Rhode Island Regional Haze State Implementation Plan Revision for the Second Implementation Period (2018-2028)

March 7, 2025

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Acronyms and Abbreviations

µg/m3	Microgram per cubic meter
AERR	Air Emissions Reporting Requirements rule
AMPD	Air Markets Program Data
BART	Best Available Retrofit Technology
BOTW	Beyond on the Way (controls)
BSMP	Basis Smoke Management Practices
BTU	British Thermal Unit
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CFR	Code of Federal Regulations
dv	Deciview
EGU	Electric Generating Unit
EPA	U.S. Environmental Protection Agency
FLM	Federal Land Manager of a Class I area
ICI	Industrial/Commercial/Institutional
IMPROVE	Interagency Monitoring of Protected Visual Environments
LTS	Long Term Strategy
MANE-VU	Mid-Atlantic/Northeast Visibility Union
MARAMA	Mid-Atlantic Regional Air Management Association
Mm-1	Inverse megameters
MMBtu	Million British Thermal Units
MW	Megawatt
MWh	Megawatt Hour
MWC	Municipal Waste Combustor
n/a	Not Applicable
NAAQS	National Ambient Air Quality Standards
NEI	National Emissions Inventory
NESCAUM	Northeast States for Coordinated Air Use Management
NH3	Ammonia
NOx	Oxides of Nitrogen
NO2	Nitrogen dioxide
NO3	Nitrate
NPS	National Park Service
OC	Organic Carbon
OTC	Ozone Transport Commission
OTB/W	On the Books/On the Way (controls)
PM	Total Particulate Matter
PM2.5	Fine Particulate Matter; particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
PM10	Particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers

RACT	Reasonably Available Control Technology
RH	Regional Haze
RIDEM OAR	Rhode Island Department of Environmental Management Office of Air Resources
RPG	Reasonable Progress Goal
RPO	Regional Planning Organization
SIP	State Implementation Plan
SO2	Sulfur Dioxide
tpy	Tons per year
TSC	Technical Support Committee (of MANE-VU)
TSD	Technical Support Document
URP	Uniform Rate of Progress
VOC	Volatile Organic Compound

Executive Summary

Regional haze is defined as visibility impairment that is caused by the emission of air pollutants from numerous anthropogenic sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources. These emissions are transported over large regions and impact national parks, forests, and wilderness areas ("Class I" Federal areas). These designated areas include 156 national parks and wilderness areas located throughout the United States. Section 169A of the Clean Air Act (CAA) provides for the protection of visibility at mandatory Federal Class I areas. In 1999, the U.S. Environmental Protection Agency (EPA) adopted the Regional Haze Rule[1] calling for state, tribal, and federal agencies to work together to improve visibility in all Federal Class I areas.

Under the Regional Haze Rule, states are required to develop a series of State Implementation Plans (SIPs) to address visibility impairment in Class I Federal areas and make reasonable progress toward achieving natural visibility conditions. In 2009 Rhode Island submitted a Regional Haze SIP for the first implementation period (2008- 2018) to EPA, which was approved in 2012[2]. This SIP was developed based on consultations and work-products of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Regional Planning Organization (RPO).

Each state is required to revise and submit a SIP revision to EPA for the second implementation period (2018-2028) by July 31, 2018, and every ten years thereafter. A 2017 Regional Haze Rule revision extended the SIP submittal date to July 31, 2021, but left the end date for the second implementation period at 2028[3].

This Regional Haze SIP revision fulfills the requirements of EPA's Regional Haze Rule at 40 CFR 51.308(f) for the second implementation period. This SIP revision evaluates the current and future projected inventory of sources, assesses the measures necessary to reduce emissions from these sources during the implementation period, addresses consultation with other states, tribes and FLMs in establishing progress goals, and discusses Rhode Islands' long-term strategy to address regional haze for Federal Class I areas affected by emissions from within the state.

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

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[1] 64 Fed. Reg. 35714, July 1, 1999

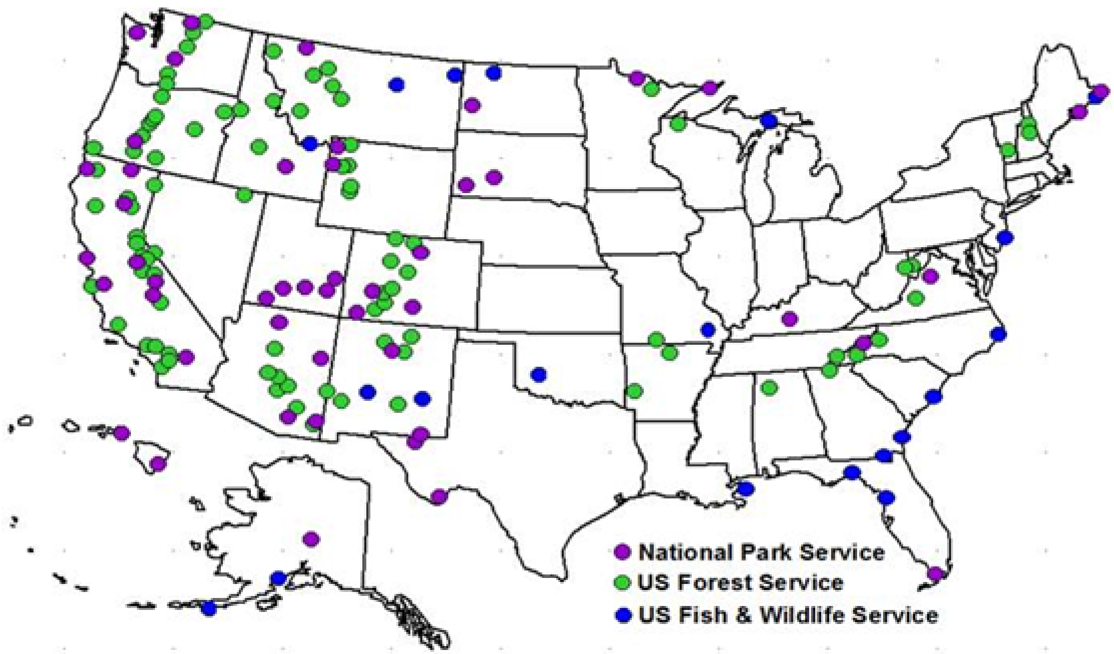
[2] Approval and Promulgation of Air Quality Implementation Plans; Rhode Island; Regional Haze. EPA. 5/22/12 77 FR 30214). https://www.federalregister.gov/d/2012-12289

