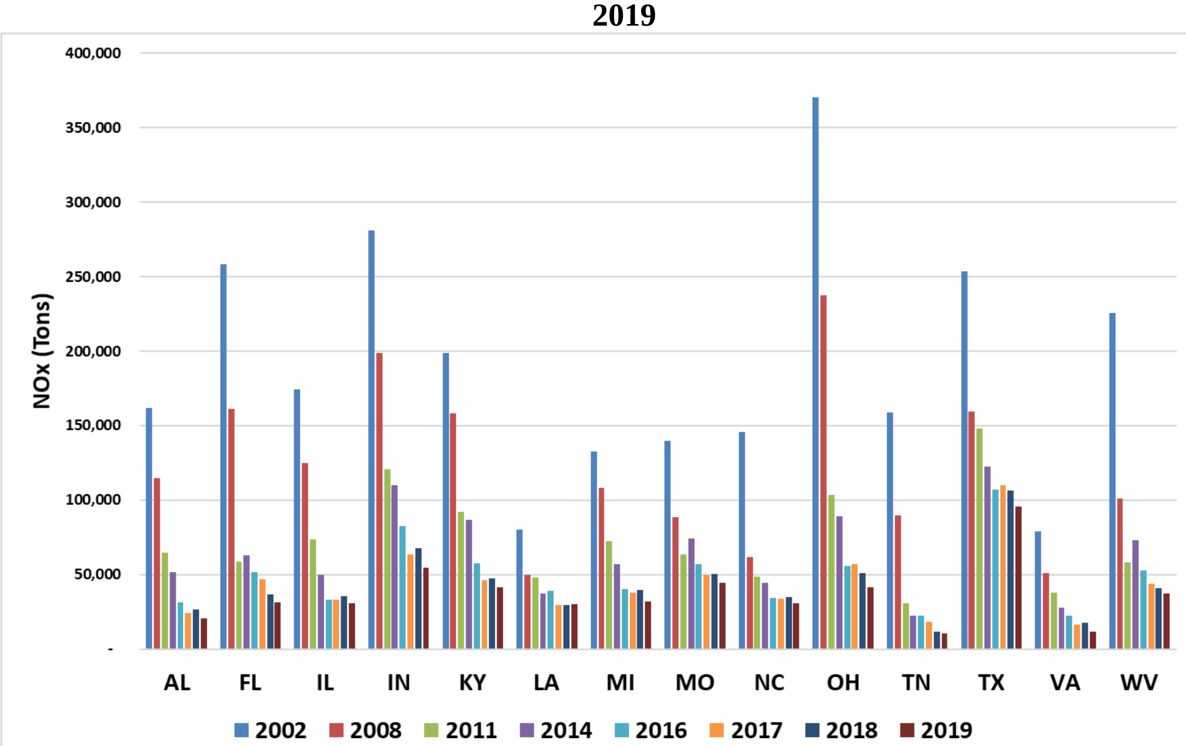


Table 7-6: NOx Emissions from AMPD Sources in the Non-MANE-VU Ask States, 2002–2019 (Tons)

State	2002	2008	2011	2014	2016	2017	2018	2019	NOx Redux 2002-2019	Percent NOx Redux 2002-2019
AL	161,559	114,587	64,579	51,850	31,127	24,085	26,728	20,571	-140,988	-87%
FL	258,378	161,297	58,854	62,984	51,442	49,084	36,875	31,251	-227,128	-88%
IL	174,247	124,787	73,892	49,758	33,298	33,066	35,310	30,655	-143,592	-82%
IN	281,146	198,948	120,941	109,708	82,615	63,421	67,776	54,464	-226,682	-81%
KY	198,599	157,995	92,180	86,980	57,767	46,057	47,503	41,341	-157,258	-79%
LA	80,365	49,875	48,024	37,264	38,836	29,249	29,575	29,848	-50,517	-63%
MI	132,623	108,117	72,286	56,833	40,366	37,739	39,550	31,741	-100,892	-76%
MO	139,799	88,742	63,419	74,252	56,692	49,692	50,393	44,165	-95,634	-68%
NC	145,706	61,669	48,889	44,288	34,287	33,761	34,663	30,748	-114,958	-79%
OH	370,497	237,585	103,591	89,346	55,756	57,039	51,172	41,349	-329,148	-89%
TN	155,996	89,673	30,819	22,382	22,610	18,201	11,629	10,263	-148,590	-94%
TX	253,861	159,668	148,073	122,540	107,158	109,901	106,258	95,562	-158,299	-62%
VA	78,868	50,887	37,651	27,648	22,280	16,545	17,740	11,506	-67,362	-85%
WV	225,371	101,046	58,223	72,970	52,584	44,079	40,925	37,012	-188,822	-84%
Total	**2,657,015**	**1,704,876**	**1,021,422**	**908,805**	**686,817**	**611,919**	**596,096**	**510,476**	**-2,149,869**	**-81%**

Figure 7-5: NOx Emissions from AMPD Sources in the Non-MANE-VU Ask States, 2002–2019



7.1.2 Particulate Matter Less Than 10 Microns

Table 7-7 shows a summary of PM_{10} emissions from all data categories – point, nonpoint, non-road, and on-road – for the period from 2002 to 2017 in Delaware. This summary is also shown graphically in Figure 7-6. Generally, PM_{10} emissions have remained relatively stable in Delaware. It should be noted that the variability in PM_{10} nonpoint emissions between the 2002/2008/2011 inventories is possibly due to changes in inventory estimation methodologies.

Table 7-7: PM_{10} Emissions in Delaware for all Data Categories, 2002–2017 (Tons)

Category	2002	2008	2011	2014	2017	PM10 Reduction (2002 - 2017)	% PM10 Reduction (2002 - 2017)
Point	3,036	3,375	1,355	613	771	-2,266	-75%
Nonpoint	12,606	17,054	12,564	13,212	15,528	2,922	23%
Nonroad	951	478	419	386	294	-657	-69%
Onroad	572	637	734	685	620	49	9%
Total	**17,165**	**21,544**	**15,071**	**14,896**	**17,213**	**48**	**0%**

Figure 7-6: PM_{10} Emissions in Delaware for all Data Categories, 2002–2017

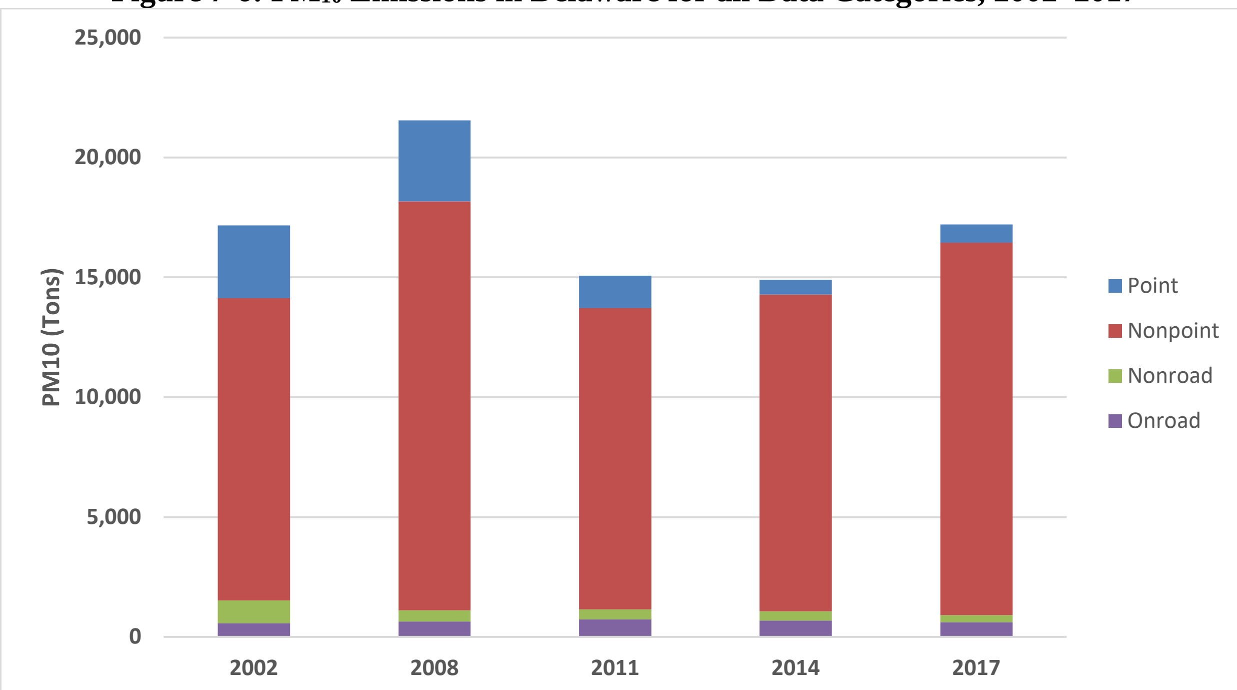


Table 7-8 and Figure 7-7 show total PM_{10} emissions from all data categories in the MANE-VU states. Similarly, Table 7-9 and Figure 7-8 show total PM_{10} emissions from all data categories in the "Ask states". PM_{10} emissions in the MANE-VU and "Ask states" show no particular pattern over the 2002 to 2017 period. Some of the large declines in PM_{10} emissions from 2002 to subsequent years, as well as some of the increases in 2014, could be due to changes in estimation methodologies for categories such as yard waste burning, paved and unpaved road dust, and residential wood combustion.

Table 7-8: Total PM_{10} Emissions in the MANE-VU States from all NEI Data Categories, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	Reduction (2002 – 2017)	Percent Reduction (2002 – 2017)
CT	53,267	39,048	39,097	28,842	29,058	-24,209	-45%
DE	17,165	21,544	15,071	14,896	17,213	48	0%
DC	6,839	5,211	3,410	3,865	3,771	-3,067	-45%
ME	69,543	52,311	49,526	35,606	60,347	-9,197	-13%
MD	126,986	92,156	74,522	114,097	91,366	-35,619	-28%
MA	209,076	165,801	162,952	109,218	65,922	-143,154	-68%
NH	46,551	33,814	33,379	21,985	21,142	-25,409	-55%
NJ	77,723	70,431	49,742	45,946	44,487	-33,236	-43%
NY	386,381	325,041	290,566	232,441	195,140	-191,240	-49%
PA	465,435	352,392	273,067	278,725	193,114	-272,321	-59%
RI	9,103	10,267	8,387	8,400	7,148	-1,955	-21%
VT	55,937	53,130	38,373	23,422	43,618	-12,319	-22%
Total	**1,524,005**	**1,221,145**	**1,038,093**	**917,443**	**772,327**	**-751,678**	**-49%**

Figure 7-7: Total PM_{10} Emissions in the MANE-VU States from all NEI Data Categories, 2002–2017

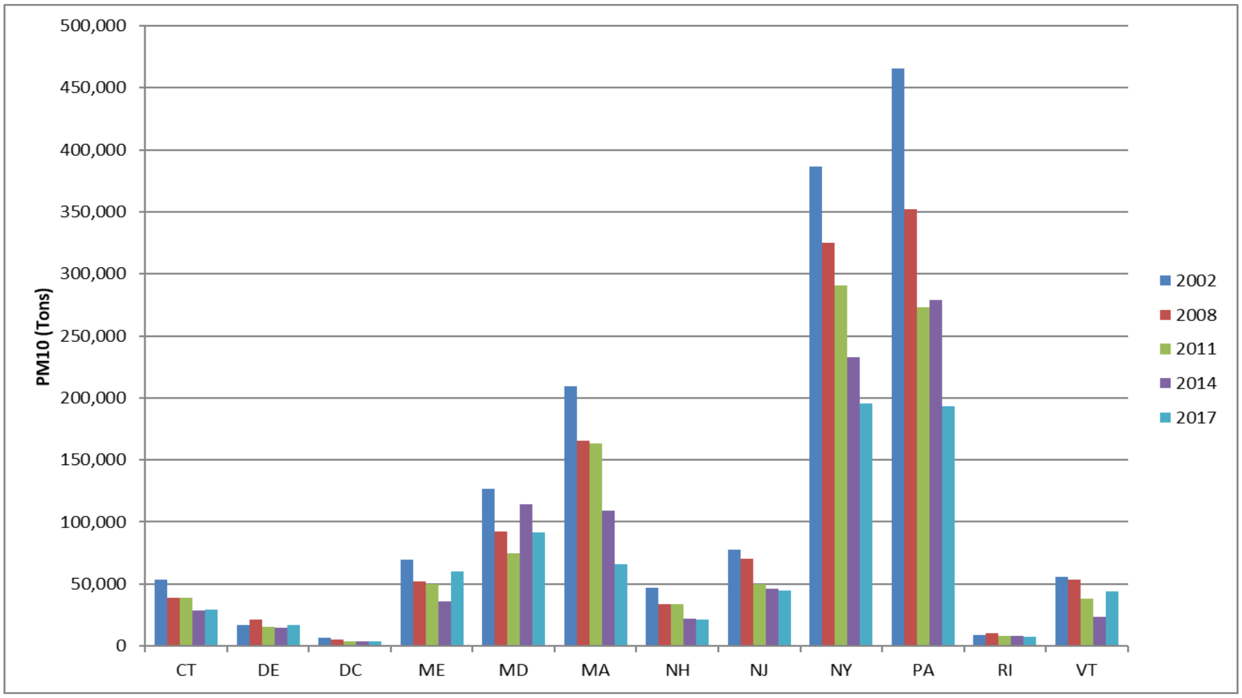
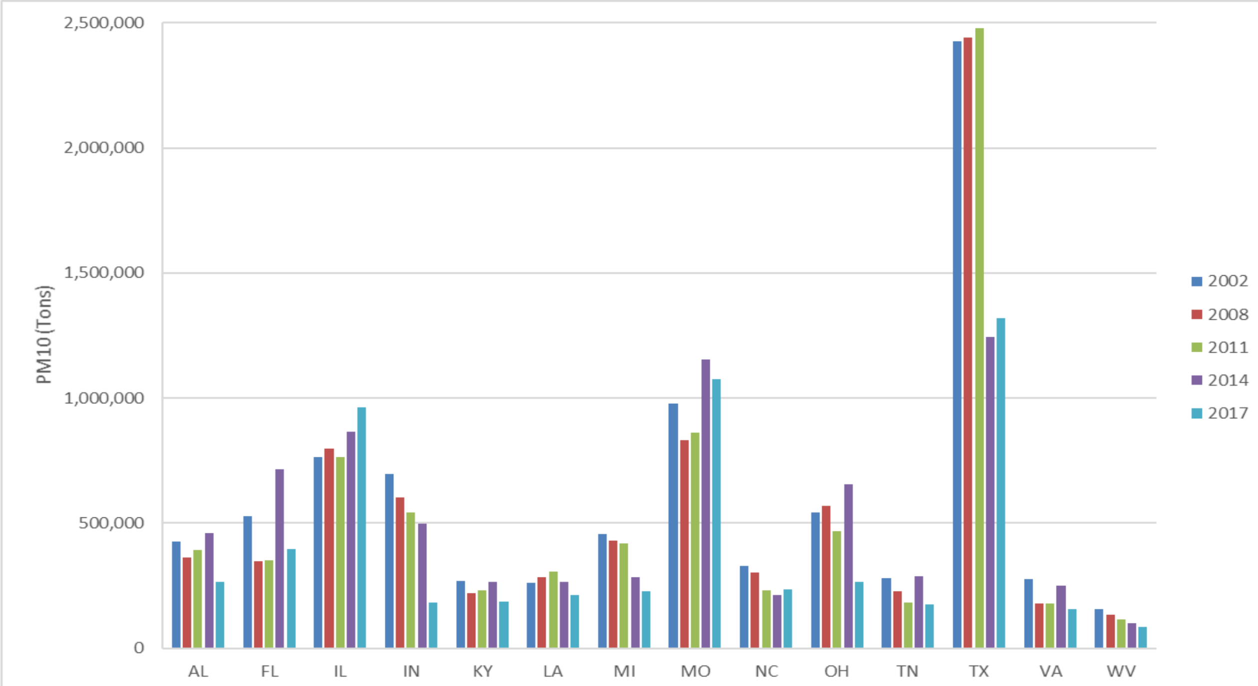


Table 7-9: Total PM_{10} Emissions in the Non-MANE-VU Ask States from all Data Categories, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	Reduction (2002 – 2017)	Percent Reduction (2002 – 2017)
AL	425,221	363,195	393,530	460,695	264,039	-161,181	-38%
FL	527,753	348,091	351,483	713,703	394,521	-133,232	-25%
IL	764,273	797,788	762,584	863,923	961,665	197,392	26%
IN	696,591	602,105	544,131	495,961	182,138	-514,452	-74%
KY	270,051	219,956	232,735	265,370	184,276	-85,775	-32%
LA	259,793	281,998	307,928	263,360	211,710	-48,083	-19%
MI	455,348	431,311	418,847	282,519	226,978	-228,370	-50%
MO	977,691	831,795	861,980	1,153,343	1,075,415	97,724	10%
NC	327,059	300,866	230,453	213,800	235,638	-91,421	-28%
OH	544,239	568,210	467,023	655,947	265,620	-278,620	-51%
TN	278,733	227,616	182,467	286,276	174,588	-104,145	-37%
TX	2,424,752	2,440,498	2,478,052	1,245,310	1,320,222	-1,104,530	-46%
VA	277,684	179,593	179,646	249,306	156,187	-121,497	-44%
WV	156,682	133,479	115,661	99,561	83,681	-73,001	-47%
Total	**8,385,869**	**7,726,500**	**7,526,521**	**7,249,074**	**5,736,679**	**-2,649,190**	**-32%**

Notes: 1. Nonpoint includes unadjusted fugitive dust.

Figure 7-8: Total PM_{10} Emissions in the Non-MANE-VU Ask States from all Data Categories, 2002–2017



Notes: 1. Nonpoint includes unadjusted fugitive dust.

7.1.3 Particulate Matter Less Than 2.5 Microns

Table 7-10 shows a summary of $PM_{2.5}$ emissions from all data categories for the period from 2002 to 2017 in Delaware. This summary is also shown graphically in Figure 7-11. 6, overall $PM_{2.5}$ emissions have remained relatively stable in Delaware.

Table 7-10: $PM_{2.5}$ Emissions in Delaware from all Data Categories, 2002 – 2017 (Tons)

Category	2002	2008	2011	2014	2017	PM2.5 Reduction (2002 – 2017)	Percent PM2.5 Reduction (2002 – 2017)
Point	2,497	2,952	1,254	452	700	-1,796	-72%
Nonpoint	2,491	2,933	3,489	2,998	3,495	1,004	40%
Nonroad	894	455	398	367	276	-618	-69%
Onroad	406	498	408	358	289	-118	-29%
Total	**6,288**	**6,838**	**5,549**	**4,174**	**4,761**	**-1,527**	**-24%**

Figure 7-9: $PM_{2.5}$ Emissions in Delaware from all Data Categories, 2002 – 2017

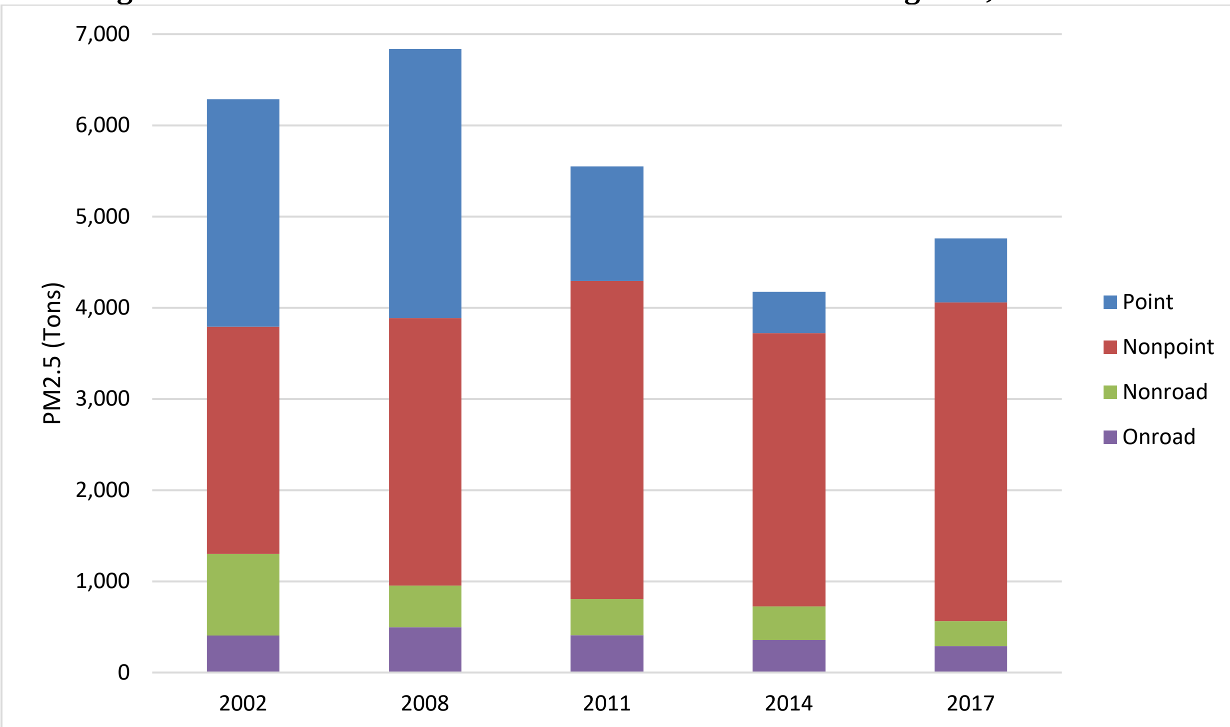


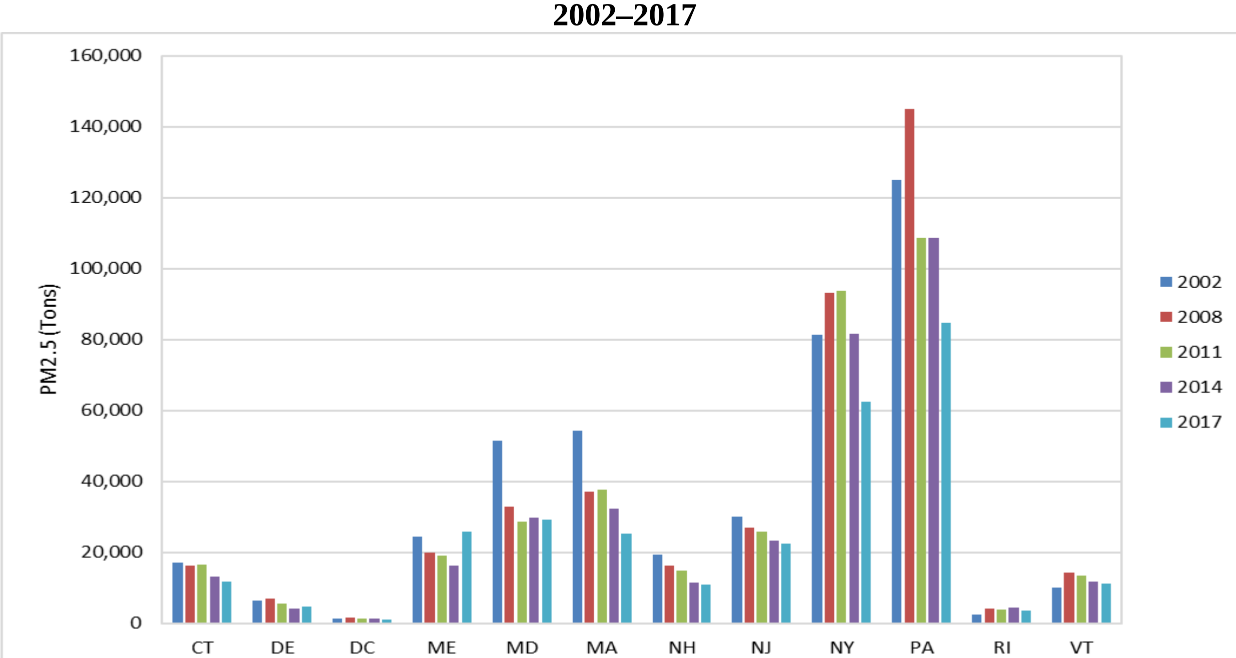
Table 7-11 and Figure 7-10 show total $PM_{2.5}$ emissions from all data categories in the MANE-VU states. Similarly, Table 7-12 and Figure 7-11 show total $PM_{2.5}$ emissions from all data categories in the "Ask states". $PM_{2.5}$ emissions in the MANE-VU and "Ask states" show no particular pattern over the 2002 to 2017 period. In some states, emissions have declined or remained constant; in others, there are increases. As with PM_{10}, some of the large declines in $PM_{2.5}$ emissions from 2002 to subsequent years, as well as some of the increases in 2014, could be due to changes in estimation methodologies for categories such as yard waste burning, paved and unpaved road dust, and residential wood combustion.

Table 7-11: Total $PM_{2.5}$ Emissions in the MANE-VU States from all Data Categories, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	PM2.5 Reduction (2002 – 2017)	Percent PM2.5 Reduction (2002 – 2017)
CT	17,183	16,190	16,545	13,088	11,723	-5,460	-32%
DE	6,288	6,838	5,549	4,174	4,761	-1,527	-24%
DC	1,343	1,694	1,361	1,263	1,047	-296	-22%
ME	24,515	19,930	19,045	16,270	25,681	1,167	5%
MD	51,465	32,947	28,499	29,848	29,063	-22,403	-44%
MA	54,140	36,965	37,770	32,192	25,209	-28,931	-53%
NH	19,207	16,257	14,710	11,358	10,921	-8,286	-43%
NJ	29,976	26,966	25,785	23,197	22,427	-7,549	-25%
NY	81,427	93,027	93,611	81,699	62,387	-19,040	-23%
PA	124,964	145,016	108,748	108,665	84,590	-40,374	-32%
RI	2,433	4,163	3,949	4,310	3,441	1,009	41%
VT	10,167	14,280	13,351	11,593	11,283	1,115	11%
Total	**423,107**	**414,275**	**368,924**	**337,657**	**292,531**	**-130,576**	**-31%**

Notes: 1. Includes unadjusted fugitive dust, except NJ 2008 which is adjusted.

Figure 7-10: Total $PM_{2.5}$ Emissions in the MANE-VU States from all Data Categories, 2002–2017

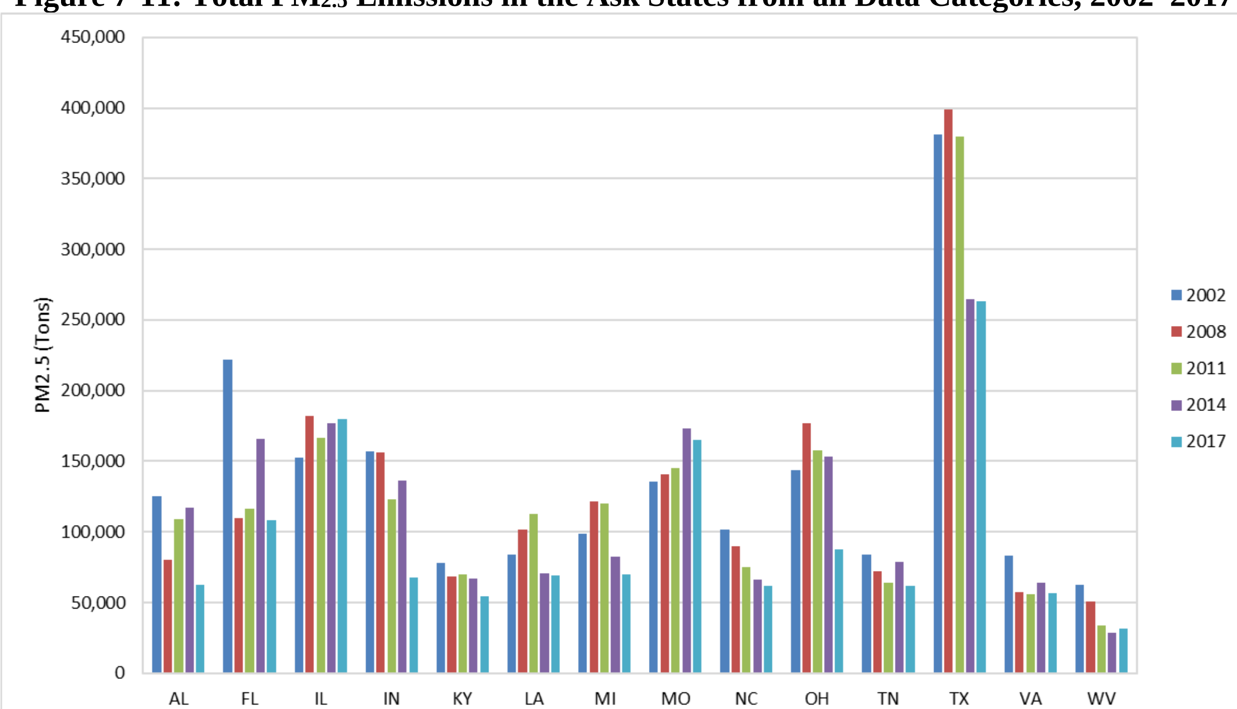


Notes: 1. Includes unadjusted fugitive dust, except NJ 2008 which is adjusted.

Table 7-12: Total $PM_{2.5}$ Emissions in the Non-Ask States from all Data Categories, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	PM2.5 Reduction (2002 – 2017)	Percent PM2.5 Reduction (2002 – 2017)
AL	125,441	80,622	109,345	117,272	62,827	-62,614	-50%
FL	222,204	109,965	116,396	165,534	108,248	-113,956	-51%
IL	152,316	182,344	166,699	176,836	179,631	27,316	18%
IN	157,078	155,982	123,193	136,613	67,517	-89,561	-57%
KY	77,952	68,484	69,665	66,812	54,566	-23,386	-30%
LA	83,989	101,593	112,415	70,884	69,341	-14,648	-17%
MI	98,713	121,710	120,121	82,780	69,910	-28,803	-29%
MO	135,832	140,955	145,230	173,260	165,196	29,364	22%
NC	101,965	89,613	74,844	66,023	61,622	-40,343	-40%
OH	143,671	176,599	157,995	153,291	87,459	-56,212	-39%
TN	84,176	72,333	63,949	79,020	61,772	-22,404	-27%
TX	381,212	399,176	379,886	264,976	263,523	-117,689	-31%
VA	83,567	57,083	56,157	64,340	56,912	-26,655	-32%
WV	62,269	50,936	33,712	28,929	31,913	-30,355	-49%
Total	**1,910,383**	**1,807,395**	**1,729,607**	**1,646,569**	**1,340,439**	**-569,944**	**-30%**

Figure 7-11: Total $PM_{2.5}$ Emissions in the Ask States from all Data Categories, 2002–2017



7.1.3.1 Woodsmoke PM

Source apportionment documented in Appendix B of the original MANE-VU Contribution Assessment also identified biomass combustion as a local source contributing to visibility impairment (Appendix 8-2). Woodsmoke, a subset of biomass combustion, also contributes to visibility impairment, with contributions typically higher in rural areas than urban areas, winter peaks in northern areas from residential wood combustion, and occasional large summer impacts at all sites from wildfires.

The MANE-VU *Technical Support Document on Agricultural and Forestry Smoke Management in the MANE-VU Region* (September 1, 2006)[31] concluded that fire from land management activities was not a major contributor to regional haze in MANE-VU Class I areas, and that the majority of emissions from fires were from residential wood combustion.

The residential wood combustion component of the inventory is shown in Table 7-13 and Table 7-14. The MANE-VU 2011 Gamma emissions inventory (described below in Section 7.2) indicates residential wood combustion represents 33% (annual average) of $PM_{2.5}$ emissions in the MANE-VU region. In Delaware residential wood combustion represents 23% of the 2011 inventory. Residential wood combustion is represented as source classification code (SCC).