[3] 82 Fed. Reg. 3078, January 10, 2017

1 THE REGIONAL HAZE ISSUE

In 1999, the Environmental Protection Agency (EPA) issued regulations designed to improve visibility in the 156 national parks and wilderness areas across the United States known as federal "Class I" areas. The affected areas include the Grand Canyon, Yosemite, Yellowstone, Mount Rainier, Shenandoah, the Great Smokies, and the Everglades (Figure 1-1). New England contains six federally designated Class I areas: Acadia National Park (Maine), Great Gulf Wilderness Area (New Hampshire), Lye Brook Wilderness Area (Vermont), Moosehorn Wildlife Refuge (Maine), Presidential Range-Dry River Wilderness Area (New Hampshire), and Roosevelt Campobello International Park (Maine/Canada). **There are no Class I areas in Rhode Island.**

Figure 1-1 Locations of Federally Protected Mandatory Class I Areas



The EPA regulations address visibility impairment in the form of regional haze. Haze is an atmospheric phenomenon that obscures the clarity, color, texture, and form of what we see. It is caused primarily by anthropogenic (manmade) pollutants but can also be caused by a number of natural phenomena, including forest fires, dust storms, and sea spray. Some haze-causing pollutants are emitted directly to the atmosphere by anthropogenic emission sources such as electric power plants, factories, automobiles, construction activities, and agricultural burning. Others occur when gases emitted to the air (haze precursors) interact to form new particles.

Emissions from these activities generally span broad geographic areas and the resulting atmospheric particulate matter can be transported hundreds or thousands of miles. Consequently, every state in the nation contributes to regional haze in one or more Class I areas. Emissions from Rhode Island sources minimally contribute to regional haze in Class I areas in nearby states, however, because of the regional nature of haze, EPA's regulations require states to consult with each other toward the national goal of improving visibility at the 156 parks and wilderness areas designated under the Clean Air Act as mandatory Class I Federal Areas.

The first RH SIP addressing the first 10-year implementation period (2008-2018) was submitted to EPA in 2009 and approved by EPA and incorporated into the RI SIP in 2012[4]. The five-year regional haze progress report was submitted to EPA in 2015 and approved by EPA for incorporation into the RI SIP in 2016.[5] This revision updates the first RH SIP for the second 10-year implementation period (2018-2028) as required by 40 CFR 51.308(f). It is based in part on documentation for the first implementation period that is already contained in the Rhode Island SIP.

1.1 Basics of Haze

Small particles and certain gaseous molecules in the atmosphere scatter and absorb light, reducing the amount of visual information about distant objects that reaches an observer and, thereby, reducing visibility. Some light scattering by air molecules and naturally occurring aerosols occurs even under natural conditions.[6] The distribution of particles in the atmosphere depends on meteorological conditions and leads to various forms of visibility impairment. When high concentrations of pollutants are well mixed in the atmosphere, they form a uniform haze. When temperature inversions trap pollutants near the surface, the result can be a sharply demarcated layer of haze.

Visibility impairment can be quantified using three different, but mathematically related measures: light extinction per unit distance (e.g., Mm^{-1})[7]; visual range (i.e., how far one can see); and deciviews (dv), a useful metric for measuring increments of visibility change that are just perceptible to the human eye. Each can be estimated from the ambient concentrations of individual particle constituents, taking into account their unique light-scattering (or absorbing) properties and making appropriate adjustments for relative humidity. Under natural conditions, visibility in the Northeast and Mid-Atlantic is estimated to be about 23 Mm^{-1}, which corresponds to a visual range of about 106 miles or 8 dv (the lower the dv, the better the visibility). Under current polluted conditions in the region, average visibility ranges from 103 Mm^{-1} in the south to

[4] Approval and Promulgation of Air Quality Implementation Plans; Rhode Island; Regional Haze. EPA. 5/22/12 77 FR 30214). https://www.federalregister.gov/d/2012-12289Ibid., 2

[5] Air Plan Approval; RI; Regional Haze Five Year Progress Report. EPA. 7/20/16. (81 FR 47036). https://www.federalregister.gov/d/2016-16941

[6] The fact that air molecules scatter more short-wavelength (blue) light accounts for the blue color of the sky. The term "aerosol" is defined as a suspension of particles in a gas. In this report, the term refers to particles suspended in the atmosphere.

[7] In units of inverse length. An inverse megameter (Mm^{-1}) is equal to one over one thousand kilometers.

55 Mm^{-1} in the north; these values correspond to a visual range of 24 to 44 miles or 23 to 17 dv, respectively. Updates to the Regional Haze Rule specify that dominant uncontrollable influences, such as volcanic activity and certain types of fires, can be removed from determination of worst visibility days for satisfaction of progress requirements. As a result, the rule now focuses on a metric referred to as the 20% most impaired visibility days.

The small particles that commonly cause hazy conditions in the East are primarily composed of sulfate, nitrate, organic carbon, elemental carbon (soot), and crustal material (e.g., soil dust, sea salt, etc.). Of these constituents, only elemental carbon impairs visibility by absorbing visible light; the others scatter light. Sulfate, nitrate, and organic carbon[8] are secondary pollutants that form in the atmosphere from precursor pollutants, primarily sulfur dioxide (SO_2), oxides of nitrogen (NO_X), and volatile organic compounds (VOCs), respectively. By contrast, soot and crustal material and some organic carbon particles are released directly to the atmosphere. Particle constituents also differ in their relative effectiveness at reducing visibility. Sulfates and nitrates, for example, contribute disproportionately to haze because of their chemical affinity for water. This property allows them to grow rapidly, in the presence of moisture, to the optimal particle size for scattering light, 0.1 to 1 micrometer.

1.2 Regulatory Framework

In amendments to the CAA in 1977, Congress added Section 169A (42 U.S.C. 7491), setting forth the following national visibility goal:

> *"Congress hereby declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Federal Class I areas which impairment results from manmade air pollution."*

The "Class I" designation was initially given to 158 areas, in existence as of August 1977 that met these criteria:

- All national parks greater than 6,000 acres.
- All national wilderness areas and national memorial parks greater than 5,000 acres.
- One international park.

In 1999, the EPA announced a major effort to improve air quality in these areas. The Regional Haze Rule calls for state and federal agencies to work together to improve visibility in 156[9] designated national parks and wilderness areas (Figure 1-1). The rule requires the states, in coordination with

[8] The term "organic carbon" encompasses a large number of hydrogen and carbon containing molecules. Light scattering secondary organic aerosols result from the oxidation of hydrocarbons that are emitted from many different sources, ranging from automobiles to solvents, to natural vegetation. Organic carbon can be emitted as a primary particle from sources such as wood burning, meat cooking, automobiles, and paved road dust.

[9] In 1980, Bradwell Bay, Florida, and Rainbow Lake, Wisconsin, were excluded for purposes of visibility protection as Federal Class I areas.

the EPA and the Federal Land Managers (FLM) represented by the National Park Service, the U.S. Forest Service and the U.S. Fish and Wildlife Service, and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment.

1.2.1 The Regional Haze Rule

Title 40: *Protection of Environment*, Part 51 – Requirements for Preparation, Adoption, and Submittal of Implementation Plans, Subpart P – Protection of Visibility (40 C.F.R. 51.300-309) contains the federal requirements states must meet to achieve national visibility goals. Known more simply as the Regional Haze Rule, these regulations were adopted on July 1, 1999, and went into effect on August 30, 1999. The rule seeks to address the combined visibility effects of various pollution sources over a large geographic region. This wide-reaching pollution net means that many states, even those without Federal Class I areas, are required to participate in haze reduction efforts.

Regional haze regulations recognize that visibility impairment is fundamentally a regional phenomenon. Emissions from numerous sources over a broad geographic area commonly create hazy conditions across large portions of the eastern U.S. because of the long-range transport of airborne particles and precursor pollutants in the atmosphere. The key sulfate precursor, SO2, for example, has an atmospheric lifetime of several days and is known to be subject to transport distances of hundreds of miles. NOX and some organic carbon species are also subject to long-range transport, as are small particles of soot and crustal material.

States are required to submit periodic plans demonstrating how they have and will continue to make progress toward achieving their visibility improvement goals. The first state plans were due in December 2007 and covered the 2008-2018 planning period. The 2017 revision to the Regional Haze Rule addresses requirements for the second planning period, 2018-2028. The updated rule makes the following changes:

- Adjusts the SIP submittal deadline for the second planning period from July 31, 2018, to July 31, 2021.
- Adjusts interim progress report submission deadlines so that second and subsequent progress reports will be due by January 31, 2025, July 31, 2033, and every 10 years thereafter.
- Removes the requirement for interim progress reports to take the form of SIP revisions. States will be required to consult with FLMs and obtain public comment on their progress reports before submission to the EPA. These progress reports will be reviewed by the EPA, but the EPA will not formally approve or disapprove them.
- Clarifies EPA's long-standing interpretations of the 1999 Regional Haze Rule, including:
    - Requirements that RPGs be set based on the long-term strategy.

- Obligations of states with mandatory Federal Class I areas and other states contributing to impairment at those areas.
- Obligations on states setting RPGs that provide for a slower rate of progress than that needed to attain natural conditions by 2064.

Additionally, the 2017 revision added the word “anthropogenic” to the definition of most impaired, that is: “Most impaired days means the twenty percent of monitored days in a calendar year with the highest amounts of **anthropogenic** visibility impairment (40 CFR §51.301). EPA’s 2018 Technical Guidance[10] states that the 20% most impaired days each year at each Class I area based on daily anthropogenic impairment. Previously, states and the EPA tracked visibility progress on the 20% worst visibility days, regardless of origin.

1.2.2 Regional Haze Rule Requirements

Table 1-1 identifies each section of the SIP that addresses the Regional Haze Rule requirements specified in 40 CFR §51.308(f) and (g) for this second planning period as well as the steps outlined in EPA’s Guidance on Regional Haze SIPs for the Second Implementation Period issued in August 2019 (EPA’s 2019 Guidance)[11].

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[10] EPA, (December 2018). *Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program*. *EPA-454/R-18-010*. Available at: https://www.epa.gov/sites/production/files/2018-12/documents/technical_guidance_tracking_visibility_progress.pdf. Appendix J.

[11] EPA, (August 2019). *Guidance on Regional Haze State Implementation Plans for the Second Implementation Period*. EPA-457/B-19-003. Available at: https://www.epa.gov/sites/default/files/2019-08/documents/8-20-2019_-_regional_haze_guidance_final_guidance.pdf