2011 residential wood combustion levels were comparable to the MANE-VU 2002 Version 3 Inventory: 33% for the MANE-VU region and 23% for Delaware. More detailed information regarding 2002 residential wood combustion emissions can be found in Delaware's 2008 Regional Haze SIP, Section 7.2.4.2[32].

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31 Technical Support Document on Agricultural and Forestry Smoke Management in the MANE-VU Region. MANE-VU. September 1, 2006. https://otcair.org/MANEVU/Upload/Publication/Reports/SmokeMgmt_TSD_090106.pdf

32 Delaware's Visibility State Implementation Plan (SIP). DNREC. September 24, 2008. https://dnrec.alpha.delaware.gov/air/quality/regional-haze/

Table 7-13: Gamma 2011 Residential Wood Combustion Emissions (Tons)

State	CO	NH_3	NOx	PM_{10}-PRI*	$PM_{2.5}$-PRI	SO_2	VOC
CT	45,804	345	712	6,474	6,470	116	8,914
DE	6,685	57	108	963	962	18	1,201
DC	2,853	23	43	404	404	6	549
ME	41,650	315	485	6,316	6,316	188	7,048
MD	20,857	192	335	3,119	3,115	56	3,446
MA	70,644	577	1,080	10,306	10,300	209	12,711
NH	42,381	327	503	6,493	6,493	170	7,311
NJ	44,060	355	710	6,302	6,295	105	8,310
NY	150,460	1,065	1,899	22,946	22,939	554	27,943
PA	164,540	1,218	2,323	23,644	23,634	474	31,534
RI	10,178	79	178	1,452	1,451	28	1,941
VT	47,285	370	568	7,142	7,140	247	7,564
Res Wood Total	647,397	4,921	8,945	95,561	95,519	2,169	118,471
Total Emissions MANE-VU	7,887,728	206,584	1,704,090	322,881	291,225	739,675	3,605,189
% of Total	**8.2%**	**2.4%**	**0.5%**	**29.6%**	**32.8%**	**0.3%**	**3.3%**

*Primary

Table 7-14: Gamma 2011 State Level $PM_{2.5}$ Residential Wood Emissions

State	Res. Wood $PM_{2.5}$	Total $PM_{2.5}$	% of Total $PM_{2.5}$ In State
CT	6,470	13,203	49%
DE	**962**	**4,273**	**23%**
DC	404	1,110	36%
ME	6,316	15,123	42%
MD	3,115	24,951	13%
MA	10,300	25,755	40%
NH	6,493	11,784	55%
NJ	6,295	23,788	27%
NY	22,939	69,185	33%
PA	23,634	88,044	27%
RI	1,451	3,488	42%
VT	7,140	10,522	68%

7.1.4 Sulfur Dioxide

Table 7-15 shows SO_2 emissions in Delaware for all data categories for 2002 to 2017; this data is also shown graphically in Figure 7-12. SO_2 emissions have shown a steady decline in Delaware over the period from 2002 to 2017, with a 98 percent reduction since 2002. This is primarily due to promulgation of 7 DE Admin Code 1146 - Electric Generating Unit (EGU) Multi-Pollutant Regulation and 7 De Admin Code 1108 - Sulfur Dioxide Emissions from Fuel Burning Equipment. Table 7-16 shows SO_2 emissions for Delaware AMPD sources for 2016 to 2019. SO_2 emissions from AMPD sources in Delaware showed a slight decline of 28% since 2016.

Table 7-15: SO_2 Emissions in Delaware from all Data Categories, 2002 – 2017 (Tons)

Category	2002	2008	2011	2014	2017	SO_2 Reduction (2002 – 2017)	Percent SO_2 Reduction (2002 – 2017)
AMPD Point	32,236	31,808	9,306	829	545	-31,691	-98%
Non-AMPD Point	42,241	9,300	2,182	1,070	537	-41,704	-99%
Nonpoint	2,785	2,814	2,298	2,328	259	-2,526	-91%
Nonroad	9,181	266	12	9	8	-9,173	-100%
Onroad	556	92	85	93	98	-458	-82%
Total	**86,999**	**44,282**	**13,883**	**4,330**	**1,448**	**-85,552**	**-98%**

Figure 7-12: SO_2 Emissions in Delaware from all Data Categories, 2002 – 2017

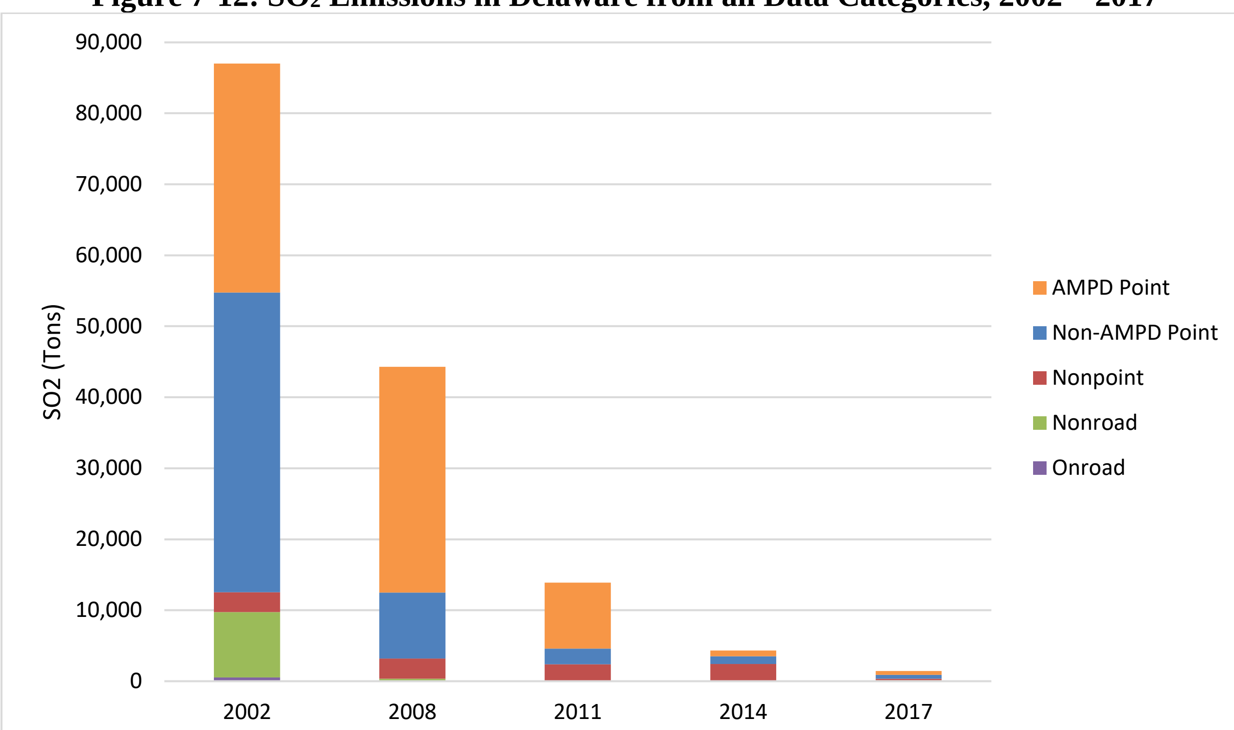


Table 7-16: SO_2 Emissions for AMPD Sources in Delaware, 2016 – 2019 (Tons)

2016	2017	2018	2019
1,725	1,722	1,433	1,250

Table 7-17 and Figure 7-13 show total SO_2 emissions from all data categories in the MANE-VU states for 2002 to 2017. A steady decrease in SO_2 emissions can be seen for each MANE-VU state over this time period, including a 98 percent reduction in SO_2 for Delaware since 2002. MANE-VU believes these decreases are attributable to the low sulfur fuel strategy and the 90% or greater reduction in SO_2 emissions at 167 EGU stacks (both inside and outside of MANE-VU) requested in the MANE-VU "Ask" for states within MANE-VU for the first regional haze planning period[33]. As MANE-VU states continue to adopt rules to implement the low sulfur fuel strategy, SO_2 emissions reductions are expected to continue beyond the 2002 to 2017 timeframe shown in Table 7-15 and Figure 7-13. Other SO_2 emissions decreases are due to source shutdowns and fuel switching due to the availability of less expensive natural gas (which has lower sulfur levels than fuel oil) in recent years.

Table 7-17: Total SO_2 Emissions in the MANE-VU States for all Data Categories, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	SO_2 Reduction (2002 – 2017)	Percent SO_2 Reduction (2002 – 2017)
CT	38,102	19,443	15,334	12,445	2,692	-35,410	-93%
DE	86,999	44,282	13,883	4,330	1,448	-85,552	-98%
DC	4,051	1,273	1,829	252	90	-3,961	-98%
ME	33,585	23,362	15,528	11,242	5,762	-27,823	-83%
MD	324,015	264,487	71,751	48,490	20,130	-303,885	-94%
MA	156,778	76,256	51,338	18,890	6,256	-150,523	-96%
NH	55,246	45,666	31,257	8,554	5,972	-49,274	-89%
NJ	96,967	44,370	17,907	9,781	4,483	-92,483	-95%
NY	326,448	193,703	114,940	52,857	25,988	-300,460	-92%
PA	1,015,732	987,671	398,497	329,804	96,263	-919,469	-91%
RI	8,158	4,345	4,689	3,406	816	-7,342	-90%
VT	4,988	4,044	3,445	1,503	743	-4,245	-85%
Total	**2,151,071**	**1,708,903**	**740,397**	**501,552**	**170,645**	**-1,980,427**	**-92%**

33 Statement of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Concerning a Course of Action within MANE-VU Toward Assuring Reasonable Progress (http://otcair.org/MANEVU/Upload/Publication/Formal%20Actions/Statement%20on%20Controls%20in%20MV_072007.pdf)

Figure 7-13: Total SO_2 Emissions in the MANE-VU States for all Data Categories, 2002–2017

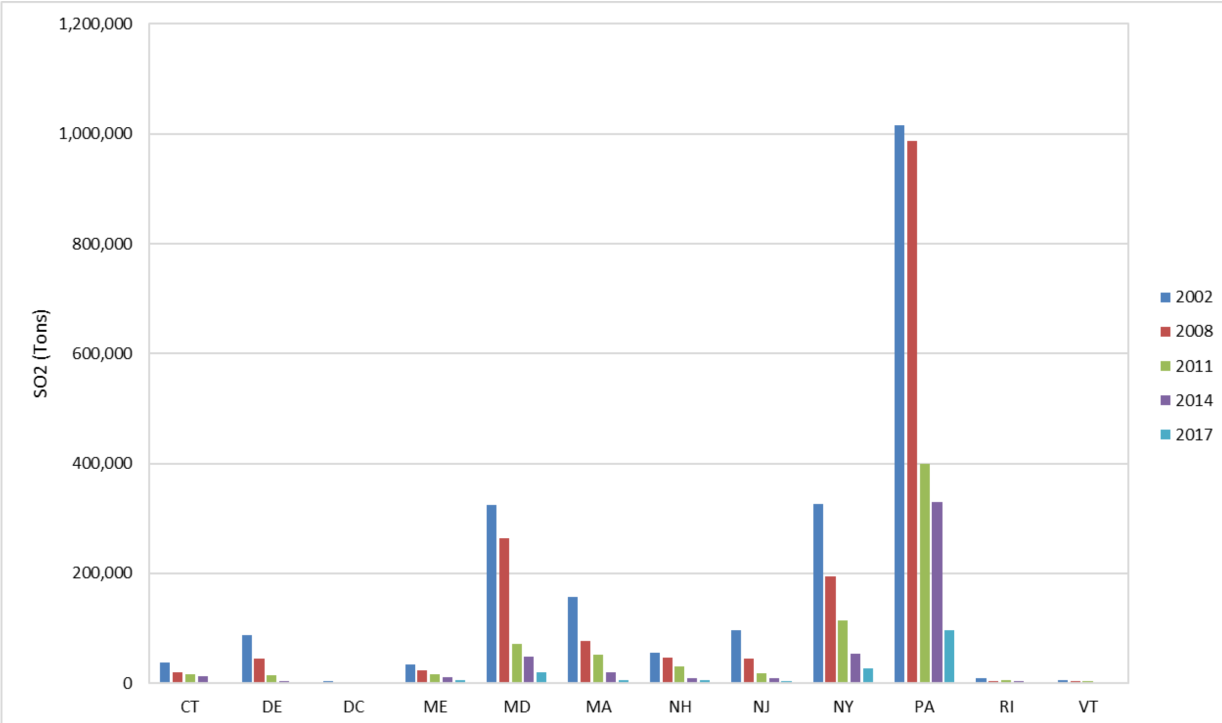


Table 7-18 and Figure 7-14 show total SO_2 emissions from all data categories in the "Ask states" for 2002 to 2017. Similar to the MANE-VU states, decreases in SO_2 can be seen for all the "Ask states" over this time period. Some of these decreases are attributable to implementation of the control measures requested in the MANE-VU "Ask" for states outside of MANE-VU for the first regional haze planning period, including timely implementation of BART requirements and a 90% or greater reduction in SO_2 emissions at 167 stacks inside and outside of MANE-VU.

Table 7-18: Total SO_2 Emissions in the Ask States for all Data Categories, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	SO_2 Reduction (2002 – 2017)	Percent SO_2 Reduction (2002 – 2017)
AL	606,778	438,066	271,687	193,886	55,399	-551,379	-91%
FL	721,898	335,270	163,081	153,735	72,069	-649,830	-90%
IL	536,620	385,948	287,312	191,331	94,085	-442,535	-82%
IN	960,539	690,040	424,984	345,279	101,092	-859,447	-89%
KY	533,614	382,044	271,432	222,090	70,125	-463,488	-87%
LA	359,641	249,149	228,997	171,510	140,630	-219,010	-61%
MI	490,487	415,620	273,393	185,320	83,719	-406,768	-83%
MO	421,708	414,816	257,510	168,808	119,252	-302,456	-72%
NC	585,453	290,648	117,772	70,067	42,539	-542,914	-93%
OH	1,286,023	877,070	680,338	376,573	125,921	-1,160,102	-90%
TN	432,890	324,690	159,164	92,498	45,427	-387,463	-90%
TX	989,242	637,591	540,665	456,508	386,832	-602,410	-61%
VA	362,478	200,581	106,386	75,660	26,517	-335,961	-93%
WV	580,073	349,331	122,109	112,405	46,391	-533,682	-92%
Total	**8,867,445**	**5,990,862**	**3,904,829**	**2,815,670**	**1,409,999**	**-7,457,447**	**-84%**

Figure 7-14: Total SO_2 Emissions in the Ask States for all Data Categories, 2002–2017

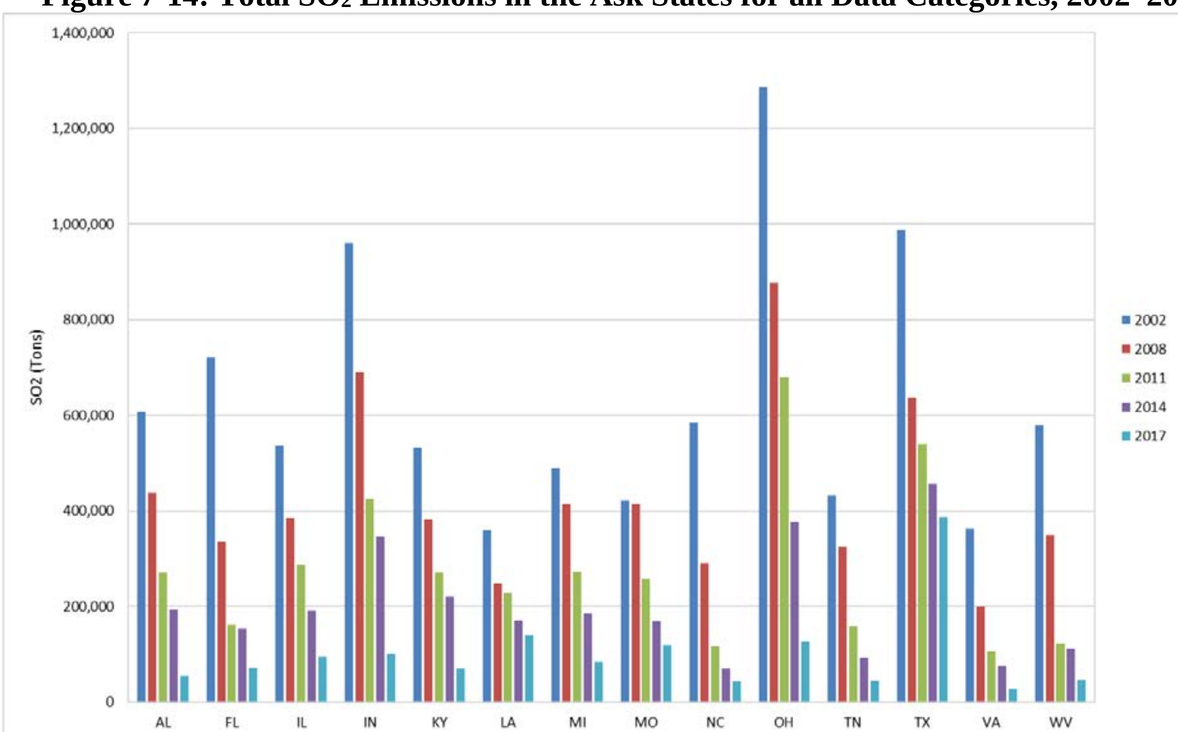


Table 7-19 and Figure 7-15 show 2016 through 2019 SO_2 emissions for AMPD sources in the MANE-VU states, and Table 7-20 and Figure 7-16 show 2016 through 2019 SO_2 emissions for AMPD sources in the "Ask states". 2019 AMPD SO_2 emissions are lower than the corresponding 2016 emissions for almost every MANE-VU and every "Ask state". Total AMPD SO_2 emissions for 2019 are well below the corresponding 2016 total for both the MANE-VU states and the "Ask states". For applicable states, some of the SO_2 reduction for AMPD sources is attributable to CSAPR[34] (formerly CAIR), which requires NOx and/or SO_2 emissions reductions from EGUs in 27 states in the eastern and central US.

Table 7-19: SO_2 Emissions from AMPD Sources in the MANE-VU States, 2002–2019 (Tons)

State	2002	2008	2011	2014	2016	2017	2018	2019	SO2 Redux 2002-2019	% SO2 Redux 2002-2019
CT	10,814	3,955	752	1,478	362	421	690	132	-10,682	-99%
DC	1,087	261	723	-	-	-	-	-	-1,087	-100%
DE	32,236	31,808	9,306	829	513	545	644	279	-31,957	-99%
MA	90,727	46,347	22,701	4,670	1,717	1,083	742	194	-90,533	-100%
MD	255,360	227,198	32,275	23,553	16,754	8,121	11,325	5,572	-249,787	-98%
ME	2,022	1,041	470	856	369	444	643	50	-1,973	-98%
NH	43,947	36,895	24,445	2,636	573	473	1,197	417	-43,530	-99%
NJ	48,269	21,204	5,414	2,655	1,725	1,722	1,433	1,250	-47,019	-97%
NY	231,985	65,427	40,756	16,676	4,533	2,561	4,889	1,972	-230,013	-99%
PA	889,766	831,915	330,539	270,332	98,006	69,790	69,018	52,394	-837,372	-94%
RI	12	18	20	17	14	18	22	16	4	31%
VT	6	2	1	2	1	1	1	1	-4	-79%
Total	**1,606,230**	**1,266,072**	**467,404**	**323,704**	**124,567**	**85,179**	**90,604**	**62,277**	**-1,543,954**	**-96%**

34 Cross State Air Pollution Rule. EPA. - https://www.epa.gov/csapr

Figure 7-15: SO_2 Emissions from AMPD Sources in the MANE-VU States, 2002–2019

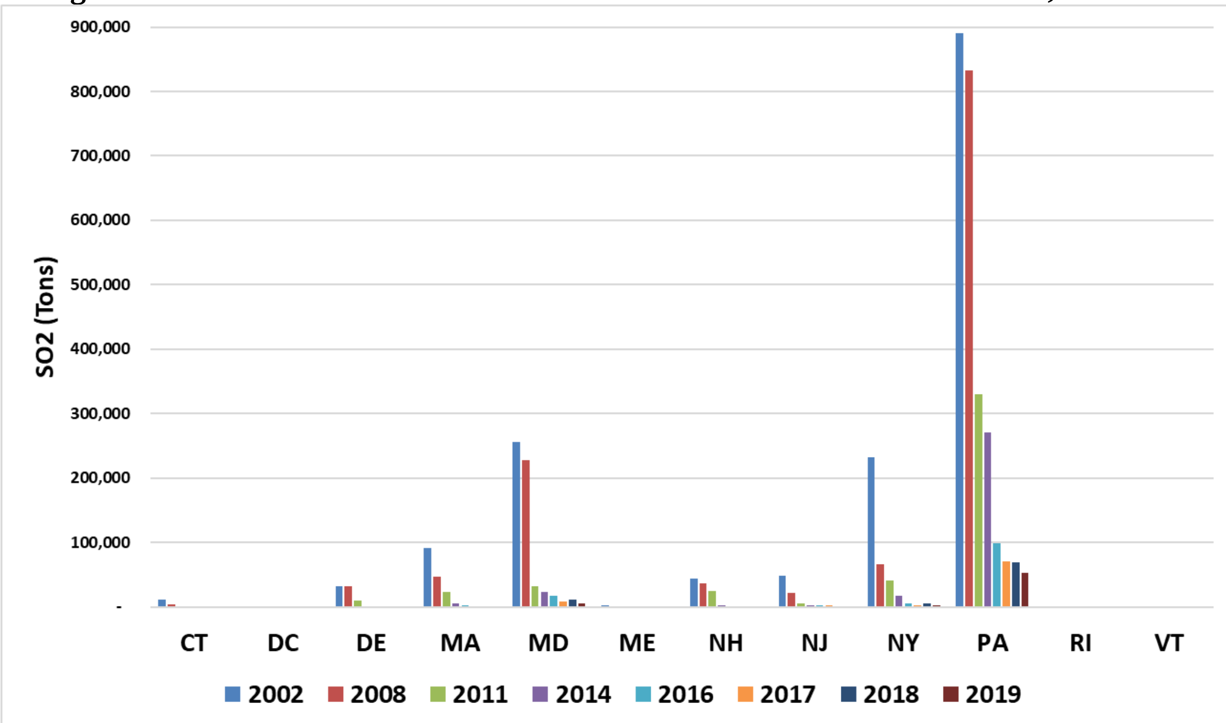
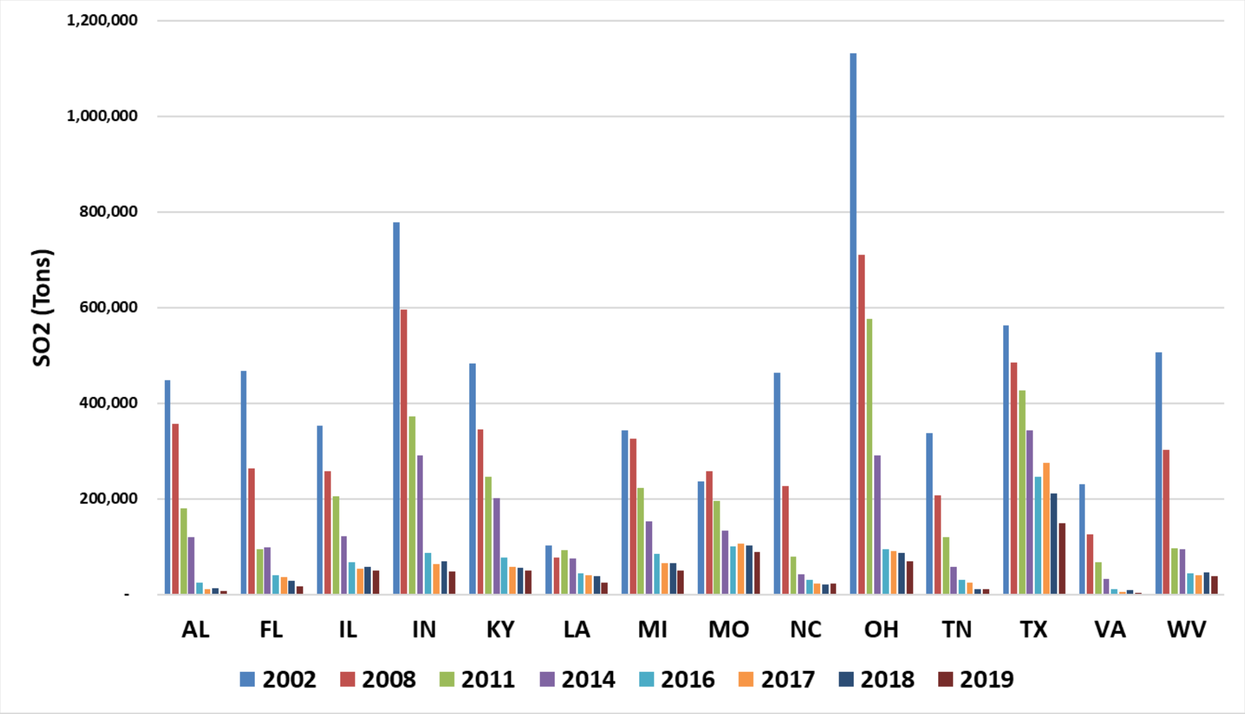


Table 7-20: SO_2 Emissions from AMPD Sources in the Ask States, 2002–2019 (Tons)

State	2002	2008	2011	2014	2016	2017	2018	2019	SO2 Redux 2002-2019	% SO2 Redux 2002-2019
AL	448,248	357,547	179,256	119,898	25,034	10,478	12,023	6,420	-441,828	-99%
FL	466,904	263,952	94,710	99,074	39,186	35,700	29,202	17,075	-449,829	-96%
IL	353,699	257,431	205,630	122,463	66,993	54,511	57,357	50,137	-303,562	-86%
IN	778,868	595,966	371,983	290,685	87,083	63,735	68,509	47,780	-731,088	-94%
KY	482,653	344,874	246,399	202,042	76,424	57,119	55,161	49,949	-432,704	-90%
LA	101,887	76,302	93,275	74,260	43,328	39,699	38,175	23,688	-78,199	-77%
MI	342,999	326,501	222,702	152,942	84,019	65,369	65,504	50,554	-292,444	-85%
MO	235,532	258,269	196,265	133,255	99,451	105,993	102,607	88,916	-146,616	-62%
NC	462,993	227,030	77,985	42,862	30,136	22,265	21,522	21,978	-441,015	-95%
OH	1,132,069	709,444	575,474	290,403	94,486	90,751	86,570	68,905	-1,063,164	-94%
TN	336,995	208,069	120,353	58,434	31,270	24,312	11,735	11,224	-325,770	-97%
TX	562,516	484,271	426,490	343,425	245,799	275,993	211,025	149,135	-413,381	-73%
VA	230,846	125,985	68,071	33,088	10,316	5,791	8,875	2,343	-228,503	-99%
WV	507,110	301,574	95,693	94,335	43,693	40,545	45,778	38,741	-468,369	-92%
Total	**6,443,319**	**4,537,215**	**2,974,287**	**2,057,164**	**977,218**	**892,262**	**814,042**	**626,846**	**-5,816,474**	**-90%**

Figure 7-16: SO_2 Emissions from AMPD Sources in the Ask States, 2002–2019



7.1.5 Volatile Organic Compounds

Table 7-21 shows VOC emissions from all data categories in Delaware over the 2002 to 2017 time period. The data is shown graphically in Figure 7-17. VOC emissions have declined during this period by 52 percent from 2002 levels. This is primarily due to promulgation of 7 DE Admin Code 1141 - Limiting Emissions of Volatile Organic Compounds from Consumer and Commercial Products.

Table 7-21: VOC Emissions from all Data Categories in Delaware, 2002 – 2017 (Tons)

Category	2002	2008	2011	2014	2017	VOC Reduction (2002 – 2017)	Percent VOC Reduction (2002 – 2017)
Point	5,043	3,132	1,750	1,210	1,058	-3,985	-79%
Nonpoint	13,653	9,558	8,518	7,191	6,819	-6,833	-50%
Nonroad	8,844	8,348	5,646	4,503	6,654	-2,191	-25%
Onroad	11,382	7,667	6,916	7,249	4,152	-7,230	-64%
Total	**38,921**	**28,705**	**22,830**	**20,153**	**18,682**	**-20,239**	**-52%**

Figure 7-17: VOC Emissions from all Data Categories in Delaware, 2002 – 2017

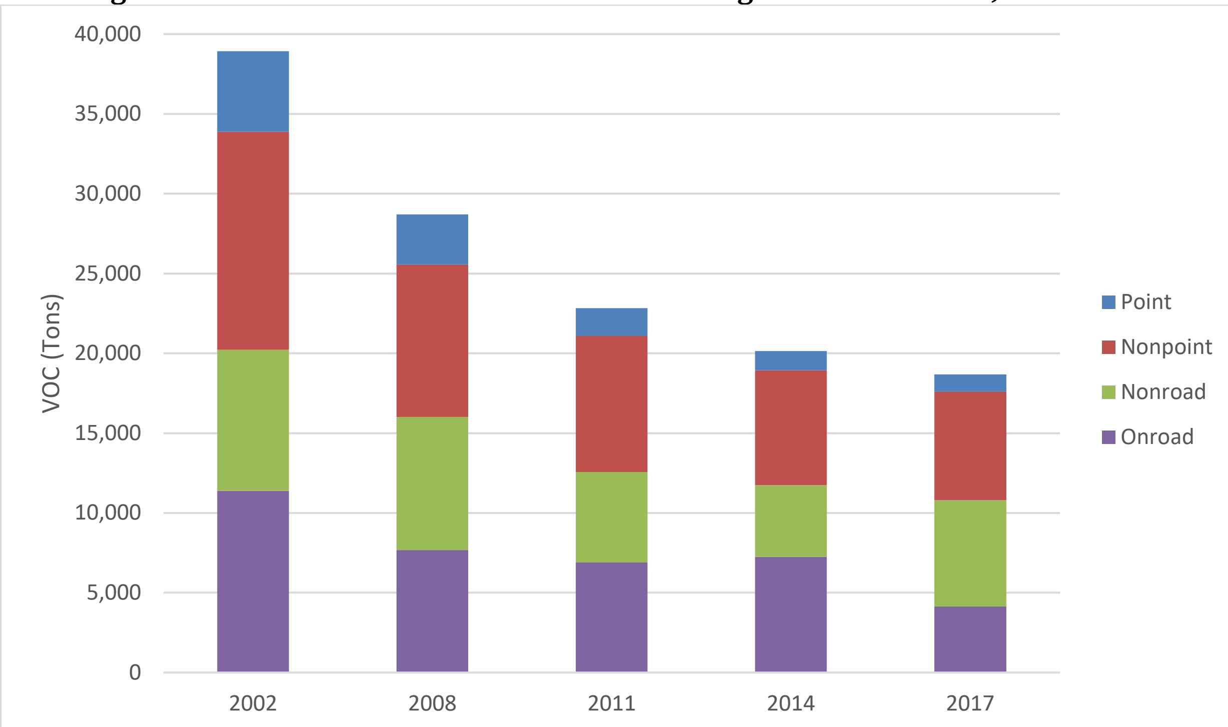


Table 7-22 and Figure 7-18 show total VOC emissions from all data categories for the MANE-VU states during the period from 2002 to 2017. Except for PA, VOC emissions have declined in all MANE-VU states during this period. The decrease between 2002 and subsequent years is likely artificially overstated for many states because of changes in estimation methodologies for nonpoint categories such as residential wood combustion and yard waste burning.