Table 1-1 Regional Haze SIP Revision Elements and Location in this SIP Revision

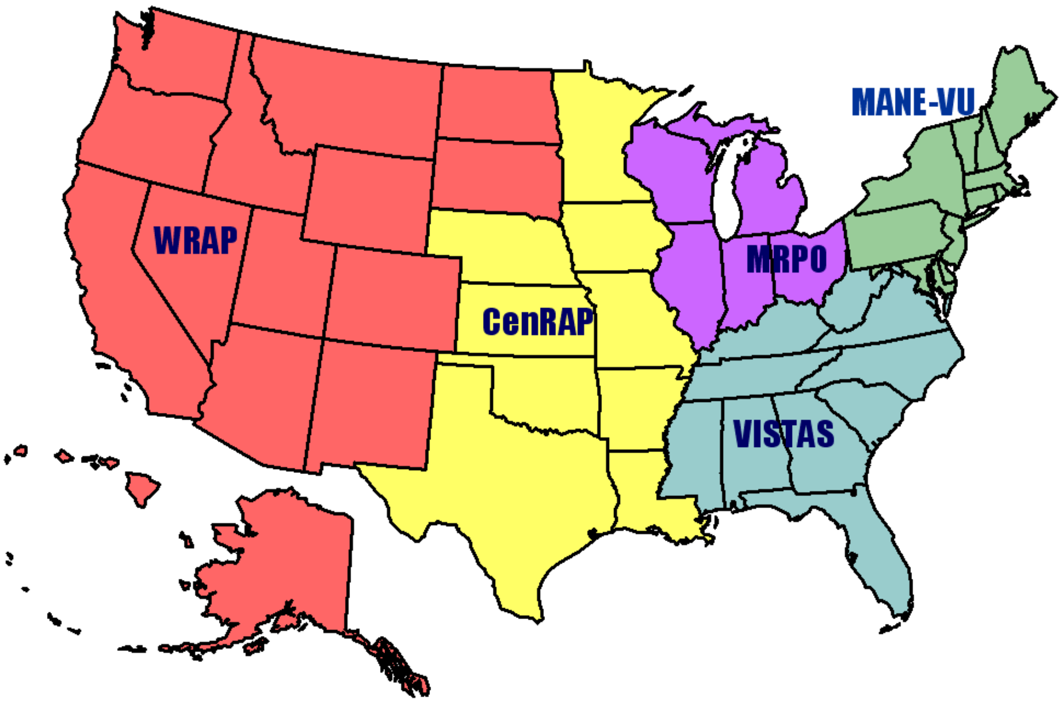
Regional Haze SIP Revision Elements - 40 CFR 51.308 ***Regional haze program requirements***		
Paragraph	**Required Element**	**Location in SIP**
(f)	*Requirements for comprehensive periodic revisions of implementation plans for regional haze*	*Section 1.2.2 Required Elements and Required Commitments* (below)
(f)(1)	*Calculations of baseline, current, and natural visibility conditions.*	Not required for non-Class 1 but provided for reference in *Section 2. Visibility Trends*
(f)(2)	*Long-term strategy for regional haze.*	*Section 6. Long-Term Strategy for RI*
(f)(3)	*Reasonable progress goals.*	Not required for non-Class 1 states but provided for reference in *Section 2. Visibility Trends*
(f)(4)	*…additional monitoring to assess reasonably attributable visibility impairment…*	Not required for non-Class 1 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). . .*	See below under (g)
(f)(6)	*Monitoring strategy and other implementation plan requirements.*	*Section 2.1 Visibility Monitoring and Section 4. Emissions Trends*
(g)	*Requirements for periodic reports describing progress towards the reasonable progress goals.*	
(g)(1)	*Status of implementation of SIP measures.*	*Section 3. Progress Report*
(g)(2)	*Summary of emissions reductions achieved through implementation of the measures* for achieving reasonable progress goals.	*Section 3. Progress Report*
(g)(3)	*For each mandatory Class I Federal area within the State, the State must assess the following visibility conditions and changes.*	Not required for non-Class 1 areas but provided for reference in *Section 2. Visibility Trends*
(g)(4)	*Trends in emissions of visibility impairing pollutants.*	*Section 4. Emissions Trends*
(g)(5)	*Significant changes in anthropogenic emissions.*	*Section 4. Emissions Trends*
(i)	*State and Federal Land Manager coordination*	*Section 7. Consultation*

1.3 Regional Planning Efforts

In 1999, EPA and affected states/tribes agreed to create five RPOs to facilitate interstate coordination on Regional Haze SIPs. These organizations provide a forum for state air control administrators to develop regional strategies to address regional haze and to coordinate with other regions. As shown in Figure 1.2, the five RPOs are MANE-VU (Mid-Atlantic/Northeast Visibility Union), VISTAS (Visibility Improvement State and Tribal Association of the Southeast), MRPO (Midwest Regional Planning Organization), CenRAP (Central Regional Air Planning

Association), and WRAP (Western Regional Air Partnership). Rhode Island is a member of the MANE-VU.

Figure 1-2 EPA-Designated Regional Planning Organizations (RPOs).



MANE-VU is comprised of Mid-Atlantic and Northeast states, tribes, and federal agencies (see Table 1-2 below). RIDEM OAR developed its regional haze SIP by participating in a regional planning process coordinated by MANE-VU. Together the MANE-VU members establish baseline and natural visibility conditions, determine the primary contributors to regional haze, identify long-term strategies and reasonable progress goals, and consult with other states, regional planning organizations, and the federal land managers for Class I areas.

For the first implementation period, MANE-VU member states adopted the "*Statement of MANE-VU Concerning a Request for a Course of Action by States Within MANE-VU Toward Assuring Reasonable Progress.*" This statement, known as the MANE-VU "Ask," outlined a strategy for reducing regional haze at MANE-VU Class I areas for the first 10-year implementation period (2008-2018) and formed the basis for the measures RIDEM OAR included in its initial haze SIP. For the second implementation period (2018-2028), Rhode Island and other member states approved the MANE-VU *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)* (Appendix 15). This new Statement forms the basis for the long-term strategy RIDEM OAR has included in this SIP revision.

Table 1-2: MANE-VU Members

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

*Non-voting member

2 Visibility Monitoring and Trends

EPA's Regional Haze Rule [40 CFR 51.308(f)(1)] requires each state containing a Class I area to determine baseline and natural visibility conditions for their Class I area in consultation with FLMs and states identified as containing sources whose emissions contribute to visibility impairment in the Class I area. MANE-VU developed a regional visibility report to fulfill this requirement, which contains details on visibility calculations and trends.[12] Rhode Island does not contain any Class I areas; however, RIDEM OAR is including in this section of its SIP revision a summary of visibility conditions from the MANE-VU report for reference.