Much of the decrease in VOCs is attributable to Federal and state rules for evaporative sources of VOC emissions such as portable fuel containers; architectural, industrial, and maintenance coatings (AIM); adhesives and sealants, consumer products; and solvent degreasing[35]. Many states rules for these types of categories are based on the OTC Model Rules[36]. Evaporative VOC emissions from these types of sources are expected to continue to decline as more states adopt rules based on the OTC Model Rules. Other decreases are due to states' VOC RACT rules. Evaporative VOC emissions from on-road mobile sources have decreased due to state motor vehicle Inspection & Maintenance (I & M) programs and the permeation of more on-board refueling vapor recovery (ORVR) equipped vehicles into the fleet. VOC emissions from non-road and on-road mobile sources are expected to continue decrease as older, more polluting vehicles are replaced by newer, cleaner ones.

35 Specifically, Delaware has promulgated regulations for portable fuel containers, AIM coatings, adhesives and sealants, consumer products and solvent degreasing (see Section 8.6.3).
36 http://otcair.org/document.asp?Fview=modelrules

Table 7-22: Total VOC Emissions from all Data Categories in the MANE-VU States, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	VOC Reduction (2002 – 2017)	% VOC Reduction (2002 – 2017)
CT	189,223	86,024	79,809	82,350	58,059	-131,163	-69%
DE	38,921	28,705	22,830	20,153	18,682	-20,239	-52%
DC	11,388	10,467	7,950	8,939	5,165	-6,223	-55%
ME	145,157	76,423	64,086	57,527	48,454	-96,703	-67%
MD	259,266	145,138	118,309	116,512	95,087	-164,179	-63%
MA	309,210	166,086	146,068	144,016	116,269	-192,942	-62%
NH	106,185	55,344	45,884	40,767	33,088	-73,097	-69%
NJ	341,276	224,688	177,043	154,589	143,384	-197,892	-58%
NY	544,016	519,566	416,915	410,573	273,152	-270,864	-50%
PA	449,637	432,590	372,135	477,338	388,427	-61,210	-14%
RI	41,448	23,770	23,186	23,499	17,965	-23,483	-57%
VT	47,157	29,131	27,869	27,366	20,922	-26,235	-56%
Total	**2,482,884**	**1,797,935**	**1,502,084**	**1,563,628**	**1,218,654**	**-1,264,229**	**-51%**

Figure 7-18: Total VOC Emissions from all Data Categories in the MANE-VU States, 2002–2017

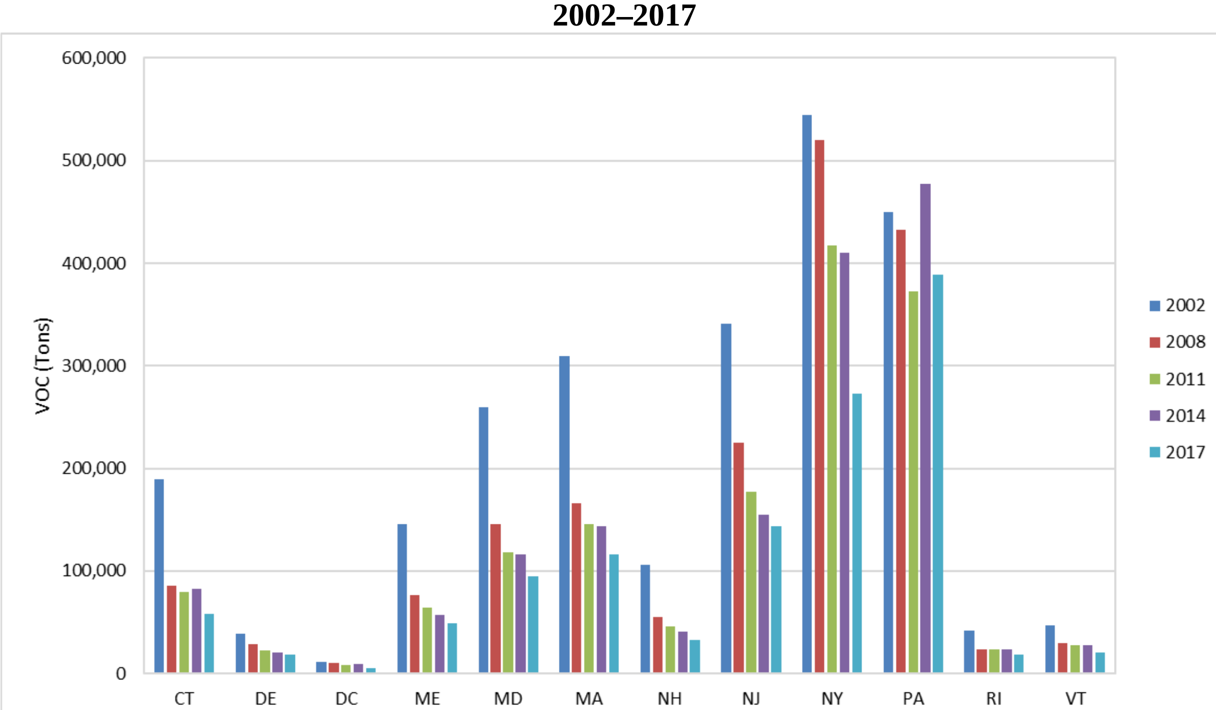
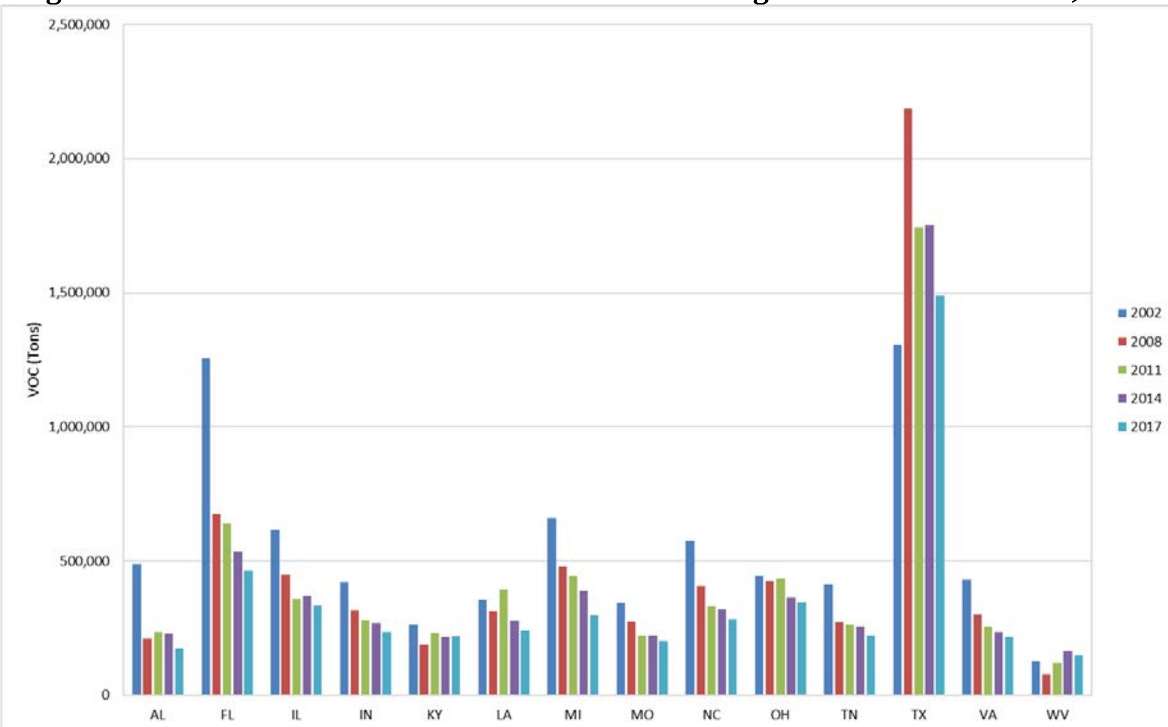


Table 7-23 and Figure 7-19 show total VOC emissions from all data categories from the "Ask states". In general, VOC emissions have declined in the "Ask states", although some states have shown little change, or even increases, in total VOC emissions from 2002 to 2017. Some of these increases, or the sharp decreases evident in AL and FL between 2002 and subsequent years, could be artificial due to methodology changes. Despite the increases in some individual states, overall total VOC emissions in the "Ask states" have declined from 2002 to 2017.

Table 7-23: Total VOC Emissions from all Data Categories in the Ask States, 2002–2017 (Tons)

State	2002	2008	2011	2014	2017	VOC Reduction (2002 – 2017)	% VOC Reduction (2002 – 2017)
AL	488,790	210,676	235,609	227,680	175,055	-313,735	-64%
FL	1,254,948	676,019	639,752	534,554	464,332	-790,616	-63%
IL	518,945	422,491	324,726	346,254	333,684	-281,753	-46%
IN	421,835	314,899	279,108	268,058	235,470	-186,365	-44%
KY	262,126	189,340	231,570	215,759	220,905	-41,222	-16%
LA	356,148	313,255	395,575	275,798	241,418	-114,730	-32%
MI	660,704	478,335	443,805	388,431	297,891	-362,813	-55%
MO	344,183	274,335	223,847	222,869	201,573	-142,610	-41%
NC	574,306	405,366	330,121	318,555	281,445	-292,851	-51%
OH	441,791	425,224	433,846	363,164	347,773	-94,018	-21%
TN	413,803	270,776	262,588	255,189	221,151	-192,652	-47%
TX	1,306,082	2,185,097	1,743,762	1,752,968	1,490,387	184,305	14%
VA	430,319	301,131	256,981	234,222	216,691	-213,628	-50%
WV	124,621	77,182	119,437	165,676	146,312	21,691	17%
Total	**7,598,602**	**6,544,127**	**5,920,726**	**5,569,177**	**4,874,098**	**-2,820,995**	**-37%**

Figure 7-19: Total VOC Emissions from all Data Categories in the Ask States, 2002–2017



7.1.6 Ammonia

Table 7-24 shows NH_3 emissions for all data categories in Delaware. This is shown graphically in Figure 7-20. It should be noted that the decrease in nonpoint NH_3 between the 2008 and 2011 inventories is due to changes in inventory estimation methodologies. While NH_3 emissions were stable between the 2014 and 2017 inventories, there was a slight increase in NH_3 emissions from 2011 to 2014. This increase is due to a change in methodology, the addition of NH_3 emissions from domestic and wild animals in 2014[37]. Emissions from animal husbandry account for the largest share of estimated NH_3 emissions in Delaware.

Table 7-24: NH_3 Emissions in Delaware from all Data Categories, 2002 – 2017 (Tons)

Category	2002	2008	2011	2014	2017	NH_3 Reduction (2002 – 2017)	Percent NH_3 Reduction (2002 – 2017)
Point	190	270	158	207	166	-24	-12%
Nonpoint	12,822	13,322	5,281	6,718	6,875	-5,946	-46%
Nonroad	5	6	6	6	7	2	37%
Onroad	903	377	326	321	305	-599	-66%
Total	**13,920**	**13,975**	**5,771**	**7,252**	**7,353**	**-6,567**	**-47%**

37 EPA 2014 National Emissions Inventory, version 2, Technical Support Document. July 2018.

Figure 7-20: NH_3 Emissions in Delaware from all Data Categories, 2002 - 2017 (Tons)

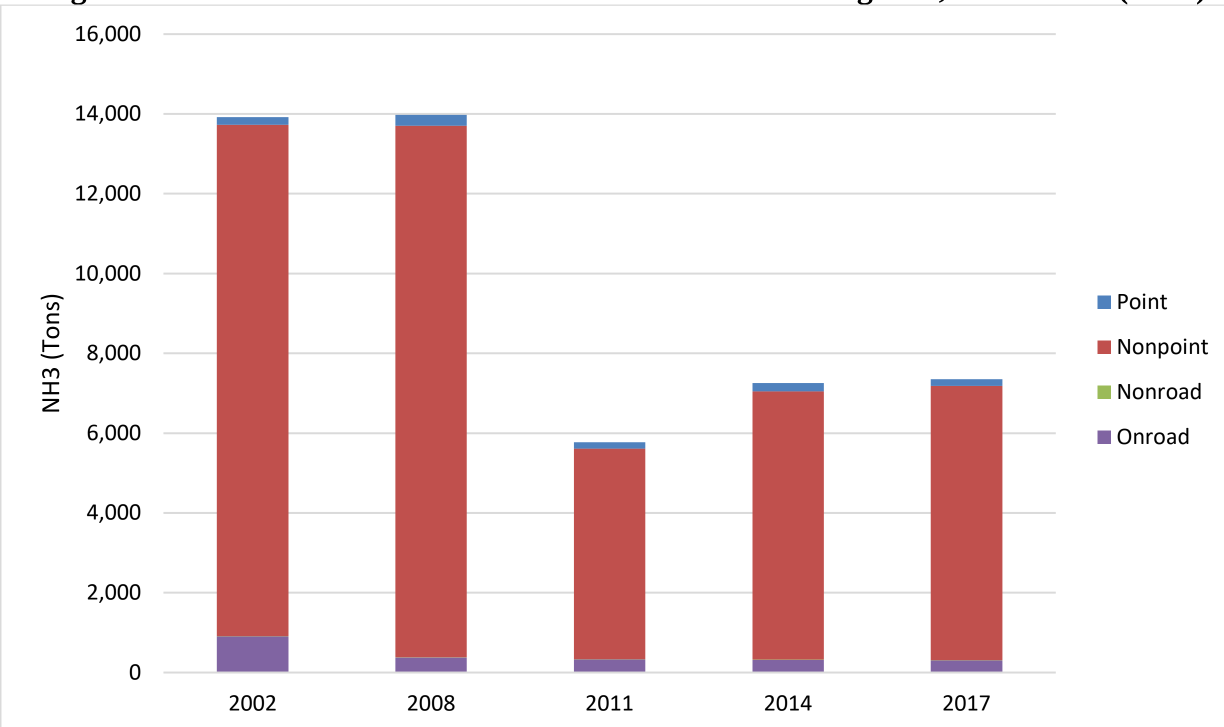
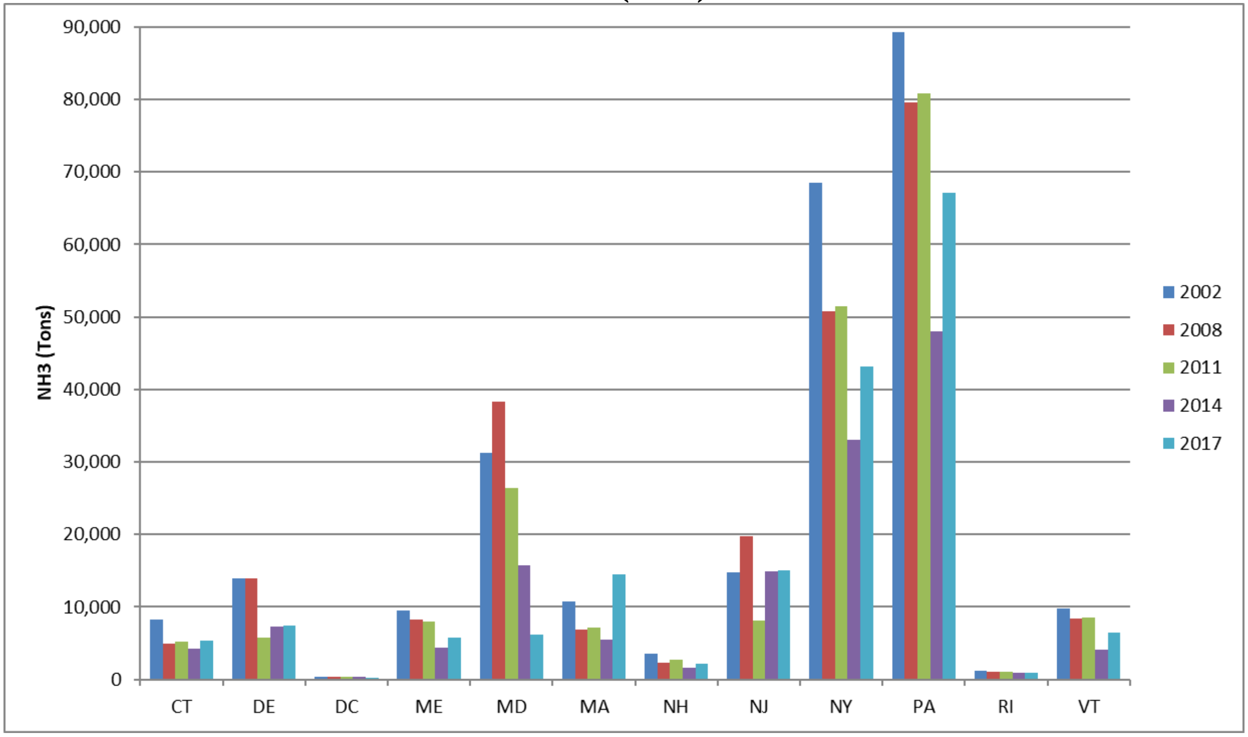


Table 7-25 and Figure 7-21 show total NH_3emissions for all data categories combined for the MANE-VU states. Some year to year variability can be seen. However, for all MANE-VU states except NJ, NH_3emissions for 2017 are lower than they were for earlier years.

Table 7-25: Total NH_3 Emissions in the MANE-VU States from all Data Categories, 2002-2017 (Tons)

State	2002	2008	2011	2014	2017	NH_3 Reduction (2002 – 2017)	Percent NH_3 Reduction (2002 – 2017)
CT	8,194	4,989	5,200	4,194	5,296	-2,898	-35%
DE	13,920	13,975	5,771	7,252	7,353	-6,567	-47%
DC	421	354	330	317	263	-158	-37%
ME	9,557	8,207	8,024	4,356	5,765	-3,792	-40%
MD	31,278	38,288	26,429	15,746	6,108	-25,170	-80%
MA	10,794	6,929	7,177	5,411	14,492	3,698	34%
NH	3,567	2,311	2,684	1,645	2,122	-1,445	-41%
NJ	14,807	19,804	8,049	14,895	14,976	169	1%
NY	68,536	50,737	51,487	33,110	43,180	-25,356	-37%
PA	89,263	79,588	80,871	48,000	67,183	-22,080	-25%
RI	1,202	1,092	1,075	862	873	-329	-27%
VT	9,810	8,379	8,567	4,148	6,490	-3,320	-34%
Total	**261,350**	**234,652**	**205,665**	**139,936**	**174,101**	**-87,248**	**-33%**

Figure 7-21: Total NH_3 Emissions in the MANE-VU States from all data Categories, 2002-2017 (Tons)

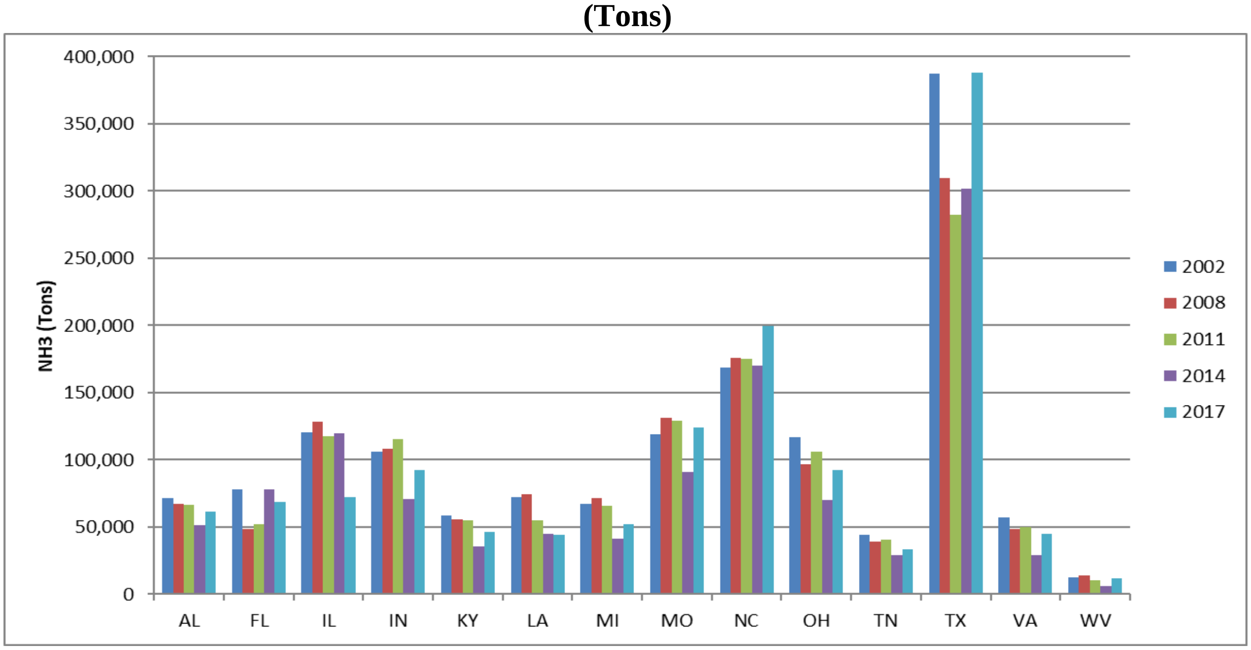


Total NH_3emissions for all data categories for the "Ask states" are shown in Table 7-26 and Figure 7-22. Again, some year to year variability in NH_3emissions can be seen. In most of the "Ask states", 2017 emissions are lower than they were for previous years.

Table 7-26: Total NH_3 Emissions in the Ask States from all Data Categories, 2002-2017 (Tons)

State	2002	2008	2011	2014	2017	NH_3 Reduction (2002 – 2017)	Percent NH_3 Reduction (2002 – 2017)
AL	71,627	67,454	66,494	51,329	61,153	-10,474	-15%
FL	77,959	48,211	52,218	77,637	68,283	-9,676	-12%
IL	120,222	128,348	117,209	119,481	71,951	-48,271	-40%
IN	106,354	108,301	115,038	71,036	92,297	-14,057	-13%
KY	58,406	55,558	55,265	35,476	46,390	-12,016	-21%
LA	72,094	74,188	55,272	44,703	44,395	-27,699	-38%
MI	66,954	71,406	65,507	41,500	52,261	-14,693	-22%
MO	119,101	131,113	128,753	90,853	124,221	5,119	4%
NC	168,398	176,143	175,127	169,777	199,395	30,997	18%
OH	117,152	96,512	105,793	69,854	92,404	-24,749	-21%
TN	43,831	39,213	40,364	29,237	33,574	-10,257	-23%
TX	387,228	309,529	282,413	301,772	388,408	1,180	0%
VA	57,150	48,462	49,935	29,151	44,768	-12,382	-22%
WV	12,832	14,100	10,668	6,162	11,815	-1,017	-8%
Total	**1,479,309**	**1,368,541**	**1,320,058**	**1,137,969**	**1,331,316**	**-147,993**	**-10%**

Figure 7-22: Total NH_3 Emissions in the Ask States from all Data Categories, 2002-2017 (Tons)



7.2 Baseline and Future Year Emission Inventories for Modeling

Section 51.308(f)(2)(iii)) of EPA's RHR requires Delaware to identify the baseline emission inventory on which strategies are based. The baseline inventory is intended to be used to assess progress in making emission reductions. MANE-VU and Delaware are using 2011 as the baseline year inventory. 2010, 2011 and 2012 were all considered for the base year for modeling. When availability of NEI data, research data, and the use of 2011 by other RPOs were taken into consideration; it was determined that 2011 would be the best base year.

A future year inventory was developed for 2028 based on the 2011 base year. This future year emission inventory includes emissions growth due to projected increases in economic activity as well as the emissions reductions due to the implementation of control measures.

The emissions dataset illustrated below is the 2011 Gamma emissions inventory. The emission inventories include carbon monoxide, but it is not considered in this SIP as it does not contribute to visibility impairment. The MANE-VU regional haze emissions 2011 Gamma inventory was also used for modeling purposes. This inventory was developed by MARAMA, the Eastern Regional Technical Advisory Committee (ERTAC) EGU Workgroup, and EPA.

The guiding philosophy behind the development of the 2011 inventory was to rely as much as possible on the collaborative work performed by the State/Local/Tribal (S/L/T) air agencies and the EPA in developing a 2011-based Modeling Platform.

For the 2028 inventory, the guiding philosophy was to use a combination of S/L/T data and methods for projecting emissions from stationary sources and to rely on EPA's 2028 Modeling Platform for mobile source emission projections. More detailed information regarding the Gamma Inventory and projections can be found in *Technical Support Document for 2011 for the Northeastern U.S. Gamma Inventory* (January 2018) [38] and *Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2011 Based Modeling Platform Support Document – October 2018 Update* (October 2018)[39] (Appendices 7-1 and 7-2, respectively). The following is a summary of the inventory source types that were utilized.

38 Technical Support Document for 2011 for the Northeastern U.S. Gamma Inventory. MARAMA. January 2018. https://www.nj.gov/dep/baqp/OA/App%204-3%202011-Gamma-TSD-Northeast-Emission-Inventory-2018.pdf

39 Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2011 Based Modeling Platform Support Document – October 2018 Update. OTC/MANE-VU. October 2018. https://otcair.org/upload/Documents/Reports/OTC%20MANE-VU%202011%20Based%20Modeling%20Platform%20Support%20Document%20October%202018%20-%20Final.pdf

7.3 Inventories for Specific Source Types

The following categories of source types were used in the 2011 Gamma emissions inventory:

- ERTAC EGU
- Other Point Sources (Non-EGU)
- Nonpoint/Area Sources
- Nonroad equipment
- Onroad vehicles
- Oil and Gas
- Biogenic Sources
- Other (Includes agricultural, prescribed, and wild fires and agricultural dust)

7.4 Summary 2002/2011 emissions inventories and 2028 emissions projections

Tables 7-27 through 7-32 represent the MANE-VU 2002 and 2011 Gamma emissions inventories and 2028 Gamma emissions projections for MANE-VU and Delaware. Gamma inventory summaries are based on dust meteorologically and precipitation adjusted emissions processed through the Sparse Matrix Operational Kernel Emissions (SMOKE) processor[40], which results in lower totals for $PM_{2.5}$ and PM_{10} compared to the unadjusted totals shown earlier obtained from the NEI. Detailed information regarding the inventories and projections can be found in Appendices 7-1 and 7-3. More detailed information regarding the development of MANE-VU 2002 Emissions Inventory can be found in Delaware's 2008 Regional Haze SIP, Section 7.1[41].

40 Sparse Matrix Operational Kernel Emissions (SMOKE) processor. https://www.cmascenter.org/smoke/
41 Delaware's Visibility State Implementation Plan (SIP). DNREC. September 24, 2008. https://dnrec.alpha.delaware.gov/air/quality/regional-haze/

Table 7-27: MANE-VU 2002 Emissions Inventory Summary–MANE-VU States [a]

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
Point	97,300	673,660	55,447	89,150	6,194	1,907,634
Area	1,528,141	262,477	332,729	1,455,311	249,795	316,357
Onroad	789,560	1,308,233	22,107	31,561	52,984	40,091
Nonroad	572,751	431,631	36,084	40,114	287	57,257
Biogenics	2,575,232	28,396	-	-	-	-
TOTAL	**5,562,984**	**2,704,397**	**446,367**	**1,616,136**	**309,260**	**2,321,339**

Table 7-28: 2011 Gamma Emissions Inventory Summary–MANE-VU States [b]

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
EGU	2,477	206,457	17,987	24,000	2,923	462,551
Non-EGU	53,046	155,892	28,669	37,773	4,950	108,301
Area/NonPoint	703,086	194,924	160,501	177,343	14,552	135,783
Nonroad	369,537	344,671	27,442	29,073	378	25,477
Oil/Gas	29,028	53,405	1,676	1,766	14	2,102
Onroad	362,357	717,012	27,133	52,081	18,094	4,793
Biogenics	2,064,088	30,564	-	-	-	-
Other	21,570	1,165	27,816	846	165,673	668
TOTAL	**3,605,189**	**1,704,090**	**291,225**	**322,881**	**206,584**	**739,675**

Table 7-29: 2028 Gamma Emissions Projections Summary–MANE-VU States [c]

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
EGU	4,871	85,182	15,060	19,115	3,114	196,760
Non-EGU	54,371	148,416	28,329	37,522	5,123	82,813
Area/NonPoint	659,063	177,995	150,922	167,001	13,641	28,159
Nonroad	219,807	193,233	13,773	14,752	475	1,967
Oil/Gas	49,830	70,737	3,101	3,196	16	6,369
Onroad	111,151	165,746	9,216	35,845	12,632	1,642
Biogenics	2,064,088	30,564	-	-	-	-
Other	22,084	1,384	29,956	147,913	169,064	771
TOTAL	**3,185,265**	**873,256**	**250,357**	**425,343**	**204,066**	**318,481**

Table 7-30: MANE-VU 2002 Emissions Inventory Summary–Delaware [a]

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
EGUs	110	11,973	2,060	2,397	43	38,038
Non-EGUs	4,645	4,372	1,606	1,820	153	35,706
Area	15,519	2,608	3,204	13,039	13,279	1,588
Onroad	10,564	21,341	415	581	903	584
Nonroad	8,010	16,227	926	1,021	5	3,983
TOTAL	**38,848**	**56,521**	**8,211**	**18,858**	**14,383**	**79,899**

Table 7-31: 2011 Gamma Emissions Inventory Summary–Delaware [b]

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
EGU	81	3,352	637	641	79	9,291
Non-EGU	1,667	2,178	604	706	78	2,190
Area/NonPoint	8,824	2,165	1,298	1,311	94	468
Nonroad	5,856	8,173	652	693	7	1,841
Oil/Gas	-	-	-	-	-	-
Onroad	6,722	13,080	395	685	320	82
Biogenics	27,243	758	-	-	-	-
Other	188	24	687	9	5,199	8
TOTAL	**50,580**	**29,730**	**4,273**	**4,045**	**5,777**	**13,881**

Table 7-32: 2028 Gamma Emissions Projection Summary–Delaware [c]

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
EGU	86	1,723	421	425	125	1,522
Non-EGU	1,879	2,072	608	705	81	2,045
Area/NonPoint	8,385	2,179	1,255	1,267	94	32
Nonroad	3,269	4,754	269	289	9	128
Oil/Gas	-	-	-	-	-	-
Onroad	2,404	3,249	151	497	256	33
Biogenics	27,243	758	-	-	-	-
Other	200	30	796	3,906	5,202	8
TOTAL	**43,465**	**14,765**	**3,501**	**7,090**	**5,767**	**3,768**

[a] Source: Pechan, 2006. "Technical Support Document for 2002 MANE-VU SIP Modeling Inventories, Version 3." November 20, 2006. Available online: http://www.marama.org/technical-center/emissions-inventory/2002-inventory-and-projections/mane-vu-2002-emissions-inventory

[b] Source: McDill and McCusker, 2018. "Technical Support Document: Emission Inventory Development for 2011 for the Northeastern U.S. Gamma Version," January 29, 2018. http://marama.org/technical-center/emissions-inventory/2011-gamma-inventory-and-projections

[c] Source: *Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2011 Based Modeling Platform Support Document – October 2018 Update*

Section 8 - Delaware’s Long-Term Strategy (40 CFR 51.308 (f)(2))

40 CFR Section 51.308(f)(2) requires States to submit a LTS that addresses regional haze visibility impairment for each mandatory Class I area within and outside the State/Tribe which may be affected by emissions from within the State.

Delaware must consult with other states affecting the Class I area to develop coordinated emission management strategies. Section 8.3.1 includes additional information regarding the contributions by individual states to regional haze at Class I areas.

During the first implementation period, Delaware was identified as contributing 3.20 % to the visibility impairment in the Brigantine National Wildlife Refuge (Brigantine) Class I area. Delaware’s highest contribution for the second implementation period continued to be Brigantine; 0.6% of sulfate and nitrate contribution, as detailed in Section 8.3.1.