40 CFR 51.308(f)(6)(iii) requires states with no Class I areas to include procedures by which monitoring data and other information are used in determining the contribution of emissions from within the state to visibility impairment at Class I areas in other states. Visibility data analysis procedures are described in the MANE-VU visibility data report[13]; other procedures and data used for determining Rhode Island's contribution to visibility impairment are described in Section 5 and the MANE-VU documents referenced there.

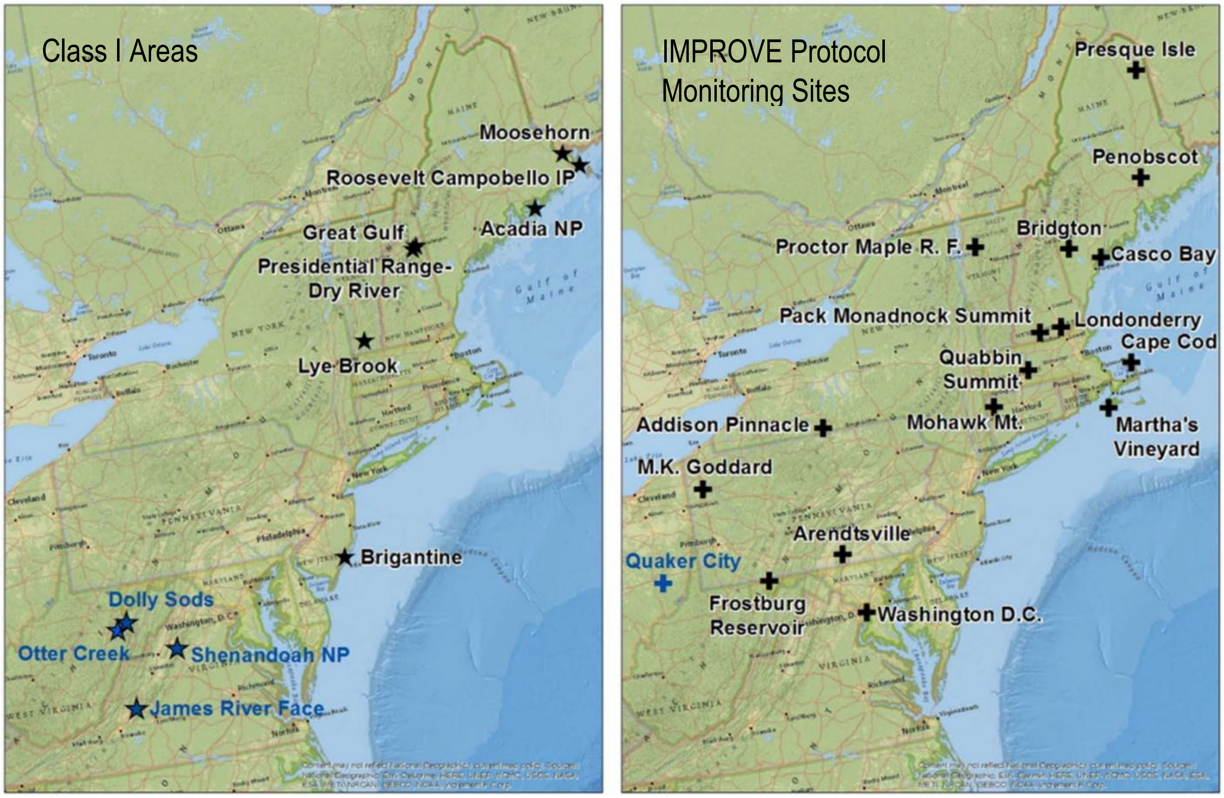
2.1 Visibility Monitoring

The Interagency Monitoring of Protected Visual Environments (IMPROVE) program was established in 1985 to provide the data needed to assess current visibility, track changes in visibility, and help determine the causes of visibility impairment in Class I areas. IMPROVE is a collaborative of state, tribal, and federal agencies, and international partners. IMPROVE monitors in and near the MANE-VU region are shown in Figure 2-1.

[12] *Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2019 (2nd RH SIP Metrics)*. MANE-VU (prepared by Maine Department of Environmental Protection). January 21, 2021 revision. (Appendix 22) Available at https://otcair.org/manevu/Document.asp?fview=Reports

[13] Ibid.

Figure 2-1: Class I Areas and IMPROVE Monitoring Sites In and Adjacent to the MANE-VU Region



Source: Figure 1-1. *Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2019 (2nd RH SIP Metrics)*. MANE-VU January 21, 2021, revision. (Appendix 22)

2.2 Visibility Trends

Visibility impairment is expressed in deciviews (dv), where the higher the value, the greater the visibility impairment (i.e., higher dv values mean worse visibility). Generally, a one deciview change in the haze index is likely to be perceptible to the human eye. The IMPROVE program calculates deciviews from several different measurements collected by its monitors. MANE-VU used IMPROVE data to assess visibility conditions for Class I areas impacted by MANE-VU states. Table 2-1 shows data from the MANE-VU visibility report for Class I areas in and near MANE-VU (i.e., potentially affected by emissions from MANE-VU states). Figures 2-2 to 2-6 (also taken from the MANE-VU report) illustrate visibility trends for MANE-VU Class I areas potentially impacted by emissions from Rhode Island. The summary below is based on the findings of the MANE-VU report.

The goal for the RHR is natural background visibility- the conditions that would exist without anthropogenic pollution. MANE-VU calculated natural background for each Class I area for the both the 20% clearest days and the 20% of days with the most impaired visibility (see Table 2-1). The RHR requires states to compare natural background visibility to a baseline visibility for the 5-year period from 2000-2004 for both the 20% clearest days and 20% most impaired days. The straight-line between the baseline (in 2000) and natural conditions (in 2064) for the 20% most impaired days defines the uniform rate of progress (URP) line or "glide path" for each Class I area (shown in Figures 2-2 to 2-6).

The actual visibility for each year after the baseline period was calculated as rolling 5-year averages for both the 20% most impaired days and the 20% clearest days for each year (also shown in Figures 2-2 to 2-6). The values for the current 5-year period (2015-2019) are in Table 2-1 and in the figures.

The RHR requires states with Class I areas to determine reasonable progress goals (RPGs) for each area to be achieved by the end of the current implementation period (i.e., 2028 for the second implementation period). The RPGs are designed to: (1) at a minimum ensure no degradation in visibility from the baseline period for the 20% clearest days and (2) achieve reasonable progress toward natural conditions for the 20% most impaired days. MANE-VU Class I states determined the 2028 RPGs based on inventory projections and modeling based on expected reductions from state long-term strategies, including responses to the MANE-VU Ask. The 2028 RPGs are shown in Table 2-1 and Figures 2-2 to 2-6 with a straight-line from the baseline period so they may be compared to current progress and the URP. The RPGs from the first implementation period are also shown in Table 2-1 for comparison.

MANE-VU drew the following conclusions from the visibility data.

- The regional efforts to reduce emissions of visibility-impairing pollutants have had a beneficial effect at the region's Class I areas. Haze levels on the 20% clearest and 20% most impaired days from 2000 through 2019 have dropped across the entire region.

- States continue to be on track for keeping visibility levels significantly below the uniform rate of progress (i.e., straight-line visibility from 2000 to 2064). Current visibility at all MANE-VU and nearby Class I areas is better than the 2028 URP visibility condition for the 20% most impaired visibility days (i.e., current visibility is better than the URP glide path from 2000-2064).

- Current visibility data from all MANE-VU and nearby Class I areas show no degradation from the 2000-2004 baseline values for the 20% clearest days.

- All modeled RPGs for 2028 are well below the URP lines in 2028.

- Although current visibility impairment (2015-2019) at all areas is lower than the 2018 RPGs from the first implementation period, it remains higher than the 2028 RPGs at nearly all area as shown in Table 2-1.

- Further progress is needed to achieve modeled 2028 RPGs at all MANE-VU and nearby Class I areas. Class I areas in the MANE-VU region need 0.23 to 1.34 dv improvements to reach their modeled 2028 RPGs; Class I areas in Virginia and West Virginia need 2.86 to 3.53 dv improvements.

Table 2-1: Baseline, Current, and Reasonable Progress Goal Haze Index Levels for Class I Areas In or Adjacent to the MANE-VU Region

Class I Area	State	CLEAREST DAYS					MOST IMPAIRED DAYS						
		Baseline (2000-04) (dv)	RPG (2018)[1]	Current (2015-18) (dv)	MV[2] (2028) (dv)	Natural Conditions	Baseline (2000-04) (dv)	RPG (2018)[1]	Current (2015-19) (dv)	URP 2019 (dv)	URP 2028 (dv)	MV[2] (2028) (dv)	Natural Conditions
Acadia National Park	ME	8.78	8.3	6.36	6.33	4.66	22.01	19.4	14.24	19.11	17.36	13.35	10.39
Moosehorn Wilderness Area	ME	9.16	8.6	6.48	6.45	5.02	20.65	19.0	12.99	18.85	16.38	13.12	9.98
Roosevelt Campobello International Park	NB												
Great Gulf Wilderness Area	NH	7.65	7.2	4.70	5.06	3.73	21.88	19.1	12.33	18.85	17.07	12.00	9.78
Presidential Range/Dry River Wilderness Area													
Lye Brook Wilderness Area	VT	6.37	5.5	4.88	3.86	2.79	23.57	20.9	14.06	20.24	18.24	13.68	10.24
Brigantine Wilderness Area	NJ	14.33	14.3	10.81	10.47	5.52	27.43	25.1	18.53	23.24	20.73	17.97	10.68
Dolly Sods Wilderness Area†	WV	12.28		6.18	7.27	3.64	28.29		17.03	23.45	20.54	15.09	8.92
Otter Creek Wilderness Area†													
James River Face Area†	VA	14.21		8.99	9.36	4.39	28.08		17.28	23.43	20.64	15.31	9.47
Shenandoah National Park†	VA	10.96		6.54	6.83	3.15	28.32		16.38	23.62	20.80	14.25	9.52

NOTE: Natural haze values are not calculated for areas without 2000-04 baseline monitoring data or nearby representative IMPROVE site values. Visibility for the Presidential Range/Dry River Wilderness Area, Roosevelt Campobello International Park and Otter Creek Wilderness are represented by the IMPROVE monitors for Great Gulf, Moosehorn and Dolly Sods, respectively.
† Class I area adjacent to the MANE-VU region
URP = Uniform Rate of Progress
[1] RPG From the first implementation period. Tracking Visibility Progress: 2004-2011; NESCAUM, April 30, 2013 (Revised May 24, 2013) (Available at: https://www.nescaum.org/documents/manevu-trends-2004-2011-report-final-20130430.pdf)
[2] Modeled Visibility in 2028 with projected controls. MANE-VU. 2018a. Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2011 Based Modeling Platform Support Document – October 18, 2018 Update (see Modeled Reasonable Progress Goal). (Appendix 21) Available at https://otcair.org/manevu/materials/reports
Sources: Tables 2-2, 2-4, 2-5. Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2019 (2nd RH SIP Metrics). January 21, 2021 revision (Appendix 22)