Since Delaware continued to have its highest contribution at the Brigantine Class I area, the LTS described below addresses visibility impairment for Brigantine. Delaware consulted with New Jersey, and this SIP includes measures needed to fulfill its agreements developed through that process. LTS must also include enforceable emissions limitations, compliance schedules, and other measures that are necessary to make reasonable progress.

Delaware has documented its LTS, as discussed below, to make reasonable progress toward visibility goals in nearby Class I areas, by reducing emissions of visibility pollutants.

8.1 Overview of the Long-Term Strategy Development Process

As a member of MANE-VU, Delaware has supported a regional approach towards deciding which control measures to pursue for reducing visibility-impairing pollutants. For the first implementation period, this regional strategy development process was based on technical analyses documented in the following reports:

- Contributions to Regional Haze in the Northeast and Mid-Atlantic United States (called the Contribution Assessment) (August 2006)[42],
- Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas (called the Reasonable Progress Report)(July 2007)[43],

42 Contributions to Regional Haze in the Northeast and Mid-Atlantic United States. NESCAUM. August 2006. https://www.nescaum.org/documents/contributions-to-regional-haze-in-the-northeast-and-mid-atlantic--united-states/mane-vu_haze_contribution_asessment--2006-0831.pdf/

43 Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas. MACTEC. July 2007. https://s3.amazonaws.com/marama.org/wp-content/uploads/2019/12/13093515/Regional_Haze_Progress_Assessment-2007.pdf

- Five-Factor Analysis of BART-Eligible Sources: Survey of Options for Conducting BART Determinations. (June 2007)[44], and
- Assessment of Control Technology Options for BART-Eligible Sources: Steam Electric Boilers, Industrial Boilers, Cement Plants and Paper and Pulp Facilities.[45]

8.1.1 Regional Process of Identifying Potential Strategies

The regional strategy development process for the first implementation period identified reasonable measures that would reduce emissions contributing to visibility impairment at Class I areas affected by emissions from within the MANE-VU region by 2018 or earlier (1st RH SIP, Section 9.1.1)[46]. These measures were used as a basis for development of the LTS for the second implementation period, ending in 2028. This section describes the process of identifying potential emission reduction strategies for the second implementation period.

MANE-VU reviewed a wide range of potential control measures to reduce emissions from sources contributing to visibility impairment in affected Class I areas. The process by which MANE-VU arrived at a set of proposed control measures started in late 2014. MANE-VU began by examining how upwind states implemented control programs to address the "Ask" from the first planning period[47] and specifically how the 167 stacks from the first planning period "Ask" reduced emissions[48]. MANE-VU then reviewed the strategies outlined in *Beyond Sulfate: Maintaining Progress towards Visibility and Health Goals*[49]. Several of these strategies were carried forward and further examined for the engineering requirements and cost-effectiveness in *2016 Updates to the Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas* (Appendix 8-4).

8.2 Technical Basis for Emission Reduction Obligations

40 CFR Section 51.308(d)(3)(iii) requires states/tribes to document in their SIPs for the first implementation period the technical basis for the state's/tribe's apportionment of emission reductions necessary to meet RPGs in each Class I area affected by the state's/tribe's emissions.

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44 Five-Factor Analysis of BART-Eligible Sources: Survey of Options for Conducting BART Determinations. NESCAUM. June 2007. https://www.nescaum.org/documents/bart-final-memo-06-28-07.pdf/

45 Assessment of Control Technology Options for BART-Eligible Sources: Steam Electric Boilers, Industrial Boilers, Cement Plants and Paper and Pulp Facilities. NESCAUM. March 2005. https://www.nescaum.org/documents/bart-control-assessment.pdf/

46 Ibid., 32. Section 9.1.1

47 Miller, Paul. Overview of state and federal actions relative to MANE-VU Asks (March 28, 2013)

48 Technical Support Committee. Status of the Top 167 Electric Generating Units (EGUs) that Contributed to Visibility Impairment at MANE-VU Class I Areas during the 2008 Regional Haze Planning Period, (July 25, 2016).

49 Beyond Sulfate: Maintaining Progress towards Visibility and Health Goals (December 17, 2012) https://www.nescaum.org/topics/regional-haze/regional-haze-documents

In its SIP for the first implementation period, the State of Delaware relied on technical analyses developed by MANE-VU to demonstrate that Delaware's emission reductions, when coordinated with those of other States and Tribes are sufficient to achieve RPGs in the Class I area affected by Delaware sources.

MANE-VU's technical documentation of the emission reductions necessary in the first implementation period to meet RPGs in the Class I area affected by the State of Delaware is summarized in the following sections of this SIP, and in additional documentation referenced in those sections:

- Baseline and Natural Background Visibility Conditions-Considerations and Proposed Approach to the Calculation of Baseline and Natural Background Visibility Conditions at MANE-VU Class I Areas (NESCAUM, December 2006)[50]
- The Nature of the Fine Particle and Regional Haze Air Quality Problems in the MANE-VU Region: A Conceptual Description (NESCAUM, November 2006; Revised August 2010 and July 2012) (Appendix 8-1)
- Contributions to Regional Haze in the Northeast and Mid-Atlantic United States (NESCAUM, August 2006) (called the Contribution Assessment)[51]
- Assessment of Reasonable Progress for Regional haze in MANE-VU Class I Areas (MACTEC, July 2007) (called the Reasonable Progress Report)[52]
- Five-Factor Analysis of BART-Eligible Sources: Survey of Options for Conducting BART Determinations (NESCAUM, June 2007)[53]
- Assessment of Control Technology Options for BART-Eligible Sources: Steam Electric Boilers, Industrial Boilers, Cement Plants and Paper and Pulp Facilities (NESCAUM, March 2005)[54]
- MANE-VU Modeling for Reasonable Progress Goals: Model Performance Evaluation, Pollution Apportionment, and Control Measure Benefits (NESCAUM, February 2008)[55]
- 2018 Visibility Projections (NESCAUM, May 2008)[56]

50 Baseline and Natural Background Visibility Conditions-Considerations and Proposed Approach to the Calculation of Baseline and Natural Background Visibility Conditions at MANE-VU Class I Areas. NESCAUM. December 2006. http://www.nescaum.org/topics/regional-haze/regional-haze-documents

51 Contributions to Regional Haze in the Northeast and Mid-Atlantic United States. NESCAUM, August 2006. http://www.nescaum.org/documents/contributions-to-regional-haze-in-the-northeast-and-mid-atlantic--united-states/

52 Assessment of Reasonable Progress for Regional haze in MANE-VU Class I Areas. MACTEC. July 2007. http://www.marama.org/visibility/RPG/FinalReport/RPGFinalReport_070907.pdf

53 Five-Factor Analysis of BART-Eligible Sources: Survey of Options for Conducting BART Determinations. NESCAUM. June 2007. http://www.nescaum.org/topics/regional-haze/regional-haze-documents

54 Assessment of Control Technology Options for BART-Eligible Sources: Steam Electric Boilers, Industrial Boilers, Cement Plants and Paper and Pulp Facilities NESCAUM, March 2005. http://www.nescaum.org/topics/regional-haze/regional-haze-documents

55 MANE-VU Modeling for Reasonable Progress Goals: Model Performance Evaluation, Pollution Apportionment, and Control Measure Benefits. NESCAUM. February 2008. http://www.nescaum.org/topics/regional-haze/regional-haze-documents

56 2018 Visibility Projections. NESCAUM, May 2008. http://www.nescaum.org/topics/regional-haze/regional-haze-documents

Finalized in August 2006, the MANE-VU Contribution Assessment[57] reflected a conceptual model in which sulfate emerged as the most important single constituent of fine particle pollution and the principal cause of visibility impairment across the region. Sulfate alone accounted for anywhere from one-half to two-thirds of total fine particle mass on the 20 percent haziest days at MANE-VU Class I sites. As a result, MANE-VU concluded that an effective emissions management approach would rely heavily on broad-based regional SO_2 control efforts in the eastern United States.

The following sections discuss the pollutants, source regions, and types of sources considered in developing the LTS for the second implementation period. The requirements for the SIP for the second implementation period are in 40 CFR 51.308(f)(2)(iii).

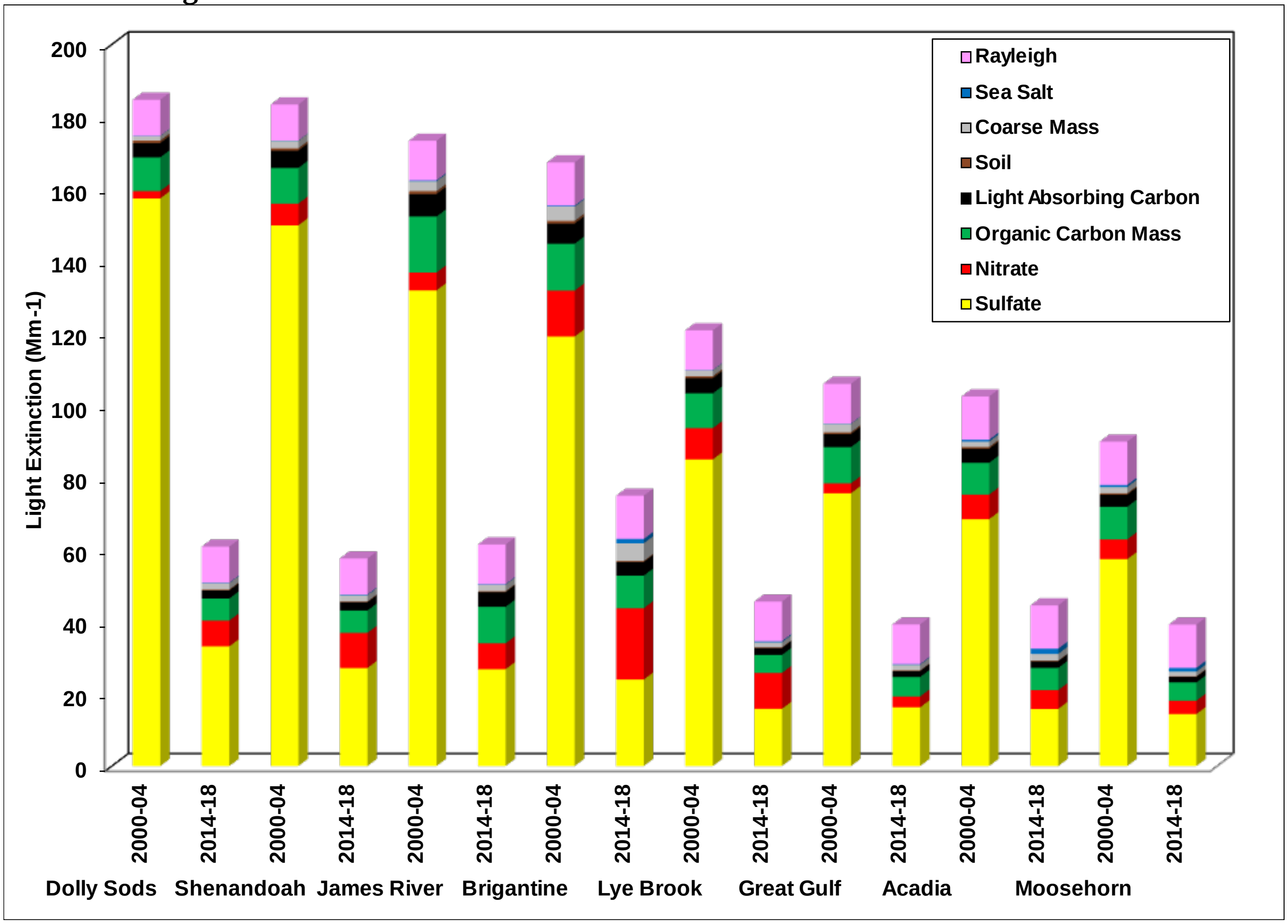
Additional documents were developed in preparation for the 2018 RH SIP Revisions:

- Contributions to Regional Haze in the Northeast and Mid-Atlantic United States: Preliminary Update Through 2007 (NESCAUM, March 2012) (Appendix 8-2)
- MANE-VU Updated Q/d*C Contribution Assessment (MANE-VU, April 2016) (Appendix 8-3)
- 2016 Updates to the Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas (January 2016) (Appendix 8-4)
- Beyond Sulfate: Maintaining Progress towards Visibility and Health Goals (NESCAUM, December 17, 2012)[58]

In regard to the second implementation period, MANE-VU concluded, after developing a conceptual model, that the sulfates from SO_2 emissions were still the primary driver behind visibility impairment in the region (five MANE-VU Class I areas and Shenandoah National Park), though nitrates from NO_x emission sources do play a more significant role than they had in the first planning period (Appendix 8-1). Figure 8-1 shows the dominance of sulfate in the extinction calculated from the 2000-2004 baseline data vs. 2014-2018 data, using the 20% most impaired days.

57 Ibid., 30
58 Ibid., 49

Figure 8-1: Contributions to $PM_{2.5}$ Extinction at Seven Class I Sites[59]



8.3 Modeling and Source Attribution Studies

8.3.1 Contributing States and Regions

The MANE-VU Contribution Assessment for the first implementation period used various modeling techniques, air quality data analysis, and emissions inventory analysis to identify source categories and states that contribute to visibility impairment in MANE-VU Class I areas and Shenandoah National Park. With respect to sulfate, based on estimates from four different techniques, the Contribution Assessment for the first implementation period estimated emissions from within MANE-VU in 2002 were responsible for about 25-30 percent of the sulfate at Class I areas and 15-20 percent at Shenandoah National Park (see Chapter 8 of the Contribution Assessment). The contribution of sulfate at these Class I areas from other regions, Canada, and outside the modeling domain were also significant.

59 MANE-VU Sites and Constituents Analyses 2000-18 Summary (2nd RH SIP, (May 2007) https://otcair.org/manevu/document.asp?fview=Reports

For the second implementation period, MANE-VU Class I states considered the modeling results documented in the Selection of States (Appendix 1-1) to determine which states should be consulted in developing the LTS for improving visibility in MANE-VU Class I areas.

Because sulfate was the primary pollutant of concern, but nitrates from NO_X emission sources play a more significant role than they had in the first planning period, Delaware chose to use the MANE-VU approach to contribution assessments, which focused on sulfates and included nitrates when they could be included in a technically sound fashion. Additionally, MANE-VU examined annual inventories of emissions to find sectors that should be considered for further analysis. EGUs emitting SO_2 and NOx and industrial point sources emitting SO_2 were found to be point source sectors of high emissions that warranted further scrutiny. Mobile sources were also found to be an important sector in terms of NOx emissions. Since power plants and mobile sources generally dominate state and regional NOx emissions inventories, only industrial sources emitting SO_2 emissions were selected for further analysis[60] (Appendix 8-2).

After this initial work, MANE-VU initiated a process of screening states and sectors for contribution using two tools, Q/d and CALPUFF (Appendices 8-3 and 8-5, respectively). Finally, results of this contribution analysis were then compared to air mass trajectories, to better understand the source areas of the country where wind patterns transported emissions to cause the 20% most impaired visibility days in a MANE-VU Class I area.

Both techniques (Q/d and CALPUFF) provided estimates for potential visibility impacting masses. Rather than relying solely on one technique for identifying contributing states, both techniques were included by means of an average of each relative contribution calculation for nitrates and sulfates. Since nitrates and sulfates have similar visibility impairment for similar ambient air concentrations, they weighted equally in the impact calculations and Q/d and CALPUFF results were also equally weighed when both were available. No point sources were modeled with CALPUFF for the District of Columbia, Florida, Louisiana, Mississippi, Rhode Island, and Vermont due to either a lack of major point sources or that their geography was just beyond the modeling domain. Therefore, only Q/d results were considered when estimating potential visibility impacts for those states.

Table 8-1 provides average percent mass-weighted sulfate and nitrate contributions for each analyzed state to five MANE-VU Class I Areas, using monitored emissions data on the 20% most impaired day to determine what pollution is leading to anthropogenic visibility impacts. The scores for the 36 states total 100 (or 100%). States listed towards the top of the table (in orange shading) are each estimated to contribute 3 percent or greater of the 36 state total contributions. States in the pink shade contribute 2 to 3 percent and states listed in green contribute less than 2 percent in this ranking.

60 Contribution Assessment Preliminary Inventory Analysis. https://otcair.org/MANEVU/Upload/Publication/Reports/Contribution%20Assessment%20Preliminary%20Inventory%20Analysis.pdf

In addition, the table provides the maximum percentage that a state contributes any Class I area in MANE-VU and the average mass estimated by the four methods. The column furthest to the right provides a relative mass factor of nitrates and sulfates combined which was used as a filter to ensure the major nitrates and sulfates mass contributing states are identified and also to determine if a state contributing a relatively low amount of mass was identified as a contributing state at one or more of the MANE-VU Class I Areas. Delaware's modeled contribution to MANE-VU Class I areas was 0.6% for Brigantine, 0.1% for Lye Brook, and 0.2% for all other MANE-VU Class I areas.

Table 8-1: Percent Mass-Weighted 2011 Sulfate and Nitrate contribution for top 36 Eastern States to all MANE-VU Class I areas: consolidated (maximum to any Class I area), individual MANE-VU Class I areas, and average contributed mass (mass factor).[61]

Rank	Maximum		Acadia		Brigantine		Great Gulf		Lye Brook		Moosehorn		Mass Factor	
1	PA	20.0	PA	12.4	PA	19.9	PA	15.6	PA	20.0	PA	10.5	PA	2.11
2	OH	11.3	OH	10.1	OH	8.8	OH	10.9	OH	11.3	OH	10.2	OH	1.06
3	NY	10.0	ME	8.3	MD	6.5	IN	8.0	NY	10.0	IN	8.0	IN	0.64
4	ME	8.3	IN	6.9	WV	6.4	NY	7.6	IN	7.4	TX	6.3	WV	0.61
5	IN	8.0	MI	6.0	NY	6.1	MI	6.6	TX	5.4	MI	6.0	MI	0.54
6	MI	6.6	NY	5.8	IN	5.4	TX	4.9	WV	5.3	NY	5.9	VA	0.47
7	MD	6.5	TX	4.7	TX	5.1	WV	4.7	MI	5.1	ME	5.6	KY	0.47
8	WV	6.4	MA	4.4	VA	4.8	IL	3.7	KY	4.2	WV	4.8	TX	0.44
9	TX	6.3	WV	3.9	KY	4.7	NH	3.7	IL	2.7	KY	4.2	NY	0.42
10	VA	4.8	NH	3.4	MI	4.5	KY	3.6	MO	2.5	IL	3.9	MD	0.40
11	KY	4.7	KY	3.4	NC	2.7	MO	3.1	LA	2.4	MA	3.4	NC	0.34
12	MA	4.4	IL	2.8	AL	2.6	ME	2.9	VA	2.4	MO	3.3	MA	0.27
13	IL	3.9	NC	2.7	LA	2.5	WI	2.6	NC	2.3	NH	3.1	NH	0.26
14	NH	3.7	MD	2.7	NJ	2.2	LA	2.2	MD	2.3	LA)	2.8	ME	0.25
15	MO	3.3	VA	2.5	IL	2.1	VA	2.1	AL	2.03	MD	2.6	AL	0.22
16	LA	2.8	MO	2.4	TN	2.01	NC	2.1	WI	1.9	AL	2.5	LA	0.21
17	NC	2.7	AL	2.2	GA	1.97	MD	2.1	OK	1.6	VA	2.4	TN	0.18
18	AL	2.6	FL	2.1	MO	1.9	VT	2.1	ME	1.6	NC	2.2	GA	0.17
19	WI	2.6	LA	2.1	FL	1.5	AL	1.8	TN	1.5	OK	1.8	MO	0.16
20	NJ	2.2	GA	1.9	MA	1.4	OK	1.8	GA	1.3	WI	1.8	FL	0.13
21	FL	2.1	WI	1.8	OK	1.4	MA	1.8	IA	1.2	TN	1.7	IL	0.12
22	VT	2.1	TN	1.5	NH	1.1	GA	1.8	MA	1.2	GA	1.7	OK	0.12
23	TN	2.01	IA	1.5	NE	1.0	IA	1.7	CT	1.2	IA	1.5	VT	0.09
24	GA	1.97	CT	1.3	AR	1.0	AR	1.3	AR	1.2	CT	1.4	NJ	0.09
25	OK	1.8	OK	1.2	CT	1.0	TN	1.3	NH	1.1	AR	1.4	IA	0.07
26	IA	1.7	AR	1.2	WI	0.9	KS	1.0	MN	1.0	KS	1.2	WI	0.07
27	CT	1.4	NJ	1.0	ME	0.9	NE	0.8	FL	1.0	NJ	0.9	CT	0.07
28	AR	1.4	MN	0.9	IA	0.9	CT	0.7	KS	0.8	MS	0.8	MS	0.07
29	KS	1.2	KS	0.8	SC	0.8	MS	0.7	NJ	0.8	NE	0.8	AR	0.06
30	NE	1.0	NE	0.8	MS	0.8	SC	0.5	MS	0.7	VT	0.8	SC	0.05
31	MN	1.0	SC	0.8	DE	0.6	MN	0.5	NE	0.6	SC	0.8	MN	0.04
32	MS	0.8	MS	0.6	KS	0.6	FL	0.5	SC	0.5	FL	0.7	NE	0.03
33	SC	0.8	VT	0.6	MN	0.6	NJ	0.4	VT	0.3	MN	0.5	RI	0.02
34	DE	0.6	RI	0.5	RI	0.3	RI	0.2	RI	0.2	DE	0.2	KS	0.02
35	RI	0.5	DE	0.2	DC	0.2	DE	0.2	DE	0.1	RI	0.1	DE	0.02
36	DC	0.2	DC	0.1	VT	0.2	DC	0.1	DC	0.1	DC	0.1	DC	0.016

61 Analysis uses monitored emissions data on the 20% most impaired day to determine what pollution is leading to anthropogenic visibility impacts. https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU%20Contributing%20State%20Analysis%20Final.pdf

8.4 Baseline Emissions

40 CFR Section 51.308(f)(f)(2)(iii) requires Delaware to identify the baseline emissions information on which the LTS is based.

- Delaware used the 2011 MANE-VU Emissions Inventory Gamma Version as its baseline inventory.

More specific information about the baseline emissions inventory data used can be found in Section 7 of this SIP.

8.5 Modeling Techniques Used

The following documents describe preliminary and final modeling runs conducted by MANE-VU and used in developing this LTS:

- MANE-VU Updated Q/d*C Contribution Assessment (MANE-VU, April 2016) (Appendix 8-3)
- 2016 MANE-VU Source Contribution Modeling Report – CALPUFF Modeling of Large Electrical Generating Units and Industrial Sources (MANE-VU, April 2017)(Appendix 8-5)
- Regional Haze Metrics Trends and HYSPLIT Trajectory Analyses (MANE-VU, March 2017)(Appendix 8-6)

As documented in the MANE-VU *Selection of States*, MANE-VU initiated a process of screening states and sectors for contribution using two tools, Q/d and CALPUFF. In addition, results of the trajectory analyses were used to identify transport patterns and can be used in conjunction with other MANE-VU contribution analysis tools (CALPUFF modeling and Q/d analyses) to determine states to be included in the consultation process. The three modeling techniques are described in more detail below.

8.5.1 Weighted Q/d

The weighted emissions over distance (Q/d) method is a method for estimating sulfate and nitrate contributions to a receptor. The empirical formula that relates emission source strength and estimated impact is expressed through the following equation:

$$I = C_i \left(Q / d \right)$$

In this equation, the strength of an emission source, Q, is linearly related to the impact, I, that it will have on a receptor located a distance, d, away. As in the previous analysis, distances were computed using the Haversine function, using an earth radius of 6371 km^2. The effect of meteorological prevailing winds can be factored into this approach by establishing the constant, Ci, as a function of the "wind direction sectors" relative to the receptor site[62]. Details of the Q/d analyses can be found in Appendix 8-3.

8.5.2 CALPUFF

For the second implementation period SIPs, New Hampshire Department of Environmental Services in conjunction with Vermont Department of Environmental Conservation performed air pollution transport modeling with the CALPUFF dispersion model, which was used to simulate sulfate and nitrate formation and transport in MANE-VU and nearby regions. The modeling effort focused on EGUs and large industrial and institutional sources in the eastern and central United States.

The 2016 modeling effort built on the 2002 point source contribution modeling performed by MANE-VU for the 2008 member states' Regional Haze SIP submittals for the first implementation period. CALPUFF simulates atmospheric transport, transformation, and dispersion through the treatment of air pollutant emissions from stacks or area sources as a series of discrete puffs. Details of the CALPUFF analyses can be found in Appendix 8-5.

For the 2016 modeling effort, the MANE-VU TSC provided a preliminary list of EGU sources. This list was based on an enhanced Q/d analysis considering recent SO_2 emissions in the eastern United States and an analysis that adjusted previous 2002 MANE-VU CALPUFF modeling by applying a ratio of 2011 to 2002 SO_2 emissions (MANE-VU Technical Support Committee 6 April 2016). This list of sources was then enhanced by including the top five SO_2 and NO_X emission sources for 2011 for each state included in the modeling domain.

The MANE-VU TSC also identified 82 industrial and institutional facilities located within the CALPUFF modeling domain that either have emissions similar in magnitude to the EGUs modeled in this exercise, or are close enough to a Class I area that they would have the potential for visibility impacts. No Delaware facilities were selected for ICI modeling, as their emissions were low and/or they were not close enough to a Class I areas that they would have the potential for visibility impacts.

The 2016 modeling was performed for specific Class I Area receptor locations in and near Dolly Sods, James River Face, Otter Creek, and Shenandoah) the MANE-VU RPO. Two emissions years were analyzed: 2011 and 2015 with 3 years of meteorological data: 2002, 2011, and 2015 (Appendix 8-5).

62 Contributions to Regional Haze in the Northeast and Mid-Atlantic United States. NESCAUM. August 2006 https://www.nescaum.org/documents/contributions-to-regional-haze-in-the-northeast-and-mid-atlantic--united-states/mane-vu_haze_contribution_asessment--2006-0831.pdf/

The year 2011 was selected for current CALPUFF work to be consistent with the base year being used in EPA and OTC/MANE-VU photochemical modeling for regional haze (projected year 2028) and other efforts. The year 2015 was added to the analysis in order to represent the most recent available year, which recognizes changes in emission controls, fuel changes, changes in operations, and facility shutdowns that may have occurred since base year 2011. This information was used to determine which individual facilities MANE-VU may have the highest impact on visibility impairment and where to focus emission reduction strategies, such as installation or upgrade of emission controls. A threshold of 3.0 Mm^{-1} was selected by MANE-VU for analysis of the technological and economic feasibility of installation or upgrade of emission controls. See Section 9-4, ("Ask #2") for discussion of the threshold selection and the selected emission reduction strategies.

Two sources, both EGUs, were selected for CALPUFF modeling using the above-mentioned criteria: Indian River Generating Station (Indian River) and Edge Moor Energy Center (Edge Moor). The results of the CALPUFF modeling for Indian River and Edge Moor are shown in Table 8-2. The highest level for Indian River was 1.7 MM^{-1} in 2011 for Shenandoah; the highest level for Edge Moor was 0.4 for James River Face. Both highest levels were well below the 3.0 Mm^{-1} threshold for control analysis set in "Ask #2).

Table 8-2: CALPUFF Modeling Results for Delaware

Class I Area	Facility	Max Extinction Value (Mm-1) 2011	Max Extinction Value (Mm-1) 2015
Acadia	Indian River	1.0	0.3
Acadia	Edge Moor	0.3	NA
Brigantine	Indian River	1.2	0.6
Brigantine	Edge Moor	0.2	NA
Great Gulf	Indian River	1.0	0.1
Great Gulf	Edge Moor	0.1	NA
Lyebrook	Indian River	1.0	0.2
Lyebrook	Edge Moor	0.1	NA
Moosehorn	Indian River	1.3	0.3
Moosehorn	Edge Moor	0.3	NA
Campobello	Indian River	1.2	0.1
Campobello	Edge Moor	0.3	NA
Presidential Range	Indian River	1.1	0.3
Presidential Range	Edge Moor	0.1	NA
Dolly Sods	Indian River	1.0	0.4
Dolly Sods	Edge Moor	0.1	NA
Otter Creek	Indian River	0.8	0.4
Otter Creek	Edge Moor	0.1	NA
James River Face	Indian River	1.1	0.7
James River Face	Edge Moor	0.4	NA
Shenandoah	Indian River	1.7	0.5
Shenandoah	Edge Moor	0.2	NA

8.5.3 HYSPLIT Trajectory Analyses

The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model (Appendix 8-6) was used to plot 72-hour back trajectories four times per day from a starting height of 500 meters above ground level. However, trajectories don't distinguish emissions density nor what area along the 72-hour projection is most likely to contribute emissions that impact the Class I areas. Trajectories can identify the frequency and general direction of air masses that are transported to a Class I area. Results of the trajectory analyses can be used to identify transport patterns and can be used in conjunction with other MANE-VU contribution analysis tools (CALPUFF modeling and Q/d analyses) to determine states to be included in the consultation process.

Two types of maps were created for each Class I area. The first map showed the frequency (count) of hourly trajectory endpoints in each of the 25x25 mile grid squares on a map to help define transport patterns to a Class I area during the most impaired visibility days. The second set of maps showed individual trajectories for each day to show seasonal differences in transport patterns (Appendix 8-6).

Results are in general agreement with CALPUFF modeling results for states that may contribute to regional haze at MANE-VU Class I areas. This trajectory analyses confirmed contribution results from the MANE-VU CALPUFF modeling. The HYSPLIT modeling did not result in any states being added or removed from the existing list of contributing states. An average of less than two percent of trajectories modeled traveled over Delaware toward MANE-VU Class I areas on impaired days (Appendix 1-1, Table 8), further supporting the results of the CALPUFF modeling, that Delaware has a relatively low contribution to visibility impairment at MANE-VU Class I areas (Table 8-1).

8.6 Emission Reductions Due to Ongoing Air Pollution Programs

40 CFR Section 51.308(f)(2)(iv)(A) requires State to consider emission reductions from ongoing pollution control programs. In developing its LTS for the second implementation period, Delaware considered federal and Delaware emission control measures being implemented by 2028. In developing the MANE-VU Gamma Inventory, state and local agencies consulted with MARAMA, ERTAC, and EPA to prepare emission projections reflecting anticipated changes in energy use, economic and population growth, and air pollution control measures expected to go into effect during the planning horizon. The future year projection methodologies vary by inventory sector. More information about the emission projections and control measures for a specific source category can be found in the MANE-VU Gamma TSD (Appendix 7-2).

Delaware-specific regulations are from 7 DE Admin. Code – Natural Resources and Environmental Control and will be referred to below by Regulation number, i.e. Regulation 1108. Except where noted, all Delaware Regulatory amendments listed in Section 8.6 have been accepted into Delaware's SIP and are necessary for reasonable progress.

The following sections provide a summary of ongoing control measures for each source category. Delaware Regulations or control measures that were promulgated in 2008 and later are considered "new". They were not included in Delaware's 1st Regional Haze SIP[63] (submitted to EPA on September 24, 2008), since that SIP was well into development by 2008. Therefore, they are considered "new" to the Regional Haze SIP.

8.6.1 EGU Emissions Controls that Will Reduce Emissions by 2028

For EGU sources within MANE-VU, Delaware relied on MANE-VU's Gamma Emissions Inventory for 2011. The 2028 inventory projections for EGUs used the ERTAC EGU Forecast Tool. This method uses base year hourly AMPD data and fuel specific growth rates and other information to estimate future activity and emissions. Future emission rates are developed from base year emission rates adjusted to account for state knowledge of known future year emission controls, fuel switches, retirements, and new units.

Other control measures for EGUs that will reduce emissions by 2028 are (Post 2007):

- Mercury and Air Toxics Rule[64]

Delaware-specific measures for EGUs that will reduce emissions by 2028 are:

<u>Existing – Accepted into the Delaware SIP (1st RH SIP)</u>

- Regulation 1144, Control of Stationary Generator Emissions, SO2, PM, VOC and NOx emission control (Original regulation effective 1/11/06)[65]
- Regulation 1146, EGUs, EGU Multi-Pollutant Regulation, SO_2 and NOx emission control (Original regulation effective 12/11/06)
- Regulation 1148, Control of Stationary Combustion Turbine Electric Generating Unit Emissions, NOx emission control (Original regulation effective 7/11/07)
- Facility and Unit shutdowns (Delaware's 1st RH SIP – Appendix 9-8)

63 Ibid., 32

64 National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units. EPA Final Rule. 77 FR 9464. February 16, 2012. https://www.govinfo.gov/content/pkg/FR-2012-02-16/pdf/2012-806.pdf

65 Regulation 1144 requires the control of air emissions from both new and existing stationary generators. The purpose of this regulation is to ensure that emissions of NOx, PM, SO2, CO, carbon dioxide (CO2), and nonmethane hydrocarbons (NMHC) from stationary generators in the State of Delaware do not adversely impact public health, safety, and welfare. Regulation No. 1144 establishes emissions standards, operating requirements, fuel sulfur content limits, and recordkeeping requirements applicable to covered generators. http://regulations.delaware.gov/AdminCode/title7/1000/1100/1144.shtml#TopOfPage

New (Post 2007) – Accepted into the Delaware SIP

- Regulation 1108, Sulfur Dioxide Emissions from Fuel Burning Equipment (Amendments effective 7/11/13)
  - Low Sulfur Fuel Requirements
- Regulation 1146, EGUs, EGU Multi-Pollutant Regulation, SO_2 and NOx emission control (Amendments effective 10/10/09)

Facility and Unit shutdowns

- City of Dover, McKee Run Generating Station. Cancellation of permits Effective November 12, 2021, see Section 8.8 for details.

8.6.2 Non-EGU Point Source Emission Reductions Expected by 2028 Due to Ongoing Air Pollution Control Programs

For Non-EGU sources within MANE-VU, Delaware relied on MANE-VU's Gamma Emissions Inventory for 2011. Control factors for Non-EGU Point Sources were applied to the 2028 MANE-VU Gamma inventory projections to represent the following national, regional, or state control measures:

- OTC and MANE-VU Control Measures
- State NOx Rules and Control Requirements
- State VOC Rules and Control Requirements
- State Fuel Oil Sulfur Rules
- Facility and Unit Closures
- Boiler Maximum Achievable Control Technology (MACT) Rules
- Reciprocating Internal Combustion Engines (RICE) MACT Standards
- Consent Decrees
- Regional Haze Plan Controls
- Stand Alone Inventories

Delaware-specific measures for Non-EGU Point Sources that will reduce emissions by 2028 are:

Existing – Accepted into the Delaware SIP (1st RH SIP)

- Regulation 1142, Section 2.0, Control of NOx Emissions from Industrial Boilers and Process Heaters at Petroleum Refineries, NOx emission control (Original regulation effective 12/1/01)
- Regulation 1142, Section 2.0, Control of NOx Emissions from Industrial Boilers and Process Heaters at Petroleum Refineries, NOx emission control, New Castle County (Original regulation effective 7/11/07)
  - Delaware City refinery is subject to an enforceable emission cap for NOx.
- Regulation 1124, Section 46.0, Crude Oil Lightering Operations, VOC emission control (Original regulation effective 5/11/07)
- Facility and Unit shutdowns (Appendix 9-8 of Delaware's first Implementation Plan)

New (Post 2007) – Accepted into the Delaware SIP

- Regulation 1142, Section 2.0, Control of NOx Emissions from Industrial Boilers and Process Heaters at Petroleum Refineries, NOx emission control, New Castle County (Amendments effective 4/11/11)
    - Delaware City refinery is subject to an enforceable emission cap for NOx.

New (Post 2007) - Submitted for inclusion into the Delaware SIP

- Regulation 1108, Sulfur Dioxide Emissions from Fuel Burning Equipment (Amendments effective 7/11/13)
    - Low Sulfur Fuel Requirements

8.6.3 Area Sources Controls Expected by 2028 Due to Ongoing Air Pollution Control Programs

For area sources within MANE-VU, Delaware relied on MANE-VU's Gamma Emissions Inventory for 2011. In general, the 2028 inventory for area sources was developed by MANE-VU applying growth and control factors to the 2011 Gamma inventory. Control factors were applied to the 2028 MANE-VU Gamma inventory projections to represent the following national, regional, or state control measures:

- OTC and MANE-VU Control Measures
- State Specific NOx Rules
- State Specific VOC Rules
- State Fuel Oil Sulfur Rules
- Portable Fuel Container Rules
- Boiler MACT Rules
- RICE MACT Rules

Delaware-specific measures for Area Sources that will reduce emissions by 2028 are:

Existing – Accepted into the Delaware SIP (1st RH SIP Implementation Period)

- Regulation 1113, Open Burning, PM, VOC and NOx emission control (Amendments effective 4/11/07)
- Regulation 1124 Section 11.0, Mobile Equipment Repair and Refinishing, VOC emission control (Amendments effective 11/11/01)
- Regulation 1124 Section 33.0, Solvent Cleaning and Drying, VOC emission control (Amendments effective 11/11/01)
- Regulation 1124 Section 36.0, Stage II Vapor Recovery, VOC Emission control (Amendments effective 1/11/2002)
- Regulation 1141 Section 1.0, Architectural and Industrial Maintenance Coatings, VOC emission control (Amendments effective 11/11/06)
- Regulation 1141 Section 3.0, Portable Fuel Containers, VOC emission control (Amendments effective 11/11/06)

New (Post 2007) - Accepted into the Delaware SIP

- Regulation 1141 Section 2.0, Consumer Products, VOC emission control (Amendments effective 4/11/09)
- Regulation 1141 Section 3.0, Portable Fuel Containers, VOC emission control (Amendments effective 4/11/10)
- Regulation 1141, Section 4, Adhesives and Sealants, VOC emission control (Amendments effective 4/11/09)

New (Post 2007) - Submitted for inclusion into the Delaware SIP

- Regulation 1108, Sulfur Dioxide Emissions from Fuel Burning Equipment (Amendments effective 7/11/13)
- Regulation 1124, Section 11.0, Mobile Equipment Repair and Refinishing, VOC emission control (Amendments effective 10/11/10)
- Regulation 1124, Sections 26.0 and 36.0, Gasoline Dispending Facilities - Decommissioning of Stage II Vapor Recovery and Stage I Enhanced Vapor Recovery, VOC emission control (Amendments effective 7/11/20)
- Regulation 1124, Section 33.0, Solvent Cleaning and Drying, VOC emission control (Amendments effective 8/11/21)

8.6.4 Controls on Nonroad Sources Expected by 2028 due to Ongoing Air Pollution Control Programs

For nonroad sources within MANE-VU, Delaware relied on MANE-VU's Gamma Emissions Inventory for 2011. The Gamma inventory used EPA NONROAD Models and the EPA NEI2025v2 for 2028 projections.

Nonroad source controls incorporated into the modeling include the following:

- Changes in fuels and engines that reflect implementation of national regulations that impact each year differently due to engine turnover
- Local control programs

8.6.5 Mobile Source Controls Expected by 2028 due to Ongoing Air Pollution Control Programs

For mobile sources within MANE-VU, Delaware relied on MANE-VU's Gamma Emissions Inventory for 2011. For the GAMMA inventory, MARAMA used EPA MOtor Vehicle Emission Simulator (MOVES) Models and the EPA NEI2025v2 for 2028 projections.

- Changes in fuels and engines that reflect implementation of national regulations that impact each year differently due to engine turnover and fuel requirements
- Local control programs

Delaware-specific measures for Area Sources that will reduce emissions by 2028 are:

Existing - Accepted into the Delaware SIP (1st RH SIP)

- Regulation 1131, Low Enhanced Inspection and Maintenance Program (Amendments effective 10/11/01)
- Regulation 1132, Transportation Conformity Regulation (Amendments effective 11/11/07)
- Regulation 1140, Delaware Low Emission Vehicle Program (Amendments effective 10/11/99)
- Regulation 1145, Excessive Idling of Heavy Duty Vehicles (Original regulation effective 4/11/05)
- 40 CFR Parts 80, 85, and 86 Control of Air Pollution from New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements.
- 40 CFR Parts 69, 80, and 86 Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements.

New (Post 2007) - Submitted for inclusion to the Delaware SIP

- Regulation 1140, Delaware Low Emission Vehicle Program (Amendments effective 3/11/18)
- Regulation 1140, Delaware Low Emission Vehicle Program (Amendments effective 5/1/19)[66]

8.7 Measures to Mitigate the Impacts of Construction Activities

40 CFR Section 51.308(d)(3)(v)(B) requires Delaware to consider in the first implementation period measures to mitigate the impacts of construction activities.

A description of MANE-VU's consideration of measures to mitigate the impacts of construction for the first implementation period can be found in the MANE-VU Construction TSD entitled, *Technical Support Document on Measures to Mitigate the Visibility Impacts of Construction Activities in the MANE-VU Region* (MANE-VU, September 2006)**[67]**. The following statements summarize the main points of this TSD:

- Although a temporary source, fugitive dust and diesel emissions from construction activities can have an effect on local air quality.

66 EPA has put a hold on the review of this SIP submittal from Delaware, due to the September 27, 2019, withdrawal of a 2013 CAA "Section 209" Waiver to California, regarding Motor Vehicle Emission and Fuel Standards. While the Clean Air Act preempts all other states from setting their own vehicle emission standards, California can request a waiver to do so if it determines that its standards are at least as protective of public health and welfare as federal standards issued by the U.S. Environmental Protection Agency.

67 Technical Support Document on Measures to Mitigate the Visibility Impacts of Construction Activities in the MANE-VU Region. MANE-VU. September 2006. https://otcair.org/MANEVU/Upload/Publication/Reports/Construction_TSD_102006.pdf

- While construction activities are responsible for a relatively large fraction of direct $PM_{2.5}$ and PM_{10} emissions in the Region, the impact on visibility is less because dust settles out of the air relatively close to the sources.

- Ambient air quality data shows that soil dust makes up only a minor fraction of the $PM_{2.5}$ measured in MANE-VU Class I areas, and impacts of diesel emissions in these rural areas are also a small part of total $PM_{2.5}$.

- The use of measures such as clean fuels, retrofit technology, best available technology, specialized permits, and truck staging areas (to limit the adverse impacts of idling) can help decrease the effects of diesel emissions on local air quality.

Delaware has regulations in place to mitigate potential impacts of construction on visibility in Class I Areas, specifically: Regulation 1106 - Particulate Emissions from Construction and Materials Handling.[68] In summary, Regulation 1106 states that any persons doing demolition, land clearing, land grading (including grading for roads), excavation, material transport, or the use of non-paved roads on private property are required to employ control dust control measures, when the Department determines that such activities could emit dust in quantities sufficient to cause air pollution.

Like 40 CFR 51.308(d)(3)(v)(B) of the RHR for the first implementation period, 40 CFR 51.308(f)(2)(iv)(B) requires each state to consider in the second implementation period measures to mitigate the impacts of construction activities on regional haze. MANE-VU's new Contribution Assessment for the second implementation period found that, from a regional haze perspective, crustal material generally continues to not play a major role in visibility impairment at MANE-VU Class I areas. Delaware's speciated monitoring network shows that in 2018 crustal material was only 4 percent of total $PM_{2.5}$[69]. Nevertheless, the crustal fraction at any given location can be heavily influenced by the proximity of construction activities; and construction activities occurring in the immediate vicinity of MANE-VU Class I Areas could have a noticeable effect on visibility.

Delaware's 2017 inventory shows $PM_{2.5}$ emissions from Commercial Construction were 135 tons, only 3% of Delaware's $PM_{2.5}$ emissions inventory. Because the contribution from construction dust is small, Delaware is determining that no changes in its regulatory program for construction dust is necessary to make reasonable progress.

68 Regulation 1106 - Particulate Emissions from Construction and Materials Handling http://regulations.delaware.gov/AdminCode/title7/1000/1100/1106.shtml

69 Delaware Ambient Air Monitoring 2020 Network Assessment. DNREC. June 30, 2020. http://www.dnrec.delaware.gov/Air/Documents/2020-delaware-air-monitoring-network-description.pdf

8.8 Source Retirement and Replacement Schedules

40 CFR Section 51.308(f)(2)(iv)(C) requires States to consider source retirement and replacement schedules in developing its LTS. Source retirement and replacement were considered in developing the 2028 emissions projections and are described in the Gamma Inventory TSD (Appendix 7-2).

McKee Run Generating Station (City of Dover)

McKee Run is a 102 MW Riley Stoker Steam Generating Unit that burns natural gas and fuel oil. On June 10, 2021 the City of Dover informed Delaware that the fuel sources at the facility had been disconnected. A close-out inspection was performed at the facility on June 14, 2021, to confirm the disconnection. The City of Dover submitted a formal letter requesting cancellation of the permits associated with the facility on August 13, 2021. Subsequently, the permits for McKee Run were cancelled on November 12, 2021 (Appendix 8-7). From 2015-2019, McKee Run averaged 17 tons of NOx and 1 ton SO_2 emissions per year.

Indian River Generating Station (NRG Energy)

In June of 2021, NRG Energy announced that it was planning to close Indian River Generating Station, a coal fired power plant, in May of 2022. The planned closure was contingent on a grid reliability study from the regional power grid operator PJM. Based on their study, PJM determined the plant is needed for reliability. In order for the transmission system to carry the weight of the plant closure, PJM would need to update its services. Those upgrades are estimated to be complete by at least 2027. Once the upgrades are complete, the plant will be able to shut down.

8.9 Agricultural and Forestry BSMPs and Smoke Management Programs

40 CFR Section 51.308(f)(2)(iv)(D) requires States to consider basic smoke management practices for prescribed fire used for agricultural and wildland vegetation management purposes and smoke management programs (SMP) in developing its LTS.

Combustion of forest and agricultural biomass is a subset of all woodsmoke. In 2005, Delaware commissioned Clarkson University to complete an analysis of $PM_{2.5}$ speciation, *Analysis of Speciation Trends Network Data Measured at the State of Delaware* (January 2005) (Appendix 8-9 - Hopke Report) [70]. The objectives of this study were to identify $PM_{2.5}$ sources and estimate their contributions to $PM_{2.5}$ mass concentrations by analysis of the data measured at the EPA Speciation Trends Networks sites in the State of Delaware (Wilmington and Dover).

70 Hopke, P. and Kim, E. (2005). Analysis of Speciation Trends Network Data Measured at the State of Delaware, Center for Air Resources Engineering and Science, Clarkson University. (Tables 6 and 7).

Based upon receptor modeling for Delaware's rural and urban Speciated Trends Network monitors, the study found that woodsmoke was not a significant source of $PM_{2.5}$ for Delaware (Appendix 8-8; Tables 6 and 7). Therefore, since contribution from woodsmoke $PM_{2.5}$ is low in Delaware, it is unlikely that fires for agricultural or forestry management cause impacts of any significance on visibility in the MANE-VU and nearby Class I Areas, including Shenandoah, Dolly Sods, Otter Creek, and James River Face.

Furthermore, Delaware's 2017 emissions inventory shows that overall $PM_{2.5}$ emissions from prescribed agricultural and forest burning are comparable to emissions in the 2000's, when the Hopke Report was conducted, as shown in Table 8-3. In addition, the total emissions were a small percent of Delaware's total $PM_{2.5}$ emissions inventory. Because the contribution from prescribed agricultural and forest burning is small, Delaware is determining that no changes in its regulatory program for smoke management is necessary to make reasonable progress.

Table 8-3: Prescribed Agricultural and Forest Burning Emissions

	2008[71] **PM 2.5 (tons)**	**2017 PM 2.5 (tons)**
Prescribed Burning (SCC 2810001500)	63	36
Agricultural Burning	12	60
TOTAL	**75**	**96**
Percent of TOTAL NEI PM2.5 Emissions in Delaware	**2%**	**2%**

A SMP is a required element of a SIP only if it is necessary to make reasonable progress. Since both the Hopke Report and Delaware's 2014 emissions inventory data show that agricultural and forestry management woodsmoke emissions are low, Delaware does not believe that a SMP is necessary to make reasonable progress.

The Department notes that Delaware's Regulation 1113 (Open Burning), prohibits prescribed and agricultural burning from May through September. Although the Department does not consider the Open Burning regulation a SMP, this regulation may benefit Class I areas to a small degree.

Regulation 1113 requires the following approvals from the Department for burning activities covered by the regulation:

- Fire companies must obtain written approvals prior to initiating any fire training exercise that involves the demolition of a structure via firefighting instruction,
- Land owners and forest management officials must obtain written approval prior to initiating a prescribed burn event, and;
- Farmers must obtain written approval before initiating an agricultural burn.

71 Delaware's 2008 Inventory was used for the comparison, as it is the first inventory in which Delaware has specific emissions estimations for agricultural burning.

Since agricultural and forestry management woodsmoke emissions are insignificant in Delaware, visibility impacts from agricultural and forestry burns will not be considered when issuing these burn authorizations.

8.10 Anticipated Net Impact on Visibility due to Projected Emissions Changes over the Long-Term Strategy Period

40 CFR Section 51.308(f)(2)(iv)(E) requires Delaware to address the net effect on visibility resulting from changes projected in point, area and mobile source emissions by 2028. The starting point for judging the progress achieved by measures included in this SIP is the 2000-2004 baseline visibility at affected Class I areas, as assessed by NESCAUM. To calculate the baseline visibility NESCAUM, using 2000-2004 IMPROVE monitoring data, averaged together the deciview value for the 20 percent best days in each year, producing a single average deciview value for the best days. Similarly, NESCAUM averaged the deciview values for the 20 percent worst days in each year, producing a single average deciview value for the worst days. Calculation of best and worst days included both biogenic and anthropogenic emissions, as detailed in NESCAUM's *Baseline and Natural Background Visibility Conditions*[72].

On January 10, 2017, US EPA published final revisions to regional haze SIPs regulations in the federal register (82 FR 3078, January10, 2017). One aspect of the new regulations would be a change from using the "20% worst days" in terms of visibility impairment to "20% most impaired days." EPA also developed draft guidance on how to develop the "20% most impaired days"; *Draft Guidance on Progress Tracking Metrics, Long-term Strategies, Reasonable Progress Goals and Other Requirements for Regional Haze State Implementation Plans for the Second Implementation Period.* (July 2016).[73] MANE-VU TSC recommended using multiple approaches to address visibility impairment, with a focus on the "20% Most Impaired Days Based on Deciviews", as detailed in Recommendation on Approaches to Selecting the 20% Most Impaired Days (MANE-VU, March 2017) (Appendix 8-8).

For the second implementation period, analyses of visibility trends is documented in *Mid-Atlantic/Northeast U.S. Visibility Data 2004-2019 (2nd RH SIP Metrics)* (MANE-VU, January 2021). Staff from the Maine Department of Environmental Protection analyzed visibility data collected at IMPROVE monitoring sites, starting in the baseline period of 2000-2004 through 2012-2016, the most recent five-year period with available data.

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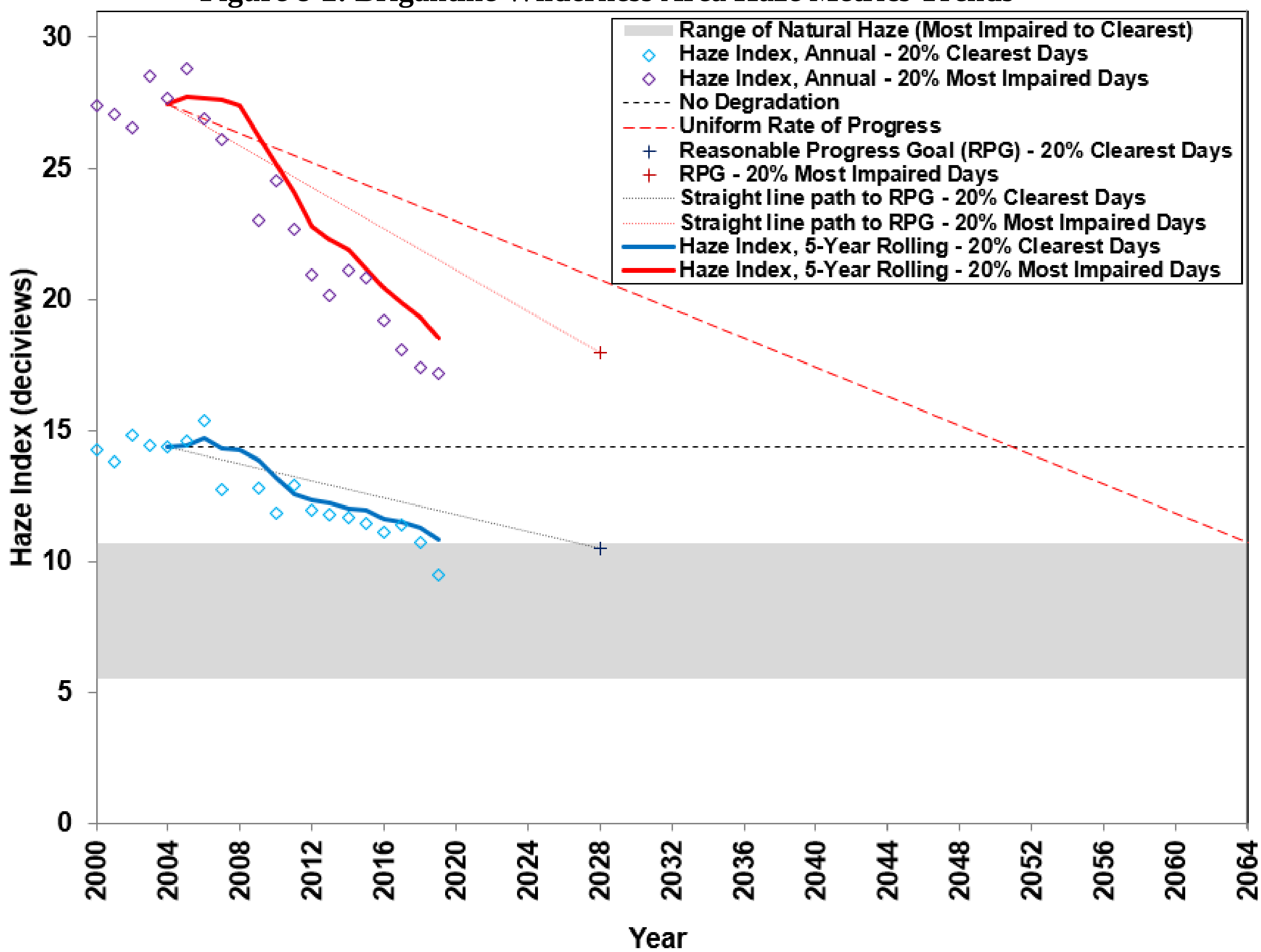
72 Baseline and Natural Background Visibility Conditions. NESCAUM. December 31, 2006. https://www.nescaum.org/topics/regional-haze/regional-haze-documents

73 Draft Guidance on Progress Tracking Metrics, Long-term Strategies, Reasonable Progress Goals and Other Requirements for Regional Haze State Implementation Plans for the Second Implementation Period. EPA. July 2016. https://www.epa.gov/sites/default/files/2016-07/documents/draft_regional_haze_guidance_july_2016.pdf

Based on rolling five-year averages demonstrating progress since the 2000-2004 baseline period, all MANE-VU and nearby Class I area (Dolly Sods, Shenandoah, and James River Face) visibility conditions are currently better than the 2028 Uniformed Rate of Progress (URP) visibility condition for the 20 percent most impaired visibility days and below baseline conditions for the 20 percent clearest days. Results for Brigantine can be found below in Figure 8-2.

Figure 8-2: Brigantine Wilderness Area Haze Metrics Trends



IMPROVE data trends indicate that states continue to be on track keeping visibility levels significantly below the uniform rate of progress levels. Delaware believes that its existing regulations and retirements, as detailed in Sections 8.6 and 8.8, are sufficient to make reasonable progress.

8.11 PSD and New Source Review

Delaware will continue carrying out the required review of proposed sources’ impacts on visibility under 40 C.F.R. § 52.26 and 52.28, by implementing the Prevention of Significant Deterioration (PSD) permit requirements for new or modified major sources of air pollutants located within 100 kilometers of the Class I area, or within a larger radius on a case-by-case basis[74], in accordance with all applicable Federal rules for review of the impacts on Class I areas.

Section 3 of Delaware’s Regulation 1125 addresses the PSD program, and requires Delaware to review PSD actions with consideration of visibility impacts. It is designed to prevent adding new (or modified) source emissions increases without determining if they will impact air quality or Class I areas adversely. Delaware’s PSD program limits adverse impacts by requiring applicable sources to install Best Available Control Technology (BACT), an emissions limitation which is based on the maximum degree of control that can be achieved, for each pollutant that would result in a significant net emissions increase at the source.[75]

8.12 Emission Limitations, Compliance Schedules, and Other Measures

40 CFR Section 51.308(f)(2) requires Delaware to ensure that their LTS includes the enforceable emission limitations, compliance schedules, and other measures necessary to make reasonable progress. Emissions reductions due to ongoing air pollution controls measures are described in Section 8.6. The federal enforceability mechanism for these measures is identified and all measures are or will be enforceable by 2028.

In addition, Delaware will continue to evaluate as appropriate and necessary the other measures included by other states in their RPGs, to determine whether they are reasonable to adopt and implement by 2028. Delaware expects to make that determination in the progress report due January 31, 2025.

8.13 Consultation on the Long-Term Strategy

40 CFR Section 51.308(f)(2)(ii) requires States to consult with other States to develop coordinated emission management strategies. This requirement applies both where emissions from the State are reasonably anticipated to contribute to visibility impairment in Class I areas outside the State and when emissions from other States are reasonably anticipated to contribute to visibility impairment in Class I areas within the State. Delaware consulted with other States by participation in the MANE-VU and inter-RPO processes that developed technical information necessary for development of coordinated strategies.

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74 On October 19, 1992 EPA issued a Guidance Memo that stated “…impacts from larger sources need to be considered at distances greater than 100 kilometers when such impacts reasonably could affect the outcome of the Class I area analysis.” Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts. EPA. October 1992.
75 Delaware Regulation 1125 – Requirements for Preconstruction Review, Section 3. http://regulations.delaware.gov/AdminCode/title7/1000/1100/1125.pdf

On May 10, 2006, MANE-VU adopted the Inter-RPO State/Tribal and FLM Consultation Framework, which set forth basic principles for the consultation process (Appendix 8-10) for the first implementation period. On May 5, 2017, MANE-VU adopted an updated consultation plan, *MANE-VU Regional Haze Consultation Plan* (May 5, 2017) (Appendix 8-11), which summarized the consultation process for the second implementation period.

MANE-VU facilitated the consultation process in two phases:

1. Intra-RPO Consultation among MANE-VU members (states, tribes, EPA and FLMs);
2. Inter-RPO Consultation between MANE-VU members and non-MANE-VU states (as identified below).

Although other states may not develop their regional haze SIPs using the same timeline as MANE-VU states, by consulting with MANE-VU early in their process, it may help them better understand MANE-VU Class I Area States' emission reduction commitments while considering their own. MANE-VU consultation meetings and conference calls included those held on the following dates, as shown in Table 8-4.

Table 8-4: MANE-VU Consultation Meetings and Conference Calls

Date	**Call/Meeting**	**Consultation Step**	**Type**
February 7, 2017	Air Directors Call	Introduction to Process & Planning	
February 28, 2017	TSC Call	**MANE-VU Intra-RPO Consultation #1**	Technical
March 7, 2017	Air Directors Call	Update	
March 28, 2017	TSC Call	**MANE-VU Intra-RPO Consultation #2**	Technical
April 11, 2017	TSC Meeting	**MANE-VU Intra-RPO Consultation #3**	Technical
April 21, 2017	FLM Call	**MANE-VU Intra-RPO Consultation #4**	Technical
April 25, 2017	TSC Call	**MANE-VU Intra-RPO Consultation #5**	Technical
May 9-11, 2017	Air Directors Meeting	**MANE-VU Intra-RPO Consultation #6**	Policy
May 30, 2017	TSC Call	**MANE-VU Intra-RPO Consultation #6b**	Technical
June 5, 2017	Annual Meeting Caucus	**MANE-VU Intra-RPO Consultation #7**	Policy
June 16, 2017	Air Directors Call	**MANE-VU Intra-RPO Consultation #8**	Policy
June 29, 2017	Commissioners Call	Briefing	
July 25, 2017	Commissioners Call	**MANE-VU Intra-RPO Consultation #9**	Policy
August 4, 2017	Air Directors Call	**MANE-VU Intra-RPO Consultation #10**	Policy
August 9, 2017	Air Directors Call	**MANE-VU Intra-RPO Consultation #11**	Policy
September 7, 2017	TSC Meeting	Update	
October 20, 2017	Technical/Air Directors Call	**MANE-VU Inter-RPO Consultation #1**	Technical
December 1, 2017	Technical/Air Directors/FLM Call	**MANE-VU Inter-RPO Consultation #2**	Technical
December 18, 2017	Technical/Air Directors Call	**MANE-VU Inter-RPO Consultation #3**	Technical
January 12, 2018	Technical/Air Directors Call	**MANE-VU Inter-RPO Consultation #4**	Technical
March 28, 2018	Commissioners Call	**MANE-VU Inter-RPO Consultation #5**	Policy

The consultation meetings took place between February 7, 2017, and March 28, 2018. This timeline was based on MANE-VU initially targeting the original July 31, 2018, deadline of the 1999 RHR[76]. Submittal of the SIPs for MANE-VU states were delayed past the July 31, 2018, deadline for a number of reasons, including but not limited to: the August 20, 2019 finalization[77] of EPA's 2016 draft regional haze guidance[78], evaluation of additional sources identified by NPS for states to include in their LTS (Section 8.13.1), and the complexity of performing four-factor analyses on individual sources (Sections 8.13.1 and 9.4).

A detailed description of the consultation process meetings and calls can be found in the *MANE-VU Regional Haze Consultation Report* (MANE-VU, July 2018) (Appendix 8-12). This process was early engagement in the SIP development process, not the formal 60-day consultation with individual states. The formal Federal Land Manager consultation is from February 11, 2021 to April 12, 2021. The State/Tribe's coordination with FLMs on LTS development is described in Section 4 of this SIP.

Through this process, Delaware consulted with other states by participating in the MANE-VU intra-RPO, inter-RPO, and EPA/FLM consultations which led to the creation of coordinated strategies, or "Asks" on regional haze. These strategies were consolidated in three "Ask" statements that identify a course of action for: a) states within MANE-VU; b) states outside of MANE-VU; and c) the EPA and FLMs for the current regional haze planning period, 2018-2028, described in Section 9.4 of this document. All MANE-VU states agreed to participated in the MANE-VU Intra-RPO consultations.

8.13.1 National Park Service Source Evaluation Request

At the close of the consultation process, on April 12, 2018 the NPS provided the MANE-VU with a list of sources (Appendix 8-13) that may impact three Class I areas (Acadia, Mammoth Cave and Shenandoah). NPS requested that MANE-VU states review and consider these sources for inclusion in their LTS. NPS used an analysis of 2014 emissions for NOx, PM_{10}, SO_2, and SO_4 divided by distance (Q/d) to estimate the impact of MANE-VU facilities on NPS Class I areas - Acadia, Mammoth Cave, and Shenandoah National Parks. To select the facilities, NPS 1) summed the source-specific Q/d values relative to a given Class I areas across all MANE-VU states relative to the Class I areas, 2) ranked the source-specific Q/d value relative to each area, 3) created a running total, and 4) identified those facilities contributing to 80% of the total impact at each NPS Class I area.

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76 Ibid., 6. The 2017 RHR extended the deadline to July 31, 2021.