Figure 2-2: Visibility Metrics Levels at Acadia National Park

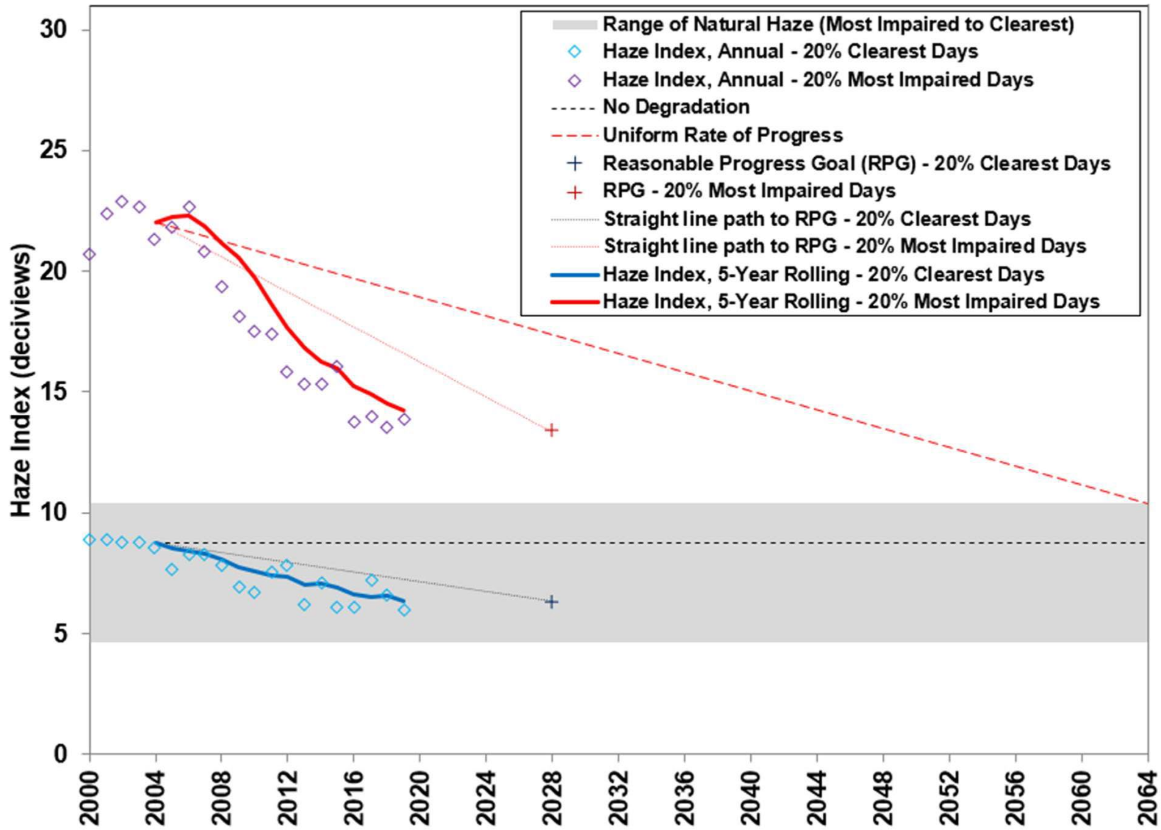


Figure 2-3: Visibility Metrics Levels at Moosehorn Wilderness Area

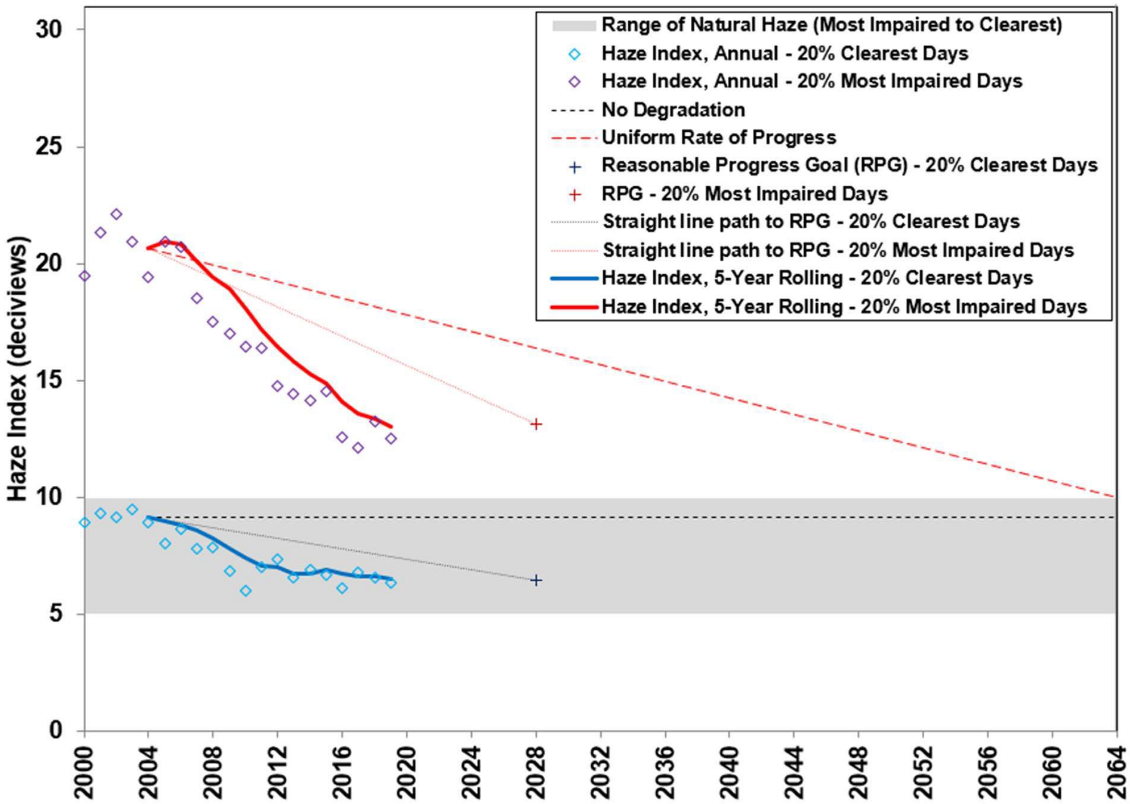