77 2019 Guidance on Regional Haze State Implementation Plans for the Second Implementation Period. EPA. August 20, 2019. https://www.epa.gov/sites/production/files/2019-08/documents/

78 Draft Guidance on Progress Tracking Metrics, Long-term Strategies, Reasonable Progress Goals and Other Requirements for Regional Haze State Implementation Plans for the Second Implementation Period. June 2016. https://www.epa.gov/sites/default/files/2016-07/documents/draft_regional_haze_guidance_july_2016.pdf

In a letter dated October 22, 2018, the NPS updated their analysis using 2017 CAMD data. They identified two facilities in Delaware that may impact Shenandoah, as shown in Table 8-5.

Table 8-5: National Park Service Identified Facilities in Delaware

Facility	Q	Distance to NPS Class I area	Q/d	NPS Class I Area
Delaware City Refinery	2,730	233	11.7	SHEN
Hay Road Energy Center	927	249	3.72	SHEN

In its October 2018 letter, NPS requested that Delaware perform a four-factor analysis for the two facilities. 40 CFR Section 51.308 (f)(2)(i)), was promulgated under the authority of section 169A(b)(2) of the CAA and requires all states to consider the following four factors to determine which additional emission control measures are needed to make reasonable progress in improving visibility: 1) costs of compliance, 2) time necessary for compliance, 3) energy and non-air quality environmental impacts of compliance, and 4) remaining useful life of any existing source subject to such requirements. These are known as the four statutory factors.

On April 9, 2021 in its response to the 60-day FLM review of the draft RH SIP, NPS stated that in light of the release of 2017 NEI and 2020 CAMD data they no longer recommend a four-factor analysis for Hay Road Energy Center.

While not all of the sources listed by the NPS are incorporated in each state's LTS, each of these sources were considered and included in MANE-VU's technical analysis for screening. Further detail regarding the processing and triage of sources and source categories can be found in Section 9 of this SIP and on the MANE-VU reports and Technical Materials webpage[79]. Through these analyses and the feedback obtained during the consultation process the MANE-VU states incorporated those sources that were deemed significant enough to warrant further action to achieve the 2028 RPGs. Those that are not included were determined not to be a priority for the 2018 planning period with regards to regional haze.

Delaware is appreciative of all the cooperation and feedback the NPS and the other FLMs have provided during this planning period. As such Delaware, has provided additional documentation below regarding the current emission limitations for the Delaware City Refinery, which shows that the facility is effectively controlled.

79 MANE-VU reports and Technical Materials. https://otcair.org/manevu/document.asp?fview=Reports

8.13.2 Delaware City Refinery

Consent Decrees

A federal consent decree (C. A. No. H-01-0978)[80] required control of SO_2, and NOx Emissions at the Refinery. The last changes to consent decree emission limits were in 2011.

Boilers and Heaters

- The Refinery was required to install NOx controls on at least 30 percent of the heater and boiler capacity located at the facility. Heaters and boilers which the Companies shut down, or for which the Companies obtained an emission limit of 0.040 pounds (lbs) of NOx per million British Thermal Units (MMBTU) or lower were considered as having NOx controls installed.
- The Refinery also accepted New Source Performance Standards (NSPS) Subpart J applicability for heaters and boilers and reduced or eliminated fuel oil firing in their heaters and boilers in an effort to reduce SO_2 emissions.

FCCU and FCU

- The Refinery consent decree required SO_2 emission reductions from the Refinery's Fluid Catalytic Cracking Unit (FCCU) and Fluid Coking Unit (FCU). For the FCCU/FCU, the Consent Decree control requirements required the installation of wet gas scrubbers for SO_2 control.
  - FCCU – the permit for the Refinery limits SO_2 to: 25 parts per million by volume, dry (ppmvd) @ 0% Oxygen (O_2) on a 365 day rolling average, 50 ppmvd @ 0% on a rolling 7 day average, and 182.3 tons per year (tpy).
  - FCU – the permit for the Refinery limits SO2 to: 25 ppmvd @ 0% O_2 on a 365 day rolling average, 50 ppmvd @ 0% on a rolling 7 day average, and 352 tpy.
- For the FCU, the Consent Decrees required selective non-catalytic reduction (SNCR) for NOx Control.
  - FCCU – the permit for the Refinery limits NOx to: 137.0 ppmvd @ 0% O_2 on a 7 day rolling average basis, and 100.7 ppmvd @ 0% O2on a 365 day rolling average basis.
  - FCU – the permit for the Refinery limits NOx to: 152.0 ppmvd @ 0% O_2 on a 30 day rolling average basis, 152.0 ppmvd @ 0% O_2 on a 7 day rolling average basis, and 115.2 ppmvd @ 0% O_2 on a 365 day rolling average basis.
- Although PM is not specifically addressed in the consent decree, the wet gas scrubbers for the FCCU and the FCU also control PM.
  - FCCU – the permit for the Refinery limits PM to 1 lb/100 of coke burn (based on Subpart J applicability, see below) and 203 tpy.
  - FCU – the permit limits PM to the emission limits listed in 7 DE Admin Code 1105, Section 5.2 (see below).

80 Heaters and Boilers Consent Decree, United States, et al. v. Motiva Enterprises LLC, Civil Action No. H-01-0978. 6th amendment, December 2, 2010. https://www.epa.gov/sites/default/files/documents/4thamendedmotiva-cd.pdf

Agreement Governing the Acquisition and Operation of Delaware City Refinery

On May 31, 2010 DNREC and Delaware City Refining Company, LLC (DCRC) entered into an agreement[81] (Appendix 8-14) to address and clarify certain regulatory considerations relevant to DCRC's acquisition and operation of the facility. The facility had been previously owned and operated by The Premcor Refining Group, Inc. (Premcor).

The agreement set NOx caps for the refinery, which were reduced over time. The current NOx Cap is 1,650 tpy. 7 DE Admin Code 1142 was revised to incorporate the NOx Caps (see below). Also, as part of the agreement, DCRC was required to submit a plan for achieving NOx emissions reductions consistent with the emission limits reflected by the NOx Caps. Subsequently, DCRC installed SNCR on the FCCU, as part of the NOx control plan.

7 DE Admin. Code 1142

7 DE Admin Code 1142 – Specific Emission Control Requirements applies to sources at the Refinery. Section 2 of the regulation addresses the control of NOx emissions from industrial boilers and process heaters at petroleum refineries. The regulation sets the following NOx emission limits:

- Section 2.3.1.3: For Boiler 1, Boiler 3, and Boiler 4, 0.015 lb/MMBTU, on a 24-hour rolling average basis.
- Section 2.3.1.4: For the FCCU Carbon Monoxide Boiler, 20 ppmvd @ 0% O_2 on a 365 day rolling average basis, and 40 ppmvd @ 0 % O_2 on a 7-day rolling average basis.
- Section 2.3.1.5: For any unit not covered by 2.3.1.3, or 2.3.1.4 0.04 lb/MMBTU, on a 24-hour rolling average basis.

As an alternative to complying with one of more of the unit specific emission limitations specified above, the Refinery can limit NOx to a yearly facility-wide cap, as detailed below. In addition, all future growth at the refinery must occur under this NOx cap. The 1,650 NOx cap did not go into place until January 1, 2015.

- Section 2.3.2.3: 1,650 tons per year, evaluated over each twelve (12) consecutive month rolling period, commencing with the twelve (12) month rolling period beginning on January 1, 2015 and ending on December 31, 2015, and continuing thereafter. In addition, all future growth at the refinery must occur under this NOx cap.

7 DE Admin. Code 1104 – PM

Regulation 1104 – Particulate Emissions from Fuel Burning Equipment applies to the Refinery. Section 2.0 – Emission Limits, applies to fuel burning equipment at the Refinery that has a heat capacity is 1,000,000 British Thermal Units (BTU) per hour or more. Regulation 1104 does not apply to the FCCU and FCU, since they are specifically covered under 7 DE Admin Code 1105 (see below). The regulation sets the following PM emission limits:

81 Agreement Governing the Acquisition and Operation of Delaware City Refinery. May 31, 2010. (Appendix 8-14).

- Section 2.1: No person shall cause or allow the emission of particulate matter in excess of 0.3 lb per MMBTU heat input, maximum two-hour average, from any fuel burning equipment.
- Section 2.2: No person shall cause or allow the emission of particulate matter in excess of 0.3 lb per MMBTU heat input, maximum 30-day rolling average, from any fuel burning equipment.

7 DE Admin. Code 1105 – PM

Regulation 1105 – Particulate Emissions from Industrial Process Operations applies to the Refinery. Section 5.1 applies to the FCCU and sets restrictions on particulate matter emissions as shown in Table 8-6.

Table 8-6: Allowable Mass Emission Rate From Catalytic Cracking Operations

Coke Burn-Off Rate (Pounds per Hour)	Mass Emission Rate (Pounds per Hour)
7,000	50
14,000	100
21,000	150
28,000	200
42,000	300
56,000	400
70,000	500

Section 5.2 applies to the FCU and sets and sets restrictions on particulate matter emissions as shown in Table 8-7.

Table 8-7: Allowable Mass Emission Rate From Fluid Coking Operations

Process Weight Rate (Barrels per Day of Fresh Feed)	Mass Emission Rate (Pounds per Hour)
5,000	15
10,000	30
15,000	50
20,000	80
30,000	100
40,000	125
50,000	150

40 CFR Part 60, Subpart J

NSPS Subpart J applies to the FCCU at the refinery and limits particulate matter emissions to 1.0 kg/Mg (2.0 lb/ton) or 1 lb/1,000 lb of coke burn-off[82].

82 Subpart J— Standards of Performance for Petroleum Refineries. EPA. 39 FR 9315. March 8, 1974.

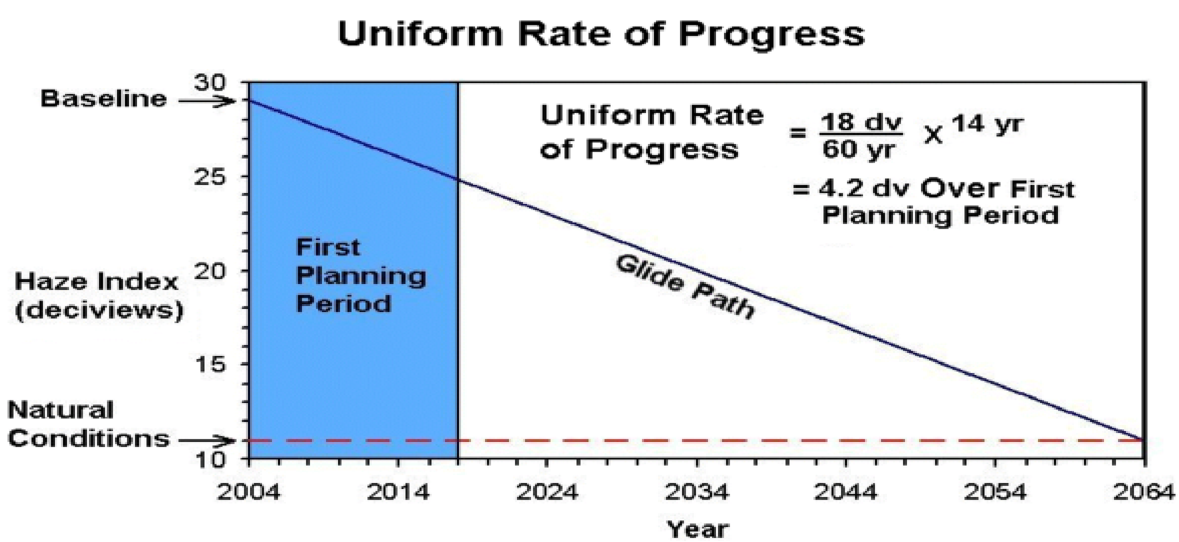
Section 9 - Reasonable Progress Goals (40 CFR 51.308 (f)(3))

The key difference between SIPs from States with Class I areas and those States without Class I areas but that may have sources that impact visibility on Class I areas is the calculation of the baseline, current, and natural visibility for their Class I areas and the determination of RPG - expressed in deciviews - that provide for reasonable progress towards achieving natural visibility by 2064. It is the Class I States' responsibility to assess these calculations. The Class I States must also consult with those States, which may reasonably be anticipated to cause or contribute to visibility impairment in their Class I areas (40 CFR 51.308 (f)(3)(i-iv)).

The baseline visibility conditions are calculated for the baseline period between 2002 and 2004. The average impairment for the most and least impaired days are determined for each calendar year and compiled into the average of five annual averages (40 CFR 51.308 (f)(1)(i)). The natural visibility conditions for the most and least impaired days is calculated by estimating the average deciview index based on available monitoring data and appropriate data analysis technique (40 CFR 51.308 (f)(1)(ii)).)).

The goals must provide improvement in visibility for the most impaired days, and ensure no degradation in visibility for the least impaired days over the SIP period. The State must also provide an assessment of the number of years it would take to attain natural visibility condition if improvement continues at the rate represented by the RPG. Figure 9-1 illustrates an example of how the URP is calculated [83].

Figure 9-1: Example Calculation of Uniform Rate of Progress



83 Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. EPA. June 2007. https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/20070601_wehrum_reasonable_progress_goals_reghaze.pdf

9.1 Consultation and Agreement with Other States' Goals

Under 40 CFR Section 51.308 (f)(2)(ii)f)(2)(ii) consultation is required in developing LTS. The rule states:

> *(ii) "The State must consult with those States that have emissions that are reasonably anticipated to contribute to visibility impairment in the mandatory Class I Federal area to develop coordinated emission management strategies containing the emission reductions necessary to make reasonable progress."*

Through the RPO "*MANE-VU Regional Haze Consultation Plan*" (Appendix 8-11), Delaware consulted with the following states having Class I areas, as those states established RPGs for their Class I areas:

- Maine
- New Hampshire
- Vermont
- New Jersey

For the second implementation period, MANE-VU used a 2% cutoff threshold for contribution of sulfate and nitrate, for determining which states would need to participate in the consultation process. MANE-VU's analysis estimated contribution from Delaware sources of less than 2% of visibility impairment for all seven MANE-VU Class I areas. Delaware's modeled contribution to MANE-VU Class I areas was 0.6% for Brigantine, 0.1% for Lye Brook, and 0.2% for all other MANE-VU Class I areas. As a MANE-VU state, Delaware was included in the consultation process under the agreed consultation plan, even though its contributions to MANE-VU Class I areas were below 2%.

9.2 Analysis of the Four Statutory Factors

40 CFR Section 51.308 (f)(2)(i)), was promulgated under the authority of section 169A(b)(2) of the CAA and requires all states to consider the following four factors to determine which additional emission control measures are needed to make reasonable progress in improving visibility: 1) costs of compliance, 2) time necessary for compliance, 3) energy and non-air quality environmental impacts of compliance, and 4) remaining useful life of any existing source subject to such requirements. These are known as the four statutory factors.

The plan must include reasonable measures and identify the visibility improvement that will result from those measures. If a Class I state proposes a rate of progress slower than the URP, this state must assess the number of years it would take to attain natural conditions if visibility improvement continues at the rate proposed.

9.3 Identification of Key Source Categories

Based on available information about emissions and potential impacts, during the 1st implementation period, the MANE-VU Reasonable Progress Workgroup selected the following source categories for detailed analysis of the four factors the CAA establishes as the basis for determining how much progress in visibility improvement is reasonable:

- Coal and oil-fired EGUs;
- Point and area source ICI boilers;
- Cement kilns;
- Lime kilns;
- The use of heating oil; and
- Residential wood combustion and open burning.

This analysis is described in detail in the *Reasonable Progress Report*[84], which summarizes MANE-VU's assessment of pollutants and associated source categories affecting visibility in Class I areas in and near MANE-VU, lists possible control measures for those pollutants and source categories, and develops the requisite four factor analysis.

In 2015, MARAMA issued a contract for SRA International, Inc. to conduct appropriate analysis to update the cost information in the following categories of the 2007 Report:

- EGUs;
- ICI Boilers;
- Heating Oil;
- Residential Wood Combustion;
- Outdoor Wood Fired Boilers.

In addition, the sections regarding EGUs and ICI boilers were expanded to describe NOx emissions control options and costs. The updated analyses are described in detail in *2016 Updates to the Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas* (Appendix 8-4).

84 Ibid., 31

9.4 MANE-VU "Asks"

According to the federal RHR (40 CFR 51.308 (f)(2)(ii) through (iv)), all states must consider, in their Regional Haze SIPs, the emission management strategies identified by other States for their sources as being necessary to make reasonable progress in any Class I area. These emission management strategies are referred to as "Asks." The "Asks" adopted by MANE-VU Class I States, for the second implementation period, were set forth by MANE-VU on August 25, 2017: *Statement of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Concerning a Course of Action within MANE-VU toward Assuring Reasonable Progress for the Second Regional Haze Implementation Period (2018-2028)* (Intra-RPO "Ask") (Appendix 9-1).

The origins of the MANE-VU Asks are rooted in the Reasonable Progress Report[85]. The purpose of the Reasonable Progress Report evaluated a range of potential SO_2, PM, and VOC emissions control measures using the four statutory factors of cost of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected sources.

Table 9-1 below, excerpted from the Reasonable Progress Report, summarizes the four-factor analysis results from the emissions categories analyzed:

85 Ibid., 31

Table 9-1: Summary of the Four Factor Analysis from the Reasonable Progress Report

Source Category	Primary Regional Haze Pollutant	Average Cost in 2006 dollars (per ton of pollutant reduction)	Compliance Timeframe	Energy and Non-Air Quality Environmental Impacts	Remaining Useful Life
Electric Generating Units	SO_2	IPM* v.2.1.9 predicts $775-$1,690 $170-$5,700 based on available literature	2-3 years following SIP submittal	Fuel supply issues, potential permitting issues, reduction in electricity production capacity, wastewater issues	50 years or more
Industrial, Commercial, Institutional Boilers	SO_2	$130-$11,000 based on available literature	2-3 years following SIP submittal	Fuel supply issues, potential permitting issues, control device energy requirements, wastewater issues	10-30 years
Cement and Lime Kilns	SO_2	$1,900-$73,000 based on available literature	2-3 years following SIP submittal	Control device energy requirements, wastewater issues	10-30 years
Heating Oil	SO_2	$550-$750 based on available literature. There is a high uncertainty associated with this cost estimate.	Currently feasible. Capacity issues may influence timeframe for implementation of new fuel standards	Increases in furnace/boiler efficiency, Decreased furnace/boiler maintenance requirements	18-25 years
Residential Wood Combustion	PM and VOC	$0-$10,000 based on available literature	Several years - dependent on mechanism for emission reduction	Reduce greenhouse gas emissions, increase efficiency of combustion device	10-15 years

* Integrated Planning Model (IPM®) application by ICF for MANE-VU

In 2015, SRA International, Inc. updated some of the cost information in the 2007 MACTEC Report and also added an evaluation of controls and costs for reducing nitrogen oxide (NO_x) emissions from electric generating units (EGUs) and industrial/commercial/institutional (ICI) boilers (Section 9-3).

Three of the emissions source categories that were analyzed in the MACTEC report for the first regional haze implementation period were carried directly over to the current (second) regional haze implementation period because MANE-VU concluded that emissions controls to address these categories are reasonable based on the four statutory factors. These categories include:

- Coal and oil-fired EGUs
- ICI Boilers
- Use of heating oil

All categories were assessed to determine validity and reasonableness in accordance with the regional haze rule and guidance. Carrying forward these categories is consistent with EPA's August 20, 2019 *Guidance on Regional Haze State Implementation Plans for the Second Implementation Period*[86], which states on page 39, "A state may consider in its analysis of control measures how it, other states, and EPA made reasonable progress decisions during the first implementation period and may consider final decisions already made in the second implementation period, if any."

Guidelines for developing and implementing RPGs were established by MANVE-VU in May 2006: Inter-PRO Consultation Briefing Book (Appendix 9-2). In addition, MANE-VU developed "Asks" for states outside of MANE-VU that were found to be contributing to visibility impairment at MANE-VU Class I states (Inter-RPO "Ask") (Appendix 9-3) and for EPA/FLMs (Appendix 9-4). MANE-VU requests that the "Asks" it developed should be implemented as soon as practicable, but no later than 2028.

For the second implementation period, MANE-VU used a 2% cutoff threshold for contribution of sulfate and nitrate, for determining which states would need to participate in the consultation process. Even though MANE-VU's analysis estimated contribution from Delaware sources of less than 2% for all MANE-VU Class I areas; as a MANE-VU state, Delaware was included in the consultation process under the agreed consultation plan. MANE-VU then requested that all of the states identified for consultation address the MANE-VU "Asks" in their SIPs.

MANE-VU "Asks" are summarized as follows:

1. EGUs with a nameplate capacity larger than or equal to 25 megawatts (MW) with already installed NOx and/or SO_2 controls: ensure the most effective use of control technologies on a year-round basis to consistently minimize emissions of haze precursors, or obtain equivalent alternative emission reductions;

2. Emission sources modeled by MANE-VU that have the potential for 3.0 Mm^{-1} or greater visibility impacts at any MANE-VU Class I area, as identified by MANE-VU contribution analyses (see Appendix 9-1): perform a four-factor analysis for reasonable installation or upgrade to emission controls;

3. Each MANE-VU State that has not yet fully adopted an ultra-low sulfur fuel oil standard as requested by MANE-VU in 2007: pursue this standard as expeditiously as possible and before 2028, depending on supply availability, where the standards are as follows:
    a. distillate oil to 0.0015% sulfur by weight (15 parts per million, or ppm),
    b. #4 residual oil within a range of 0.25 to 0.5% sulfur by weight, and
    c. #6 residual oil within a range of 0.3 to 0.5% sulfur by weight.

86 Ibid., 79

4. EGUs and other large point emission sources larger than 250 MMBTU per hour heat input that have switched operations to lower emitting fuels: pursue updating permits, enforceable agreements, and/or rules to lock-in lower emission rates for SO_2, NOx and PM. The permit, enforcement agreement, and/or rule can allow for suspension of the lower emission rate during natural gas curtailment;

5. Where emission rules have not been adopted, control NOx emissions for peaking combustion turbines that have the potential to operate on high electric demand days (HEDD) by:
    a. Striving to meet NOx emissions standard of no greater than 25 ppm at 15% O2 for natural gas and 42 ppm at 15% O2 for fuel oil but at a minimum meet NOx emissions standard of no greater than 42 ppm at 15% O2 for natural gas and 96 ppm at 15% O2 for fuel oil, or
    b. Performing a four-factor analysis for reasonable installation or upgrade to emission controls, or
    c. Obtaining equivalent alternative emission reductions on HEDD.

    HEDD are days when higher than usual electrical demands bring additional generation units online, many of which are infrequently operated and may have significantly higher emission rates than the rest of the generation fleet. Peaking combustion turbine is defined for the purposes of this "Ask" as a turbine capable of generating 15 MW or more, that commenced operation prior to May 1, 2007, is used to generate electricity all or part of which is delivered to the electric power distribution grid for commercial sale and that operated less than or equal to an average of 1752 hours (or 20%) per year during 2014 to 2016;

    (Note: SO_2 emissions for fuel oil units are addressed with "Ask" item 3.a. above)

6. Each State should consider and report in their SIP measures or programs to: a) decrease energy demand through the use of energy efficiency, and b) increase the use within their state of Combined Heat and Power (CHP) and other clean Distributed Generation technologies including fuel cells, wind, and solar.

The MANE-VU Intra-RPO "Ask" (Appendix 9-1) and the Inter-RPO "Ask" (Appendix 9-2) each contain a listing of emissions units that MANE-VU identified as having the potential to cause 3 Mm^{-1} or greater impact at one or more of the MANE-VU Class I areas ("Ask" #2). The Intra- and Inter-RPO "Asks" request that states inside and upwind, respectively, of the MANE-VU region perform a 4-factor analysis for the listed emissions units as part of their SIP submittals in order to satisfy the "Ask".

MANE-VU developed the lists in the Intra- and Inter-RPO "Asks" using a technical analysis documented in the *2016 MANE-VU Source Contribution Modeling Report* dated April 4, 2017 (Appendix 8-5). The lists in the Intra- and Inter-RPO "Asks" were based on those emissions units in Tables 34 and 35 of the 2016 Modeling Report with an estimated potential contribution to visibility impairment at any MANE-VU Class I area of 3 Mm^{-1} or more. The 3 Mm^{-1} threshold was chosen by MANE-VU after extensive discussion amongst its members. The origins of the 3 Mm^{-1} threshold are documented in the *MANE-VU Regional Haze Consultation Report* dated July 2018 (Appendix 8-12). The following bullets highlight the rationale for choosing the 3 Mm^{-1} threshold. The page numbers in parentheses refer to the applicable pages in the 2018 Consultation Report.

- A "Top-10 impacting units at each Class I area" type of approach was considered in the early stages of developing the analysis. However, it was felt that this type of approach would have an unfair balance of requiring more stringent criteria for some facilities near clearer Class I areas than would be applied to those affecting hazier Class I areas. The MANE-VU states agreed to identify a uniform threshold that approximates the average of the top 10 most potentially contributing units. Therefore, it was felt that a threshold based on an absolute Mm^{-1} magnitude would be more appropriate (pages 8, 14, and 17/18).
- Preliminary analysis showed that a 3 Mm^{-1} threshold would approximate the top 7 to 26 impacting emissions units, depending on Class I area (page 10).
- A higher (i.e. less restrictive) threshold of 10 Mm^{-1} and lower (i.e. more restrictive) thresholds of 1 and 2 Mm^{-1} were considered. However, preliminary analysis showed that a cutoff of 5 or 10 Mm^{-1} would only have the potential to bring in a very small number of units. Lower thresholds of 2 and 1 Mm^{-1} roughly doubled and tripled the number of units identified for 3 Mm^{-1} with diminishing potential visibility benefit per analysis required.
- Because all MANE-VU Class I areas are monitoring better than rate of progress requirements and have already made progress towards meeting 2028 RPGs, the state workload for performing 4-factor analyses was considered and it was agreed to not seek a more stringent threshold. This approach limited the "Ask" to those units with the greatest potential for visibility improvements per analysis conducted.

On August 20, 2019, EPA released its *Guidance on Regional Haze State Implementation Plans for the Second Implementation Period*[87]. Although Section 3 of this guidance lays out some helpful suggestions for selecting sources for analysis of emissions control measures, it reiterates that "The Regional Haze Rule does not explicitly list factors that a state must or may not consider when selecting the sources for which it will determine what control measures are necessary to make reasonable progress."

In light of the flexibility of the above regulations and guidance, MANE-VU set a scientifically defensible threshold of 3 Mm^{-1}. This threshold is conservative in that it brings into consideration those emissions units that are reasonably anticipated to cause or contribute to visibility at one or more of MANE-VU's Class I areas. Yet this threshold is not so low as to require four-factor analyses of units that are not reasonably anticipated to impact visibility.

87 Ibid., 54

Section 10 - How Delaware Achieves the "Asks" (40 CFR 51.308 (f)(3))

Section 9.4 of this SIP discussed "Asks" agreed upon by MANE-VU Class I states (Appendix 9-1). This section addresses the six (6) "Asks", and demonstrates how Delaware will meet each of them. Additional measures adopted by Delaware are also discussed.

Given Delaware's low modeled contribution to visibility impairment[88] (Table 8-1) and low actual and projected emissions (Section 7.1 and Tables 7-32 respectively); Delaware believes that its existing regulations and retirements, as detailed in Sections 8.6 and 8.8, are sufficient to make reasonable progress. However, as a MANE-VU state Delaware agreed to address and implement, when technically and economically feasible, each of the MANE-VU "Asks"; which may provide additional visibility improvement benefits. In this section Delaware addresses each of the six (6) "Asks" and has implemented the "Asks" when technically and economically feasible.

Use of controls and permit limits at the facilities listed below can be influenced by two variables, fuel type and season. Facility specific fuel type and seasonality issues are addressed below for each facility.

- Fuel type – Controls are often designed to be used with a specific fuel type (Coal, Fuel Oil, or Natural Gas). Therefore, controls might only be used at a facility when firing a specific type of fuel.

- Ozone Season – 7 **DE Admin. Code** 1148, Control of Stationary Combustion Turbine Electric Generating Units. Regulation 1148 requires subject stationary combustion turbine EGUs with a base-load nameplate capacity of one MW or greater to limit NOx emissions during the ozone season (May – September): 42 ppmv for natural gas and 88 ppmv for fuel oil. Therefore, controls may only be used at a facility during the ozone season, to meet the requirements of Regulation 1148. In addition, permit limits may vary depending on the season.

10.1 Operation of Existing Controls for large EGUs – "Ask #1"

Electric Generating Units (EGUs) with a nameplate capacity larger than or equal to 25MW with already installed NOx and/or SO2 controls: ensure the most effective use of control technologies on a year-round basis to consistently minimize emissions of haze precursors, or obtain equivalent alternative emission reductions;

Table 10-1 shows the current status of NOx and SO_2 controls for units in Delaware that are affected by the "Ask #1". All the units that burn fuel oil are covered by Delaware's low sulfur fuel regulation, 7 DE Admin. Code 1108. Therefore, Delaware's analysis will focus on NOx controls.

88 Delaware's modeled contribution to MANE-VU Class I areas was 0.6% for Brigantine, 0.1% for Lye Brook, and 0.2% for all other MANE-VU Class I areas.

Table 10-1: Delaware Units for "Ask #1"

Facility	Unit	MW	NOx Control	NOx Control year-round	SO_2 Control	SO_2 Control year-round
Christiana Energy Center	CH11	26.0	Water Injection (WI)	**N**	Sulfur in oil limit	Y
Christiana Energy Center	CH14	26.0	WI	**N**	Sulfur in oil limit	Y
Delaware City Refinery	CT-1	92.0	Dry Low NOx Burner (LNB)/SCR	Y	NA [a]	NA [a]
Delaware City Refinery	CT-2	92.0	Dry LNB/SCR	Y	NA [a]	NA [a]
Edge Moor	3	75.0	LNB/SNCR	LNB-Y **SNCR-N**	Sulfur in oil limit	Y
Edge Moor	4	176.8	LNB/SNCR	LNB-Y **SNCR-N**	Sulfur in oil limit	Y
Edge Moor	5	446.0	LNB/SNCR	LNB-Y **SNCR-N**	Sulfur in oil limit	Y
Energy Center Dover	CT-1	50.0	SCR/WI	Y [b]	NA [a]	NA [a]
Energy Center Dover	CT-2	50.0	WI	Y [c]	Sulfur in oil limit	Y
Garrison	CT1	235.0	LNB/SCR/WI	LNB/SCR-Y **WI-N**	Sulfur in oil limit	Y
Hay Road	HR1	122.0	Dry LNB/WI	LNB-Y **WI-N**	Sulfur in oil limit	Y
Hay Road	HR2	122.0	Dry LNB/WI	LNB-Y **WI-N**	Sulfur in oil limit	Y
Hay Road	HR3	122.0	Dry LNB/WI	LNB-Y **WI-N**	Sulfur in oil limit	Y
Hay Road	HR5	144.0	Dry LNB/WI/SCR	LNB/SCR-Y **WI-N**	Sulfur in oil limit	Y
Hay Road	HR6	144.0	Dry LNB/WI/SCR	LNB/SCR-Y **WI-N**	Sulfur in oil limit	Y
Hay Road	HR7	144.0	Dry LNB/WI /SCR	LNB/SCR-Y **WI-N**	Sulfur in oil limit	Y
Indian River	4	445.5	LNB/ SCR	Y	Sulfur in oil limit Circulating Dry Scrubber	Y
McKee Run	3	113.6	LNB	Y	Sulfur in oil limit	Y
VanSant	1	45.1	WI	Y	Sulfur in oil limit	Y
Warren Beasley	1	92.0	SCR/WI	Y	Sulfur in oil limit	Y
Warren Beasley	2	51.0	SCR/WI	Y	Sulfur in oil limit	Y

[a] Unit fires natural gas only, units were designed to fire natural gas and have historically fired only natural gas.
[b] Permit requires water injection at all times that electrical power is being produced at 10MWe or greater
[c] Permit requires water injection at all times that electrical power is being produced at 10MWe or greater (except for periods of fuel switching, which are limited to 30 minutes each event)

10.1.1 Ask #1" – Year-Round Operation of NOx and/or SO2 Controls

As shown in Table 10-1, Permits for four facilities covered under "Ask #1" do not require the use of NOx and/or SO_2 controls year-round on the units. Delaware had met this portion of "Ask #1" by performing analyses on these units in order to determine if year-round controls were technically and economically feasible, as discussed below. Average operating hours and NOx emissions for these four facilities are shown in Table 10-2.

Where applicable, information is included about the four statutory factors to determine which additional emission control measures are needed to make reasonable progress in improving visibility: 1) costs of compliance, 2) time necessary for compliance, 3) energy and non-air quality environmental impacts of compliance, and 4) remaining useful life of any existing source subject to such requirements.

Table 10-2: Average Operating Hours and NOx Emissions for Units Under "Ask #1"

Facility	Unit	2015-2019 Ave. Annual Operating Hours	2015-2019 Ave. Annual NOx Emissions (tons)
Christiana Energy Center	11	16	1.8
Christiana Energy Center	14	14	1.6
Edge Moor	3	1326	23.3
Edge Moor	4	1453	41.3
Edge Moor	5	1853	101.6
Garrison	CT1	5460	36.6
Hay Road	HR1	4293	147.0
Hay Road	HR2	4120	139.5
Hay Road	HR3	4288	136.1
Hay Road	HR5	4022	31.8
Hay Road	HR6	4060	33.3
Hay Road	HR7	4170	34.8

Christiana Energy Center (Calpine) - Units CH11 and CH14

Christiana Energy Center operates two distillate fired combustion turbines (Units CH11 and CH14) which use WI systems as NOx control devices. As shown in Table 10-2 the units have relatively low operating hours and emissions. The Units combust distillate fuel oil. In accordance with Regulation 1148, the current permit limits are 88 ppm, during the ozone season (May-Sept). Therefore, the facility only uses WI during the ozone season, to meet the requirements of Regulation 1148.

In accordance with 7 DE Admin. Code 1108, Christiana uses low sulfur fuel to control SO_2 emissions on a year-round basis.

A summary of the information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

<u>WI</u>

- Calpine rents water demineralization units to supply water to each unit for WI for the ozone season. The WI system is not weatherized to operate in cold temperatures. The system could be damaged if operated in cold weather as is it currently designed. While the water tanks remain at the site, the demineralization equipment is removed each winter and returned to the rental company.
- Cost of Compliance - Calpine evaluated the cost of updating the system for cold weather operations. The WI system would require a new heated building in order to operate during cold weather, an estimated annual cost of $5,300/ton of NOx removed for Unit 11 and $2,300/ton for Unit 14. In addition, there would be significant space constraints associated with placing a new structure at the facility. Therefore, the analysis indicated that it was not economically feasible to weatherize the system, to allow for year-round WI. Costs for year-round water rentals are based on current rental agreements at the facility and recent purchase costs of similar building structures by the company.
- Time Necessary for Compliance – Time for compliance would be dependent on the time needed to procure the appropriate state and local approvals for the construction of a new heated building on site. Though if approvals were obtained, it is expected that a new building could be constructed before the end of the 2nd Regional Haze compliance period, 2028.
- Non-air Environmental Impacts of Compliance – Space constraints and increased water use.
- Remaining Useful Life of Source –There are no planned retirement dates so operation through 2028 is expected.
- The Department also requested that Calpine evaluate the economic feasibility of operating controls in the two months adjacent to the ozone season, April and October, as the likelihood of encountering freezing temperatures is lower. In its analysis, Calpine agreed to rent the demineralization units for the months of April and October and run the WI systems during those months to increase the control of NOx. The facility's Title V permit will be revised to reflect the extension of the 88 ppm permit limit and the injection of water during the months of April and October. The new permit was issued on May 19, 2021(AQM-003/00317) (Appendix 10-2).

The Department agrees with Calpine's evaluation that year-round WI is economically infeasible during the months of November – March, but feasible during the months of April and October. Therefore, the Department will revise the permits for Christiana Energy Center, to require the use of WI and add an 88 ppm limit for the months of April and October for Units 11 and 14. The new permit was issued on May 19, 2021 (AQM-003/00317) (Appendix 10-2).

Edge Moor (Calpine) - Unit 3, 4 and 5

Edge Moor operates three boilers (Unit 3, 4, and 5) which use LNB and SNCR systems as NOx control devices. The Units combust primarily natural gas and distillate and residual fuel oil, landfill gas, digester gas, re-refined oil as secondary fuels. Edge Moor's Title V Permit requires that the NOx burners operate year-round, but does not require that the SNCR systems be operated at all times for the Unit. The SNCR is only required to be operated when firing coal, not natural gas.

In accordance with 7 DE Admin. Code 1108, Edge Moor uses low sulfur fuel to control SO_2 emissions on a year-round basis.

A summary of the information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

SNCR

- Calpine evaluated the technical and economic feasibility of operating the SNCR year round.

  Units 3 and 4

  Units 3 and 4 burn natural gas only. The SNCR systems were originally installed to control NOx emissions from coal firing, when coal was the primary fuel for these units. Though the Title V permit still allows coal to be combusted, no coal has been combusted in the units since 2010. In 2019 Unit 3 operated only 572 hours and Unit 4 615 hours.
  - Cost of Compliance - The SNCR systems are not designed to be operated while burning natural gas and would need to be reconfigured, at a cost of $500,000 per unit. Information on costs were calculated using the approach outlined in EPA's Control Cost Manual.
    The flue gas temperatures are compatible with effective SNCR operation only at high (>80%) load operations. Therefore, only marginal (30%) NOx reductions are expected with SNCR Units with such a limited operation. Therefore, the analysis indicated that it is not cost effective to operate the existing SNCR systems when burning natural gas.
  - Time Necessary for Compliance – It is expected that the SNCR could be modified before the end of the 2nd Regional Haze compliance period, 2028.
  - Non-air Environmental Impacts of Compliance – Ammonia-slip emissions and negative impact dispatch of the unit for power production.
  - Remaining useful Life of Source – There are no planned retirement dates so operation through 2028 is expected.

  Unit 5

  Unit 5 burns both natural gas and oil. The SNCR is used when firing fuel oil. When firing natural gas, the maximum output is limited to about 250 MW; oil firing must be added to achieve higher loads. The furnace temperature at the SNCR urea injection location does not reach the temperatures needed for effective SNCR operational until the boiler reaches loads of about 300 to 350 MW. Due to these limitations and the SNCR has been rarely used. Calpine believes that the SNCR could be modified to provide some degree of NOx reduction when firing natural gas and at lower loads, but that the reconfiguration would not be cost effective. In 2019 Unit 5 operated only 774 hours.

- Cost of Compliance - Estimated capital costs would be \$300,000 and daily operating costs would be \$4,000. Calpine estimated an annual cost of \$10,000/ton of NOx removed. Therefore, the analysis indicated that it is not cost effective to run the SNCR while burning natural gas and at lower loads. Information on costs were calculated using the approach outlined in EPA's Control Cost Manual.
- Time Necessary for Compliance – It is expected that the SNCR could be modified before the end of the 2nd Regional Haze compliance period, 2028.
- Non-air Environmental Impacts of Compliance – Increased use of demineralized water for urea solution production, negative impact dispatch of the unit for power production.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.

The Department agrees with Calpine's evaluation that it is not economically feasible to run the SNCRs year-round; given the costs and limited operation of the units.

Garrison (Calpine) – Unit CT1

Garrison operates a combustion turbine (CT1) which uses LNB, an SCR system, and a WI system as a NOx control devices. Unit CT1 combusts low sulfur distillate fuel oil and natural gas. While Garrison's Title V permit does not specifically contain any requirements to run the WI, the facility runs WI while burning fuel oil in order to meet its year-round permit limit of 47.3 lb/hr for NOx. The WI is not required to be used on a year-round basis. In accordance with 7 DE Admin. Code 1108, Garrison uses low sulfur fuel to control SO_2 emissions on a year-round basis.

A summary of the information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

<u>WI</u>

- Calpine evaluated the technical feasibility of running the WI controls when burning natural gas. They stated in their analysis that it is not technically feasible to operate the existing WI system when burning natural gas. CT1 is specifically designed to use WI only when combusting oil, which is a different type of combustion mode. The design and operation of the LNB is incompatible with modification or retrofit to accommodate WI. Therefore, running the WI controls when burning natural gas is technically infeasible.
- Cost of Compliance – NA, use of WI while burning natural gas technically infeasible.
- Time Necessary for Compliance – NA, use of WI while burning natural gas technically infeasible.
- Non-air Environmental Impacts of Compliance – NA, use of WI while burning natural gas technically infeasible.
- Remaining Useful Life of Source – NA, use of WI while burning natural gas technically infeasible.

Hay Road (Calpine) - Units 1, 2, 3 5, 6, and 7

Hay Road operates three combustion turbines (Units 1, 2, and 3) which use Low NOx combustion when firing natural gas in pre-mix mode and a WI system when firing natural gas or fuel oil in diffusion mode, as NOx control devices. Hay Road's Title V Permit does not require that the WI systems be operated when burning natural gas, on a year-round basis.

Hay Road operates three additional combustion turbines (Units 5, 6, and 7) which use Low NOx combustion on natural gas pre-mix mode, a WI system when firing natural gas or fuel oil in diffusion mode, and post combustion SCR as NOx control devices. Hay Road's Title V Permit does not require that the WI systems be operated when firing natural gas. In accordance with 7 DE Admin. Code 1108, Hay Road uses low sulfur fuel to control SO_2 emissions on a year-round basis.

A summary of the analyses information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

<u>WI</u>

- Calpine evaluated the technical and economic feasibility of running the WI controls when burning natural gas. The combustion turbines are specifically designed to utilize the WI systems only when combusting oil or natural gas in diffusion mode. Calpine stated in their analysis that it is not technically feasible to operate the WI system when burning natural gas in pre-mix mode. The LNB utilized on the units when firing natural gas in premix mode are specifically designed to control NOx emissions, without the need to inject water or steam to reduce combustion temperatures. The design and operating of LNB is incompatible with modification or retrofit to accommodate WI.
- Cost of Compliance - NA, use of WI while burning natural gas technically infeasible.
- Time Necessary for Compliance – NA, use of WI while burning natural gas technically infeasible.
- Non-air Environmental Impacts of Compliance – NA, use of WI while burning natural gas technically infeasible.
- Remaining Useful Life of Source – NA, use of WI while burning natural gas technically infeasible.

The Department agrees with Calpine's evaluation that it is not technically feasible to run the WI systems when burning natural gas in pre-mix mode, year-round.

10.1.2 "Ask #1" – Effective use of NOx and/or SO2 Controls

Delaware is in the process of updating all applicable permits that do not currently include language regarding the effective use of controls for applicable facilities (optimization of controls and/or operation in accordance with the manufacturer's recommendations). In addition, many of the applicable units currently have short term emission limits that help ensure the effective use of controls. Therefore, Delaware has met this portion of "Ask #1". The Department expects that the updated permits will be issued by the end of January 2022.

10.2 Four-Factor Analyses for Sources that have a Large Potential for Visibility Impacts – "Ask #2"

Emission sources modeled by MANE-VU that have the potential for 3.0 Mm-1 or greater visibility impacts at any MANE-VU Class I area, as identified by MANE-VU contribution analyses (see Appendix 9-1): perform a four-factor analysis for reasonable installation or upgrade to emission controls;

Delaware does not have any sources on the listing of emission units for the Four-Factor Analyses for Sources that have a Large Potential for Visibility Impacts "Ask". Therefore, this demonstrates that Delaware has met "Ask #2".

10.3 Low Sulfur Fuel Oil Strategy – "Ask #3"

Each MANE-VU State that has not yet fully adopted an ultra-low sulfur fuel oil standard as requested by MANE-VU in 2007: pursue this standard as expeditiously as possible and before 2028, depending on supply availability, where the standards are as follows:

a. distillate oil to 0.0015% sulfur by weight (15 ppm),

b. #4 residual oil within a range of 0.25 to 0.5% sulfur by weight, and

c. #6 residual oil within a range of 0.3 to 0.5% sulfur by weight.

In 2013 Delaware adopted a new low-sulfur fuel regulation which went into effect July 1, 2016.[89] The old and new limits for fuel sulfur content in Delaware are shown in Figure 10-3:

Table 10-3: 7 DE Admin Code 1108 (low-sulfur fuel regulation) – Old vs. New Sulfur Limits/Effective Dates

Fuel Type	Pre-Regulation limits	New Regulation Limits (ppm)	Effective Date
No. 2 and Lighter	3,000	15	July, 2016
No. 4	10,000	5,000	July, 2016
No. 5 and No. 6	10,000	5,000	July, 2016

This demonstrates that Delaware has met "Ask #3" for Low Sulfur Fuel Oil.

10.4 Locking in Lower Emission Rates into Permits – "Ask #4"

EGUs and other large point emission sources larger than 250 MMBTU per hour heat input that have switched operations to lower emitting fuels: pursue updating permits, enforceable agreements, and/or rules to lock-in lower emission rates for SO2, NOx and PM. The permit, enforcement agreement, and/or rule can allow for suspension of the lower emission rate during natural gas curtailment;

89 The effective date of the regulation is July 11, 2013. The final regulation can be found at: http://regulations.delaware.gov/AdminCode/title7/1000/1100/1108.shtml

Delaware has one EGU larger than 250 MMBTU/hr heat input that has switched operations to lower emitting fuels, and Calpine - Edge Moor. Permits for the facility have been updated to lock in lower emission rates for SO_2, NOx and PM. City of Dover - McKee Run also fell under this "Ask", but the permits for the facility were cancelled on November 12, 2021 (Appendix 8-7). Therefore, this demonstrates that Delaware has met "Ask #4".

10.5 Four-Factor Analyses for Peaking Combustion Turbines on High Electric Demand Days (HEDD) – "Ask #5"

Where emission rules have not been adopted, control NOx emissions for peaking combustion turbines that have the potential to operate on high electric demand days by:

a. *Striving to meet NOx emissions standard of no greater than 25 ppm at 15% O2 for natural gas and 42 ppm at 15% O2 for fuel oil but at a minimum meet NOx emissions standard of no greater than 42 ppm at 15% O2 for natural gas and 96 ppm at 15% O2 for fuel oil, or*
b. *Performing a four-factor analysis for reasonable installation or upgrade to emission controls, or*
c. *Obtaining equivalent alternative emission reductions on high electric demand days.*

Table 10-4 shows the current status of NOx emission standards for units in Delaware that meet the definition of a HEDD unit as defined for the purposes of the "Ask".

Table 10-4: Delaware Units Affected by HEDD "Ask #5"

		Strive		Minimum	
Facility	**Unit**	**25 ppm at 15% O_2 for Natural Gas**	**42 ppm at 15% O_2 for Fuel Oil**	**42 ppm at 15% O_2 for Natural Gas**	**96 ppm at 15% O_2 for Fuel Oil**
Christiana Energy Center	11	NA	**N**	NA	**N** [a]
Christiana Energy Center	14	NA	**N**	NA	**N** [a]
Delaware City Energy Center	10	NA	**N**	NA	**N**
Energy Center Dover	C-2	Y	NA	Y	NA
Indian River	5	NA	**N**	NA	**N**
VanSant	1	**N**	**N**	Y	Y
Warren Beasley	1	Y	Y	Y	Y
West Energy Center	10	NA	**N**	NA	**N** [a]

[a] DE Admin Code 1148, Control of Stationary Combustion Turbine Electric Generating Unit Emissions, applies to the unit. Regulation 1148 limits Natural Gas to 42 ppm and fuel oil to 88 ppm, but is only applicable during the ozone season, May – September (8/11/10, 75 FR 48566).

Delaware met "Ask #5" for two facilities by meeting the emission limits set in option "a" of the Ask, as shown in Table 10-4: Energy Center Dover and Warren Beasley. As shown in in Table 10-4 permits for the remaining five facilities do not currently meet the NOx standards in option "a of the Ask. Delaware has met "Ask #5" for these five facilities by performing a four-factor analyses on applicable units (option "b" of the Ask), as discussed below. Average operating hours and NOx emissions for these five facilities are shown in Table 10-5.

Table 10-5: Average Operating Hours and NOx Emissions for Units Under "Ask #5"

Facility	Unit	2015-2019 Ave. Annual Operating Hours	2015-2019 Ave. NOx Emissions (tons)
Christiana Energy Center	11	16	1.8
Christiana Energy Center	14	14	1.6
Delaware City Energy Center	10	15	0.4
Indian River	5	20	1.4
VanSant	1	106	4.5
West Energy Center	10	21	1.2

Christiana Energy Center (Calpine) - Units 11 and 14

Christiana Energy Center operates two distillate fired combustion turbines (Units CH11 and CH14) which use WI systems as NOx control devices. As shown in Table 10-5 the units have relatively low operating hours and emissions. The Units combust distillate fuel oil. In accordance with Regulation 1148, the current permit limit is 88 ppm, during the ozone season. Therefore, the units do not meet either of the "Ask" limits of 42 ppm or 96 ppm for fuel oil, on a year-round basis. Calpine's evaluation of the WI to meet the limits in "Ask #5" can be found in Section 10.1.1, under "Ask #1".

In addition, Calpine evaluated potential new controls, to address "Ask #5". A summary of the four-factor analyses information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

<u>SCR (new control)</u>

- Calpine evaluated the cost of installing SCR on the unit. Installation of SCR would require new buildings to be erected on site. Calpine responded that there would be significant space constraints associated with placing new structures at the facility. In addition, the site is unmanned and would present challenges for managing operations and maintenance for the complex new control systems.
- Cost of Compliance - Calpine calculated that the capital costs for installation of SCR at Christiana Energy Center would be $3,000,000 and estimated annual costs of $71,000/ton of NOx removed for Unit 11 and $31,000/ton for Unit 14. Therefore, the analysis indicated that it was not economically feasible to install an SCR. Information on costs were calculated using the approach outlined in EPA's Control Cost Manual. In addition, Calpine used previous bids from an evaluation of the potential for retrofitting SCR on several combustion turbines at its facilities in New Jersey, to help determine estimated costs.
- Time Necessary for Compliance – Time for compliance would be dependent on the time needed to procure the appropriate state and local approvals for the construction of a new heated building on site. Though if approvals were obtained, it is expected that a new building could be constructed before the end of the 2nd Regional Haze compliance period, 2028.

- Non-air Environmental Impacts of Compliance – space constraints, ammonia slip, negative impact dispatch of the unit for power production, increased power consumption, and power loss from reduced heat rate and back pressure across the catalysts.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.

SNCR (new control)

SNCR, to be effective in reducing NOx emissions, requires a temperature window that is significantly higher than the exhaust temperatures from the combustion turbines. Therefore, SNCR is not considered technically feasible for Christiana.

Natural Gas Conversion

The facility does not have a natural gas supply pipelines or storage on site and has not had access to pipelines/storage in the past. In addition, the units themselves are not capable of firing natural gas fuel without very significant modifications. Therefore, it is not economically feasible to convert to natural gas for these units.

Conclusion

The Department agrees with Calpine's evaluation that year-round WI is economically infeasible during the months of November – March, but feasible during the months of April and October. Therefore, the Department will revise the permits for Christiana, to require the use of WI and add an 88 ppm limit for the months of April and October for Units 11 and 14. The new permit was issued on May 19, 2021 (AQM-003/00317) (Appendix 10-2).

Delaware City Energy Center (Calpine) - Unit 10

Delaware City Energy Center operates a distillate fuel fired turbine (Unit 10) which uses a WI system as a NOx control device. As shown in Table 10-5 the unit has relatively low operating hours and emissions. The Unit combusts distillate fuel oil. In accordance with Regulation 1148, the current permit limit is 88 ppm, during the ozone season. Therefore, the unit does not meet either of the "Ask" limits of 42 ppm or 96 ppm for fuel oil, on a year-round basis.

A summary of the four-factor analyses information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

WI (existing control)

- Calpine rents water demineralization units to supply water to the unit for WI for the ozone season. The WI system is not weatherized to operate in cold temperatures. The system could be damaged if operated in cold weather as is it currently designed. While the water tanks remain at the site, the demineralization equipment is removed each winter and returned to the rental company.

- Cost of Compliance - Calpine evaluated the cost of updating the system for cold weather operations. The WI system would require a new heated building in order to operate during cold weather, an estimated annual cost of $14,700/ton of NOx removed. In addition, there would be significant space constraints associated with placing a new structure at the facility. Therefore, the analysis indicated that it was not economically feasible to weatherize the system, to allow for year-round WI. Costs for year-round water rentals are based on current rental agreements at the facility and recent purchase costs of similar building structures by the company.
- Time Necessary for Compliance – Time for compliance would be dependent on the time needed to procure the appropriate state and local approvals for the construction of a new heated building on site. Though if approvals were obtained, it is expected that a new building could be constructed before the end of the 2nd Regional Haze compliance period, 2028.
- Non-air Environmental Impacts of Compliance – Space constraints and increased water use.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.
- The Department also requested that Calpine evaluate the economic feasibility of operating controls in the two months adjacent to the ozone season, April and October, as the likelihood of encountering freezing temperatures is lower. In its analysis, Calpine agreed to rent the demineralization unit for the months of April and October and run the WI system during those months to increase the control of NOx. The facility's Title V permit will be revised to reflect the extension of the 88 ppm permit limit and the injection of water during the months of April and October. The new permit was issued on May 19, 2021 (AQM-003/00005) (Appendix 10-2).

<u>SCR (new control)</u>

- Installation of SCR would require new buildings to be erected on site. Calpine responded that there would be significant space constraints associated with placing new structures at the facility. In addition, the site is unmanned and would present challenges for managing operations and maintenance for the complex new control systems.
- Cost of Compliance - Calpine calculated that the capital costs for instillation of SCR at Delaware City Energy Center would be $2,800,000 and estimated annual costs of $147,000/ton of NOx removed. Therefore, the analysis indicated that it was not economically feasible to install SCR. Information on costs were calculated using the approach outlined in EPA's Control Cost Manual. In addition, Calpine used previous bids from an evaluation of the potential for retrofitting SCR on several combustion turbines at its facilities in New Jersey, to help determine estimated costs.
- Time Necessary for Compliance – Time for compliance would be dependent on the time needed to procure the appropriate state and local approvals for the construction of a new heated building on site. Though if approvals were obtained, it is expected that a new building could be constructed before the end of the 2nd Regional Haze compliance period, 2028.

- Non-air Environmental Impacts of Compliance – space constraints, ammonia slip, negative impact dispatch of the unit for power production, increased power consumption, and power loss from reduced heat rate and back pressure across the catalysts.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.

SNCR (new control)

SNCR, to be effective in reducing NOx emissions, requires a temperature window that is significantly higher than the exhaust temperatures from the combustion turbines. Therefore, SNCR is not considered technically feasible for Delaware City.

Natural Gas Conversion

The facility does not have a natural gas supply pipelines or storage on site and has not had access to pipelines/storage in the past. In addition, the units themselves are not capable of firing natural gas fuel without very significant modifications. Therefore, it is not economically feasible to convert to natural gas for this unit.

Conclusion

The Department agrees with Calpine's evaluation that year-round WI is economically infeasible during the months of November – March, but feasible during the months of April and October. Therefore, the Department will revise the permits for Delaware City, to require the use of WI and add an 88 ppm limit for the months of April and October for Unit 10. The new permit was issued on May 19, 2021 (AQM-003/00005) (Appendix 10-2).

Indian River (NRG) - Unit 5

Indian River operates a combustion gas turbine (Emission Unit 5) which uses a WI system as a NOx control device. As shown in Table 10-5 the unit has relatively low operating hours and emissions. Unit 5 combusts distillate fuel oil. The current permit limit is 88 ppm, during the ozone season. Therefore, the unit does not meet either of the "Ask" limits of 42 ppm or 96 ppm for fuel oil, on a year-round basis.

A summary of the four-factor analyses information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

WI (existing control)

- The WI system at the facility is not weatherized to operate in cold temperatures. Therefore, the system could be damaged if operated in cold weather as is it currently designed. NRG evaluated the cost of updating the system for cold weather operations. The capital costs of converting the system for winter operation would require constructing a stand alone building for WI system, new water tanks, transformers and electrical system modifications, heat tracing, heating systems, piping, foundation work, and control system modifications.

- Cost of Compliance - NRG estimated the total capital cost to be $205,200 and an annual cost of $192,000/ton of NOx removed. Costs estimates were based on estimates for a similar project in another state.
- Time Necessary for Compliance – Construction of a new building and other necessary components would take approximately 1 year.
- Non-air Environmental Impacts of Compliance – Potential additional emissions for additional power generation to power WI and heating equipment. Increased water use.
- Remaining Useful Life of Source – Shutdown expected by 2027. In June of 2021, NRG Energy announced that it was planning to close Indian River Generating Station, a coal fired power plant, in May of 2022. The planned closure was contingent on a grid reliability study from the regional power grid operator PJM. Based on their study, PJM determined the plant is needed for reliability. In order for the transmission system to carry the weight of the plant closure, PJM would need to update its services. Those upgrades are estimated to be complete by at least 2027. Once the upgrades are complete, the plant would be able to shut down.

The Department also requested that NRG evaluate the economic feasibility of operating controls in the two months adjacent to the ozone season, April and October, as the likelihood of encountering freezing temperatures is lower. In its analysis, NRG stated that because the demineralized water is required and the water source is rented, adding operations in April and October would result in an added expense in the range of $5,000 per month, or $10,000 for two months. These estimates are based off of previous rental costs at the facility.

The probability of the unit operating during these months is extremely low. Over the past 5 years, the unit has only operated a total of 6.22 hours in the months of April and October. In addition, the facility does not anticipate that the Unit would be called to be run for system reliability in these months and they would not schedule a required stack test at this time. Therefore, expanding WI operations to include April or October is not economically feasible.

<u>Natural Gas Conversion (new control)</u>

The facility does not have a natural gas supply pipelines or storage on site and has not had access to pipelines/storage in the past. NRG has considered replacement of the unit, if associated with a conversion to natural gas. The inability of third-party companies to bring a natural gas supply to the area has prohibited this option. As a result, the facility does not have cost information available for this option. Therefore, it is not economically or technically feasible to convert to natural gas for this unit.

<u>Conclusion</u>

The Department agrees with the NRG's evaluation that additional NOx controls are economically infeasible.

Van Sant (City of Dover) - Unit 1

VanSant operates a combustion gas turbine (Unit 1) which uses a WI system as a NOx control device. As shown in Table 10-5 the unit has relatively low operating hours and emissions. Unit 1 combusts natural gas as a primary fuel and distillate fuel oil as a secondary fuel. The current permit limits are 42 ppm for natural gas and 77 ppm for fuel oil. Therefore, the unit does not meet the lower "Ask" limits of 25 ppm for natural gas and 42 ppm for fuel oil.

A summary of the four-factor analyses information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

<u>WI (existing control)</u>

- In order to increase the WI rate for the existing WI system, to decrease NOx, the water treatment facility at Van Sant would have to be upgraded and a new tank would have to be installed, to meet the additional water usage demand.
- Cost of Compliance - The total capital investment for this upgrade, including additional tanks, is approximately $1,355,000. This cost included equipment costs of $300,000 for a new water tank and $500,000 for an upgraded ion exchange system (including demolition and instillation). The total annual cost of the upgrades is estimated to be $334,897/ton of NOx removed. Therefore, upgrading the WI system is economically infeasible. Costs were estimated from vendor quotes and methods in the EPA's Control Cost Manual.
- Time Necessary for Compliance – Unit could be equipped with upgrades to the WI system in approximately 18 months.
- Non-air Environmental Impacts of Compliance – Increased deionized water use, increased power for deionized water system.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.

<u>Dry LNB (new control)</u>

- Cost of Compliance - The total capital investment of retrofitting the unit with LNB combustion was estimated to be $3,473,000. The City of Dover estimated that the total annual cost would be $161,920/ton of NOx removed. Therefore, the analysis indicated that it was not economically feasible to install an LNB. Costs were estimated using the methods in the EPA's Control Cost Manual.
- Time Necessary for Compliance – Unit could be equipped with LNB in approximately 18 months.
- Non-air Environmental Impacts of Compliance – None expected.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.

<u>SCR (new control)</u>

- Cost of Compliance - The total capital investment of retrofitting the unit with SCR was estimated to be $5,875,572. The City of Dover estimated that the total annual cost would be $155,431/ton of NOx removed. Therefore, the analysis indicated that it was not economically feasible to install an SCR.
- Time Necessary for Compliance – Unit could be equipped with SCR in approximately 18 months.
- Non-air Environmental Impacts of Compliance – Transport, handling and use of aqueous ammonia; ammonia slip; and replacement and disposal of spent catalyst.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.

<u>SNCR (new control)</u>

- Because SNCR required a temperature window that must be between approximately 1,400ºF and 2,000ºF, which is higher than the exhaust temperature from a natural gas fired combustion turbine, the flue gas would need to be heated to be within that range. The supplemental heating system would rely on additional natural gas combustion, thereby increasing emissions from the system. The cost of heating the flue gas from the combustion turbine to the proper range for SNCR would be $340,857 annually and $100,784/ton of NOx removed. Therefore, the analysis indicated that it was not economically feasible to install an SNCR.
- Cost of Compliance - The cost of heating the flue gas from the combustion turbine to the proper range for SNCR would be $340,857 annually and $100,784/ton of NOx removed. Therefore, the analysis indicated that it was not economically feasible to install an SNCR.
- Time Necessary for Compliance – Unit could be equipped with SNCR in approximately 18 months.
- Non-air Environmental Impacts of Compliance – Transport, handling and use of aqueous ammonia; ammonia slip; and increased use of natural gas for heating of flue gas which would result in additional emissions.
- Remaining Useful Life of Source – Current projected lifespan through 2041. There is no planned retirement date so operation through 2028 is expected.

<u>Conclusion</u>

The Department agrees with the City of Dover's evaluation that additional NOx controls are economically infeasible.

West Energy Center (Calpine) - Unit 10

West Energy Center operates a distillate fuel fired turbine (Unit 10) which uses a WI system as a NOx control device. As shown in Table 10-5 the unit has relatively low operating hours and emissions. The Unit combusts distillate fuel oil. In accordance with Regulation 1148, the current permit limit is 88 ppm, during the ozone season. Therefore, the unit does not meet either of the "Ask" limits of 42 ppm or 96 ppm for fuel oil, on a year-round basis.

A summary of the four-factor analyses information submitted by the operator (Appendix 10-1) regarding the economic and technical feasibility of increased NOx controls is detailed below.

WI (existing control)

- Calpine rents water demineralization units to supply water to the unit for WI for the ozone season. The WI system is not weatherized to operate in cold temperatures. The system could be damaged if operated in cold weather as is it currently designed. While the water tanks remain at the site, the demineralization equipment is removed each winter and returned to the rental company.
- Cost of Compliance - Calpine evaluated the cost of updating the system for cold weather operations. The WI system would require a new heated building in order to operate during cold weather, an estimated annual cost of $19,000/ton of NOx removed. In addition, there would be significant space constraints associated with placing a new structure at the facility. Therefore, the analysis indicated that it was not economically feasible to weatherize the system, to allow for year-round WI. Costs for year-round water rentals are based on current rental agreements at the facility and recent purchase costs of similar building structures by the company.
- Time Necessary for Compliance – Time for compliance would be dependent on the time needed to procure the appropriate state and local approvals for the construction of a new heated building on site. Though if approvals were obtained, it is expected that a new building could be constructed before the end of the 2nd Regional Haze compliance period, 2028.
- Non-air Environmental Impacts of Compliance – Space constraints and increased water use.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.
- The Department also requested that Calpine evaluate the economic feasibility of operating controls in the two months adjacent to the ozone season, April and October, as the likelihood of encountering freezing temperatures is lower. In its analysis, Calpine agreed to rent the demineralization unit for the months of April and October and run the WI system during those months to increase the control of NOx. The facility's Title V permit will be revised to reflect the extension of the 88 ppm permit limit and the injection of water during the months of April and October. The new permit was issued on May 19, 2021(AQM-003/00006) (Appendix 10-2).

SCR (new control)

- Calpine evaluated the cost installing SCR on the unit. Installation of SCR would require new buildings to be erected on site. Calpine responded that there would be significant space constraints associated with placing new structures at the facility. In addition, the site is unmanned and would present challenges for managing operations and maintenance for the complex new control systems.

- Cost of Compliance - Calpine calculated that the capital costs for instillation of SCR at West Energy Center would be $3,000,000 and estimated annual costs of $171,000/ton of NOx removed. Therefore, the analysis indicated that it was not economically feasible to install SCR. Information on costs were calculated using the approach outlined in EPA's Control Cost Manual. In addition, Calpine used previous bids from an evaluation of the potential for retrofitting SCR on several combustion turbines at its facilities in New Jersey, to help determine estimated costs.
- Time Necessary for Compliance – Time for compliance would be dependent on the time needed to procure the appropriate state and local approvals for the construction of a new heated building on site. Though if approvals were obtained, it is expected that a new building could be constructed before the end of the 2nd Regional Haze compliance period, 2028.
- Non-air Environmental Impacts of Compliance – space constraints, ammonia slip, negative impact dispatch of the unit for power production, increased power consumption, and power loss from reduced heat rate and back pressure across the catalysts.
- Remaining Useful Life of Source – There is no planned retirement date so operation through 2028 is expected.

SNCR (new control)

SNCR, to be effective in reducing NOx emissions, requires a temperature window that is significantly higher than the exhaust temperatures from the combustion turbines. Therefore, SNCR is not considered technically feasible for West.

Natural Gas Conversion

The facility does not have a natural gas supply pipelines or storage on site and has not had access to pipelines/storage in the past. In addition, the units themselves are not capable of firing natural gas fuel without very significant modifications. Therefore, it is not economically feasible to convert to natural gas for this unit.

Conclusion

The Department agrees with Calpine's evaluation that year-round WI is economically infeasible during the months of November – March, but feasible during the months of April and October. Therefore, the Department will revise the permits for West, to require the use of WI and add an 88 ppm limit for the months of April and October for Unit 10. The new permit was issued on May 19, 2021(AQM-003/00005) (Appendix 10-2).

10.6 Energy Efficiency, Combined Heat and Power, and other Clean Distributed Generation Technologies – "Ask #6"

Each State should consider and report in their SIP measures or programs to: a) decrease energy demand through the use of energy efficiency, and b) increase the use within their state of Combined Heat and Power (CHP) and other clean Distributed Generation technologies including fuel cells, wind, and solar.

Delaware has implemented a number of measures related to Energy Efficiency, CHP, and other Clean Distributed Generation Technologies.

For instance, in accordance with Executive Order 31 issued by Delaware Governor Ruth Minner, the Energy Task Force addressed the following goals:

- The expansion of the diversity of fuels used to meet Delaware's current and future energy needs.
- The development of conservation programs to reduce the need to build more electricity generation facilities.
- Ensuring that energy infrastructure will meet Delaware's future needs for efficiently transporting energy resources.
- Encouraging producers of clean energy technologies and producers of energy efficient products to locate their business operations in Delaware.

Recent Initiatives in Delaware related to energy efficiency include:

- The Delaware Energy Efficiency Advisory Council (EEAC) helps Delawareans reduce energy loss and cost through energy efficiency programs. The EEAC, established in 2014, is a collaborative panel of representatives that develops statewide programs to increase energy efficiency, reduce energy usage, and lower consumer energy costs.

- The DNREC provides grants through the Energy Efficiency Investment Fund and Energy Efficiency Industrial Program to help commercial and industrial customers replace aging, inefficient equipment and systems with energy efficient alternatives.

- The DNREC's Division of Energy and Climate created the Delaware Energy Code Coalition in 2011. The Coalition brings together a diverse group of state and local stakeholders responsible for advising the Division on energy code implementation, infrastructure, updates, and compliance.

- In 2017, DNREC's Division of Climate Coastal and Energy launched the CHP Grant Pathway Program. This program was designed to encourage the development of CHP in Delaware.

Delaware also continues to promote renewable energy and address climate change. Delaware's renewable energy portfolio standards (RPS) are established by the Renewable Energy Portfolio Standards Act (26 Del.C. § 351 – § 364), first adopted in 2005. The Act is intended to establish a market in Delaware for electricity from renewable sources and to lower the cost of renewable energy to consumers. The Act allows utilities to meet their portfolio standards by buying renewable energy credits and solar renewable energy credits from wind, solar and other renewable sources.

The RPS was strengthened in 2021 through Senate Bill (SB) 33. SB 33 raises Delaware's the RPS for regulated utilities to 40% by 2035. The new law raised Delaware's previous RPS goal of 25% renewable energy by 2025. The RPS solar carve-out also will nearly triple from 3.5% by 2025 to 10% by 2035.

Governor Minner joined with nine other Northeastern and Mid-Atlantic states in May 2003 to develop a regional program to reduce CO_2 emissions from power plants. Delaware adopted the Regional Greenhouse Gas Initiative (RGGI) in 2008, which has resulted in over 50% reduction in CO2 emissions from the power sector. RGGI is successfully reducing carbon pollution, while supporting economic growth and grid resiliency. Over RGGI's first four control periods (2009-2020), the states that participated during that time saw a 53% reduction in power sector carbon emissions (comparing 2020 to the baseline period of the 2006-2008 average), while the regional economy continued to grow.

In addition, in February of 2014, DNREC's Division of Energy and Climate issued the *Delaware Climate Change Impact Assessment*. The purpose of the Assessment is to increase Delaware's resiliency to climate change by understanding and communicating the current and future impacts of climate change.

Finally, throughout 2020 and 2021, the State has engaged residents and businesses to develop Delaware's Climate Action Plan, which was released in November 2021. Delaware's Climate Action Plan will guide state efforts to:

- Minimize greenhouse gas emissions, which drive the climate change we see today, and
- Maximize resilience to climate change impacts.

Implementing the strategies in this plan will help Delaware meet its greenhouse gas emissions goals and better prepare for climate change impacts. Taking these actions can also build economic opportunities and improve public health. This demonstrates that Delaware has met "Ask #7" for continued evaluation of these other control measures.

10.7 Status of "Asks" in First State Implementation Plan (40 CFR 51.308 (g)(1) and (g)(2)))

During the first implementation period MANE-VU adopted Four "Asks" for MANE-VU Class I states. More details about the "Asks" can be found in Delaware's 2008 Regional Haze SIP, Section 10.4. The following sections provide an update on the status of Delaware's progress on the "Asks" for the first implementation period.

10.7.1 BART

40 CFR 51.308 (f), by referring to 51.308(g)(1) as a requirement for periodic regional haze SIP revisions, requires that the SIP revisions must describe the status of implementation of all measures included in the SIP for achieving RPGs for Class I areas within and outside the State that are affected by emissions from within the State [40 CFR 51.308 (g)(1)]. In establishing RPGs for the first implementation period, MANE-VU Class I states relied in part on timely implementation of BART requirements. This section includes updated information pertaining to the status of Delaware's BART sources.

In its 2008 Regional Haze SIP, Delaware's DNREC identified four EGUs located in Delaware that satisfy the size, type, and age criteria for BART eligibility. Detailed information about the units is shown in Table 10-6.

Table 10-6: Delaware BART-subject EGUs

Facility	Unit	Nameplate Rating (MW)	Boiler Type	Primary Fuel	Date of Commercial Operation	Heat Input Capacity (MMBTU/hr)
Edge Moor	4	177	Tangentially-fired	Bituminous Coal	4/1/1966	1867
Edge Moor	5	446	Dry bottom wall-fired	Residual Fuel Oil	8/1/1973	4695
Indian River	3	177	Dry bottom wall-fired	Bituminous Coal	6/1/1970	1904
McKee Run	3	114	Dry bottom wall-fired	Residual Fuel Oil	9/1/1975	1180

10.7.1.1 BART - Sulfur Dioxide and Oxides of Nitrogen

In its 2008 Regional Haze SIP, Delaware provided a detailed discussion of its development of 7 DE Admin Code 1146, a non-trading emissions control regulation for EGUs that was established primarily as a measure to aid in the attainment of the ozone and fine particulate matter ambient air quality standards, and to reduce emissions of the neurotoxin mercury.

7 DE Admin Code 1146 provides for stringent control of EGU NOx and SO_2 emissions by implementation of unit-specific annual NOx and SO_2 mass emissions caps and short term (rolling 24-hour) NOx and SO_2 emission rate limits (lb/MMBTU). In its Regional Haze SIP, Delaware demonstrated that 7 DE Admin Code 1146 was superior to a unit-by-unit BART analysis with regards to SO_2 and NOx emissions control for EGUs, and included 7 DE Admin Code 1146 in the Regional Haze SIP as an alternative measure to BART for SO_2 and NOx under 40 CFR 51.308(e)(2)(i). More details on the analysis can be found in Delaware's 2008 Regional Haze SIP, Section 8.4.1. Delaware's EGUs that were subject to 7 DE Admin Code 1146 are shown in Table 10-7.

Table 10-7: Delaware's EGUs Subject to 7 DE Admin Code 1146

Facility	Unit	Nameplate Rating (MW)	Initial Year of Operation	Primary Fuel on September 25, 2008	Heat Input Rating (MMBTU/hr)
Edge Moor	3	75	1954	Bituminous Coal	1117
Edge Moor	4	177	1966	Bituminous Coal	1867
Edge Moor	5	446	1973	Residual Fuel Oil	4695
Indian River	1	82	1957	Bituminous Coal	1090
Indian River	2	82	1959	Bituminous Coal	1186
Indian River	3	177	1970	Bituminous Coal	1904
Indian River	4	442	1980	Bituminous Coal	5091
McKee Run	3	114	1975	Residual Fuel Oil	1180

Subsequent to the promulgation of 7 DE Admin Code 1146, sources subject to the requirements of 7 DE Admin Code 1146 utilized a variety of methods to achieve significant SO_2 and NOx reductions. These emissions reduction methods included installation of controls, fuel switches, and acceptance of operating restrictions. The following list indicates SO_2 and NOx emissions reduction methodologies associated with the sources that were subject to 7 DE Admin Code 1146:

- Edge Moor Unit 3 was formerly a primarily coal-fired EGU. Subsequent to promulgation of 7 DE Admin Code 1146, this unit has taken permit (permit AQM-003/00007) conditions to convert from utilizing coal as the unit's primary fuel with residual fuel-oil as a secondary fuel, to utilizing natural gas as the primary fuel with No. 2, No. 6, Landfill Gas, Digester Gas, and re-refined oil as secondary fuels. The unit remains subject to the 7 DE Admin Code 1146 residual fuel oil sulfur limit of 0.5% by weight, NOx emissions rate limit of 0.125 lb/MMBTU (requirement beginning January 1, 2012), and an annual SO_2 mass emissions limit of 235 tpy. However, an annual NOx mass emissions limit of 265 tpy, taken in conjunction with the fuel conversion, is more restrictive than those of 7 DE Admin Code 1146.

- Edge Moor Unit 4 was formerly a primarily coal-fired EGU. Subsequent to promulgation of 7 DE Admin Code 1146, this unit has taken permit (permit AQM-003/00007) conditions to convert from utilizing coal as the primary fuel with residual fuel-oil as a secondary fuel, to utilizing natural gas as the primary fuel with No. 2, No. 6, Landfill Gas, Digester Gas, and re-refined oil as secondary fuels. The unit remains subject to the 7 DE Admin Code 1146 residual fuel oil sulfur limit of 0.5% by weight, NOx emissions rate limit of 0.125 lb/MMBTU (requirement beginning January 1, 2012), and an annual SO_2 mass emissions limit of 428 tpy. However, an annual NOx mass emissions limit of 483 tpy, taken in conjunction with the fuel conversion, is more restrictive than those of 7 DE Admin Code 1146.

- Edge Moor Unit 5, which previously used residual fuel oil as primary fuel and natural gas as a secondary fuel; now utilizes natural gas as the primary fuel with No. 2, No. 6, Landfill Gas, Digester Gas, and re-refined oil as secondary fuels. Applicable specific requirements of 7 DE Admin Code 1146 include the NOx mass emissions rate limit of 0.125 lb/MMBTU (beginning January 1, 2012), an annual NOx mass emissions limit of 1348 tpy, and an annual SO_2 mass emissions limit of 4,600 tpy.

- Indian River Unit 1, a coal-fired unit, was shutdown in April of 2011 as required under consent decree (C.A. No. 07C-02-283FSS).

- Indian River Unit 2, a coal-fired unit, was shutdown in April of 2010 as required under consent decree (C.A. No. 07C-02-283FSS).

- Indian River Unit 3, a coal-fired unit, was shutdown in December 2013 as required under consent decree (C.A. No. 07C-02-283FSS).

- Indian River Unit 4 is a coal-fired EGU. The unit has installed NOx controls (SCR) and SO_2 controls (FGD). These controls became operational in December 2011. The unit is in compliance with a consent decree (C.A. No. 07C-02-283FSS) SO_2 emissions rate limitation of 0.20 lb/MMBTU (rolling 24-hour average) and NOx emissions rate limitation of 0.10 lb/MMBTU (rolling 24-hour average). The unit remains subject to the requirements of 7 DE Admin Code 1146 for an annual SO_2 mass emissions cap of 3,657 tpy and an annual NOx mass emissions cap of 2,032 tpy.

- McKee Run Unit 3 was formerly a primarily residual oil-fired EGU. The unit has elected to take permit (permit AQM-001/00002) conditions converting from the utilization of residual fuel oil as the primary fuel to utilizing natural gas as the primary fuel and low-sulfur #2 fuel oil (0.05% sulfur by weight) as the secondary fuel. The permit conditions for this unit also include a facility-wide annual SO_2 mass emissions cap of 400 tpy and an annual NOx mass emissions cap of 244 tpy.

  On June 10, 2021 the City of Dover informed Delaware that the fuel sources at the facility had been disconnected. A close-out inspection was performed at the facility on June 14, 2021, to confirm the disconnection. The City of Dover submitted a formal letter requesting cancellation of the permits associated with the facility on August 13, 2021. Subsequently, the permits for McKee Run were cancelled on November 12, 2021 (Appendix 8-7).

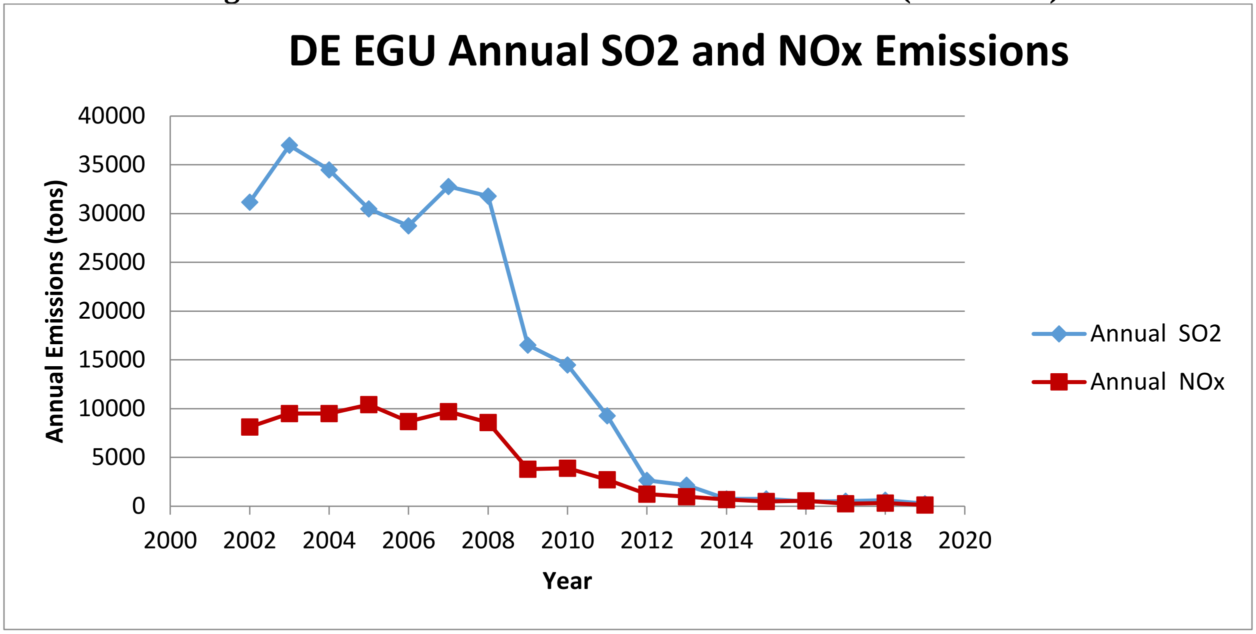
The SO_2 and NOx emissions limitations of 7 DE Admin Code 1146, and related consent decrees and permit conditions (DE SO_2/NOx Reductions), have served to significantly reduce the SO_2 and NOx emissions from Delaware's EGUs that were subject to 7 DE Admin Code 1146.

Table 8-8 shows the total annual SO_2 and NOx mass emissions from this group of EGUs. The data was taken from the EPA's AMPD, and includes the baseline year 2002 through calendar year 2019, the last calendar year with full year data available in the EPA's AMPD at the time of preparation of this document. The table also shows the amount of SO_2 and NOx emissions reductions that have annually occurred relative to the 2002 baseline year emissions, for Delaware's EGUs subject to 7 DE Admin Code 1146 (see Table 10-7). Figure 10-1 represents the DE EGU annual SO_2 and NOx emissions data from Table 10-8.

Table 10-8: AMPD SO_2 and NOx emissions reductions relative to the 2002 baseline year emissions

Year	Annual Total NO_x (tons)	Annual Total SO_2 (tons)	NO_x Reduction from 2002 (tons)	SO_2 Reduction from 2002 (tons)
2002	8,143	31,183	0	0
2003	9,492	36,998	-1,349	-5,815
2004	9,495	34,475	-1,352	-3,292
2005	10,419	30,482	-2,276	701
2006	8,675	28,738	-532	2,445
2007	9,714	32,778	-1,571	-1,595
2008	8,587	31,785	-444	-602
2009	3,803	16,524	4,340	14,659
2010	3,911	14,485	4,232	16,698
2011	2,731	9,278	5,412	21,905
2012	1,248	2,644	6,895	28,539
2013	976	2,170	7,167	29,013
2014	701	765	7,442	30,418
2015	487	769	7,656	30,414
2016	541	492	7,602	30,691
2017	266	524	7,877	30,659
2018	312	625	7,831	30,558
2019	**138**	**266**	**8,005**	**30,917**

Figure 10-1: DE AMPD EGU annual SO_2 and NOx (2002-2019)



It can be seen in the data from Table 10-8 and Figure 10-1 that there was a step change reduction in SO_2 and NOx annual emissions beginning in 2009. The 2009 SO_2 and NOx emissions step change corresponds to the first stage of SO_2 and NOx emissions reduction requirements imposed by 7 DE Admin Code 1146. The data indicates that by 2019 the EGUs that were subject to 7 DE Admin Code 1146 had reduced SO_2 mass emissions by 30,917 tpy (approximately 99%) and reduced NOx mass emissions by 8,005 tpy (approximately 98%). Table 10-9 compares 2002 and 2019 actual SO_2 and NOx emissions, by unit.

Table 10-9: 2002 vs. 2019 actual emissions

Facility	Unit	2002 Actual SO_2 Emissions (tons)	2002 Actual NOx Emissions (tons)	2019 Actual SO_2 Emissions (tons)	2019 Actual NOx Emissions (tons)
Edge Moor	3	3,343.6	921.6	0.1	7.7
Edge Moor	4	5,051.0	1,095.7	0.2	13.7
Edge Moor	5	2,132.5	1,288.9	19.4	39.1
Indian River	1	3,949.6	707.5	0.0	0.0
Indian River	2	3,833.3	640.7	0.0	0.0
Indian River	3	4,682.1	663.9	0.0	0.0
Indian River	4	7,490.7	2,479.1	246.2	73.7
McKee Run	3	700.4	345.3	0.0	3.7
	Total	**31,183.2**	**8,142.7**	**265.8**	**137.9**

10.7.1.2 BART - Particulate Matter

As documented in the 2008 Regional Haze SIP, the owner/operator of Delaware's four BART eligible EGUs were requested to conduct BART determinations using the 5-factor analysis for PM:

(1) Cost of compliance,
(2) The energy and non-air quality environmental impacts of compliance,
(3) Pollution control equipment in use at the source,
(4) The remaining useful life of the source, and
(5) The degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

For each of those four BART eligible EGUs, the following sections discuss the status of the implementation of primary particulate matter BART for the respective BART eligible EGU.

Edge Moor Unit 4

At the time of submittal of Delaware's 2008 Regional Haze SIP, Edge Moor Unit 4 utilized bituminous coal as its primary fuel, with No. 6 fuel oil and natural gas as secondary fuels, and included a cold side precipitator for particulate emissions control. Edge Moor Unit 4's owner/operator, Conectiv (now owned by Calpine), identified the technologically feasible options for Edge Moor Unit 4 to include the existing ESP and the addition of a dry sorbent injection (DSI) system, and an ESP/DSI combination to include a downstream baghouse.

In 2010, the Edge Moor facility was purchased by Calpine Mid-Atlantic Generation (Calpine). Calpine subsequently made the decision to convert Edge Moor Unit 4 from utilizing coal as the primary fuel to utilizing pipeline natural gas as the primary fuel. Calpine currently utilizes natural gas as the primary fuel with No. 2, No. 6, Landfill Gas, Digester Gas, and re-refined oil as secondary fuels. The Title V permit for Edge Moor was revised on August 2, 2017. The permit revision established a PM_{10} emission rate for Unit 4 of 0.2 lb/MMBTU, maximum 2-hour average.

Relative to a pulverized coal-fueled steam generator utilizing an ESP (and firing coal fuels similar to those most recently combusted at Edge Moor Unit 4), AP-42 emissions factors estimate an approximate 90% reduction in particulate emissions when firing pipeline natural gas.
Therefore, it is Delaware DNREC's determination that the conversion of Edge Moor Unit 4 to pipeline natural gas primary fuel meets the requirements for primary particulate matter BART for Edge Moor Unit 4.

Edge Moor Unit 5

At the time of submittal of Delaware DNREC's 2008 Regional Haze SIP, Edge Moor Unit 5 used residual fuel oil as primary fuel and natural gas as a secondary fuel. Conectiv identified no technologically feasible options for Edge Moor Unit 5 except the use of a lower sulfur (0.5% sulfur) residual fuel oil.

The Unit now utilizes natural gas as the primary fuel with No. 2, No. 6, Landfill Gas, Digester Gas, and re-refined oil as secondary fuels. The restriction to accept only residual fuel oils with a sulfur content of 0.5% or less has been incorporated into Edge Moor Unit 5's operating permit (permit AQM-003/00007). The Title V permit for Edge Moor was most recently revised on August 2, 2017, establishing a PM_{10} emission rate for Unit 5 of 0.2 lb/MMBTU, maximum 2-hour average. Therefore, Edge Moor Unit 5 is in compliance with the particulate matter BART for the unit identified in Delaware's 2008 Regional Haze SIP and permit conditions serve to help ensure continued compliance.

Indian River Unit 3

At the time of submittal of Delaware DNREC's 2008 Regional Haze SIP, Indian River Unit 3 incorporated a bituminous coal fueled wall-fired steam generator that utilized a cold side ESP. NRG identified no technologically feasible options for Indian River Unit 3 other than the continued operation of the existing ESP. Per consent decree (C.A. No. 07C-02-283FSS) Unit 3 was shut down on December 31, 2013.

McKee Run Unit 3

At the time of submittal of Delaware DNREC's 2008 Regional Haze SIP, McKee Run Unit 3 utilized 1% sulfur residual fuel oil as its primary fuel (and pipeline natural gas as a secondary fuel) and incorporated a mechanical cyclone separator and ash reinjection for particulate emissions control. The analysis conducted by McKee Run Unit 3's owner, the City of Dover, indicated that BART for Unit 3 was a fuel switch from 1% sulfur residual fuel oil to 0.5% sulfur fuel oil.

Subsequent to Delaware's 2008 Regional Haze SIP submittal, the City of Dover made the decision to perform a fuel switch at McKee Run Unit 3 from using No. 6 residual fuel oil as the primary fuel (with pipeline natural gas as a secondary fuel) to pipeline natural gas as the primary fuel (with 0.05% sulfur #2 fuel oil as a secondary fuel). The requested fuel switch was approved and incorporated into McKee Run Unit 3's operating permit (permit AQM-001/00002).

Relative to a residual fuel oil fueled steam generator utilizing 0.5% sulfur No. 6 residual fuel oil, AP-42 emissions factors estimate an approximate 82% reduction in primary particulate emissions when firing pipeline natural gas. Therefore, it is Delaware DNREC's determination that the conversion of McKee Run Unit 3 to pipeline natural gas primary fuel meets the requirements for primary particulate matter BART for McKee Run Unit 3.

On June 10, 2021 the City of Dover informed Delaware that the fuel sources at the facility had been disconnected. A close-out inspection was performed at the facility on June 14, 2021, to confirm the disconnection. The City of Dover submitted a formal letter requesting cancellation of the permits associated with the facility on August 13, 2021. Subsequently, the permits for McKee Run were cancelled on November 12, 2021 (Appendix 8-7).

10.7.2 90% or Greater Reduction in SO_2 from EGUs – (167 stacks)

In its 2008 regional haze SIP, Delaware indicated that the 90% reduction in SO_2 from the Edge Moor Unit 5 and Indian River Units 1-4 was relative to a baseline of calendar year 2002 actual SO_2 mass emissions levels from those units. Based on the actual 2002 SO_2 mass emissions from the subject Delaware EGUs, Delaware determined that the actual SO_2 reduction obligation for those units was 19,909 tons/year.

Delaware's analysis indicated that it was not feasible to achieve an SO_2 mass emissions reduction of 19,909 tons/year from Edge Moor Unit 5 and Indian River Units 1-4 alone. Alternatively, in the 2008 regional haze SIP document Delaware indicated that SO_2 emissions reductions from all of the EGU units affected by Delaware's 7 DE Admin Code 1146 would exceed 19,909 tons of annual SO_2 reductions. Delaware indicated that the SO_2 emissions reductions achieved by 7 DE Admin Code 1146 demonstrated that Delaware had met its obligation. Subsequently, Indian River Units 1-3 were shutdown.

10.7.3 Low Sulfur Fuel Strategy

Details on the status of Delaware's Low Sulfur Fuel Strategy can be found in Section 10.3 above.

10.7.4 Continued Evaluation of Other Controls

Details on the status of other control methods can be found in Section 8.6 above.

Section 11 - Comprehensive Periodic Implementation Plan Revisions (40 CFR 51.308 (f) and (g))

40 CFR 51.308(g) requires periodic reports evaluating progress towards the RPGs established for each mandatory Class I area. The a summary of how the specific components of 51.308(g) are addressed in this SIP is detailed below:

<u>51.308 (g)(1) states</u>: "*A description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for mandatory Class I Federal areas both within and outside the State.*"

- The status of implementation of measures included in the first implementation period are is addressed can be found in the following subsections of this SIP. These measures include:
  - o BART - Subsection 10.7.1
  - o 90% or Greater Reduction in SO2 from EGUs – (167 stacks) – Subsection 10.7.2
  - o Low Sulfur Fuel Strategy – Subsection 10.3
  - o Continued Evaluation of Other Controls – Subsection 8.6

<u>51.308 (g)(2) states:</u> "*A summary of the emissions reductions achieved throughout the State through implementation of the measures described in paragraph (g)(1) of this section.*"

- Emission reductions for specific facilities targeted in the first implementation period are described in Subsection 10.7.1.1 - BART Sulfur Dioxide and Oxides of Nitrogen, Tables 10-6 and 10-7.
- Emissions reductions for other sources are described in Section 7.

<u>51.308 (g)(3) states</u>: "*For each mandatory Class I Federal area within the State, the State must assess the following visibility conditions and changes, with values for most impaired, least impaired and/or clearest days as applicable expressed in terms of 5-year averages of these annual values.*"

- Delaware has no mandatory Class I area; a summary of visibility changes in the region is provided in Section 5 for reference.

<u>51.308 (g)(4) states:</u> "*An analysis tracking the change over the period since the period addressed in the most recent plan required under paragraph (f) of this section in emissions of pollutants contributing to visibility impairment from all sources and activities within the State.*"

- Emissions trends data addressing this requirement are presented in Section 7 – Emissions Trends.
- Emission reductions for specific facilities targeted in the first implementation period are described in Subsection 10.7.1.1 - BART Sulfur Dioxide and Oxides of Nitrogen, Tables 10-6 and 10-7.

<u>51.308 (g)(5)</u>: "*An assessment of any significant changes in anthropogenic emissions within or outside the State that have occurred since the period addressed in the most recent plan required under paragraph (f) of this section including whether or not these changes in anthropogenic emissions were anticipated in that most recent plan and whether they have limited or impeded progress in reducing pollutant emissions and improving visibility.*"

- In general, anthropogenic emissions within Delaware and the MANE-VU states have decreased, as anticipated in the first SIP. This is detailed in Section 7. These changes have not limited or impeded progress in reducing pollutant emissions and improving visibility.

In accordance with the requirements listed in 40 CFR 51.308(g), Delaware will submit a report on reasonable progress to EPA by January 31, 2025; July 31, 2033; and every 10 years thereafter. The reports will evaluate the progress made towards the RPGs for Brigantine. All requirements listed in 51.308(g) shall be addressed in the progress report.

In addition, 40 CFR 51.308(f) requires Delaware to revise its visibility implementation plan and submit a plan revision to EPA by July 31, 2028; and every ten years thereafter. In accordance with the requirements listed in 40 CFR 51.308(f), Delaware will revise and submit this SIP to the EPA by in accordance with the above schedule.

A summary of submittal dates through July 31, 2043 is shown below in Table 11-1.

Table 11-1: Summary of Submittal Dates

Report	**Due date**
Progress Report	January 31, 2025
10-Year SIP	July 31, 2028
5-Year Progress Report	July 31, 2033
10-Year SIP	July 31, 2038
5-Year Progress Report	July 31, 2043

Delaware commits to update the emissions inventory periodically, in accordance with Section 40 CFR 51.308 (f)(6)(v).

Section 12 - Determination of the Adequacy of the Existing Plan

As required by 40 CFR 51.308(h), depending on the findings of the progress report, required under 40 CFR 51.308 (g), Delaware will consider taking one of the following actions at the same time it submits the progress report:

(1) If the State determines that the existing implementation plan requires no further substantive revision in order to achieve established goals for visibility improvement and emissions reductions, the State will provide to the Administrator a negative declaration that further revision of the existing implementation plan is not needed.

(2) If the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources in another State(s) which participated in a regional planning process, the State will provide notification to the Administrator and to the other State(s) which participated in the regional planning process with the States. The State will also collaborate with the other State(s) through the regional planning process for the purpose of developing additional strategies to address the plan's deficiencies.

(3) If the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources in another country, the State will provide notification, along with available information, to the Administrator.

(4) If the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources within the State, the State will revise its implementation plan to address the plan's deficiencies within one year.

The findings of the progress report will determine which action is appropriate and necessary.

The criteria that Delaware plans to use in evaluating the options above include emissions inventories, monitoring data, future MANE-VU projects and on-going consultation with New Jersey.