Figure 2-4: Visibility Metrics Levels at Great Gulf Wilderness Area

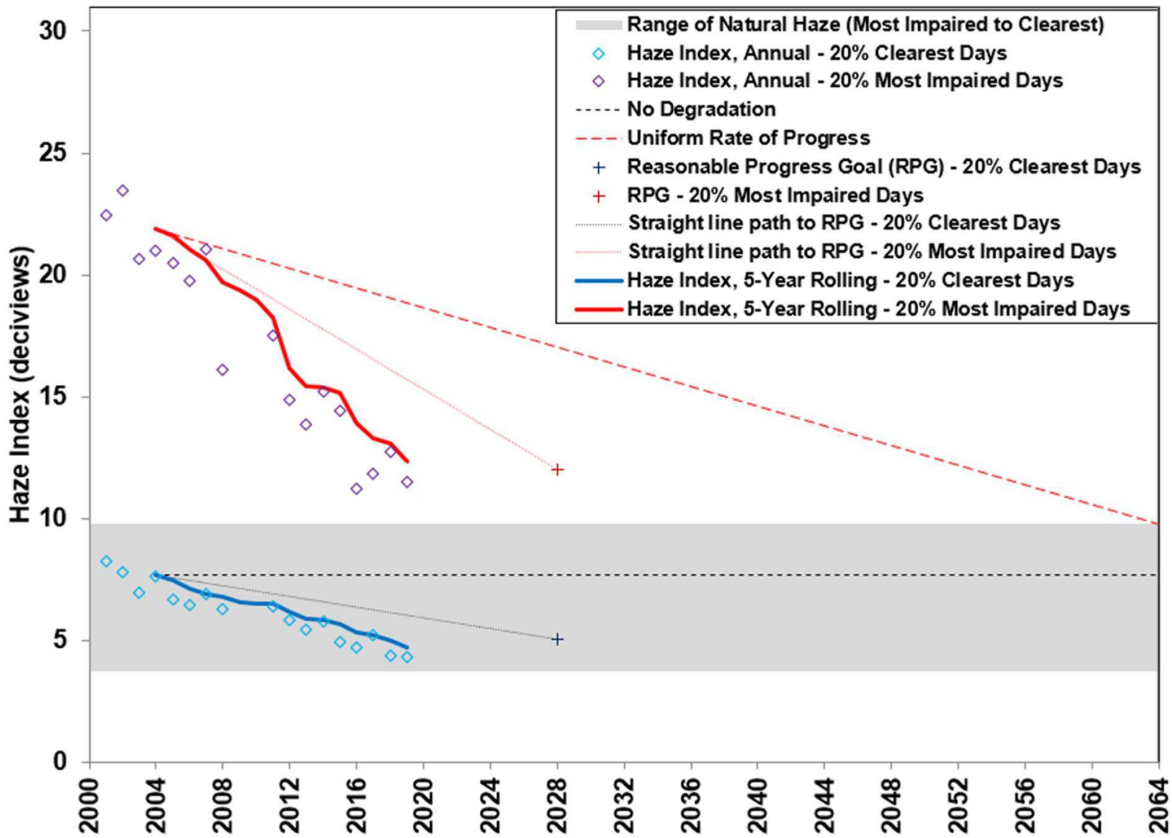


Figure 2-5: Visibility Metrics Levels at Lye Brook Wilderness Area

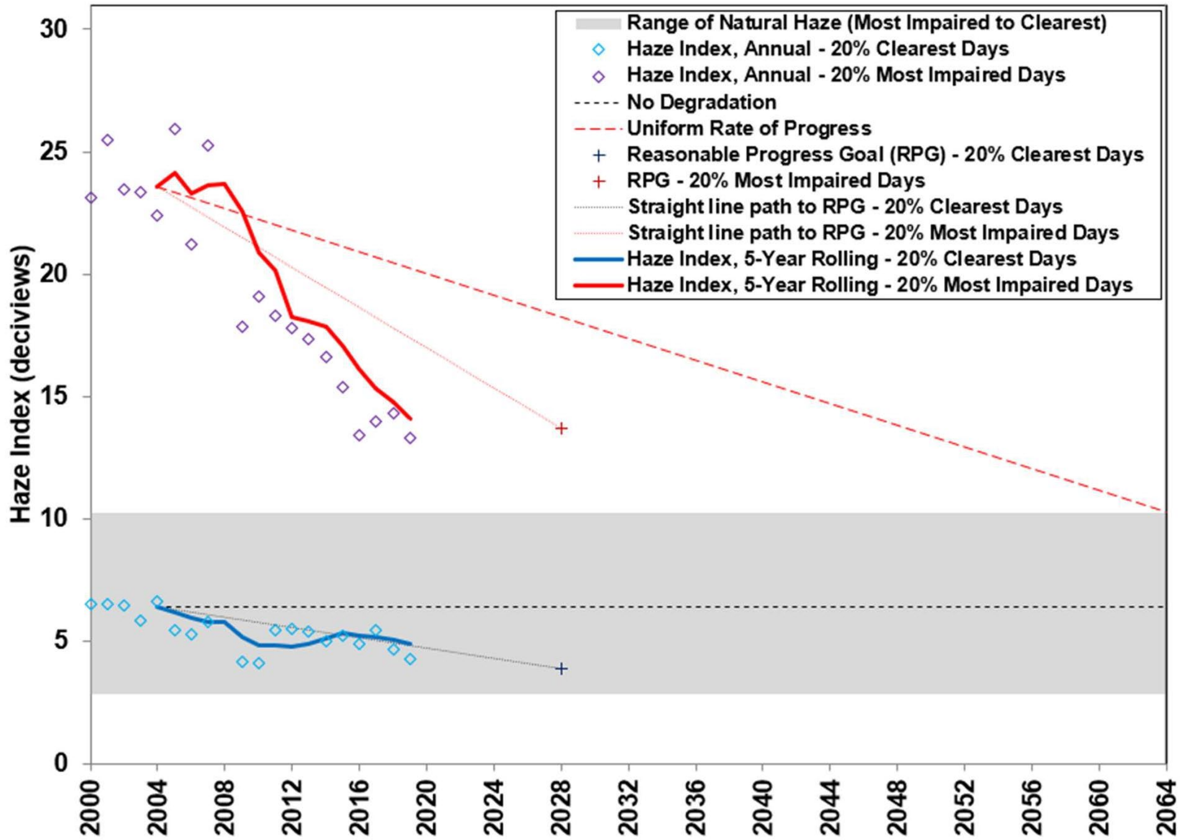
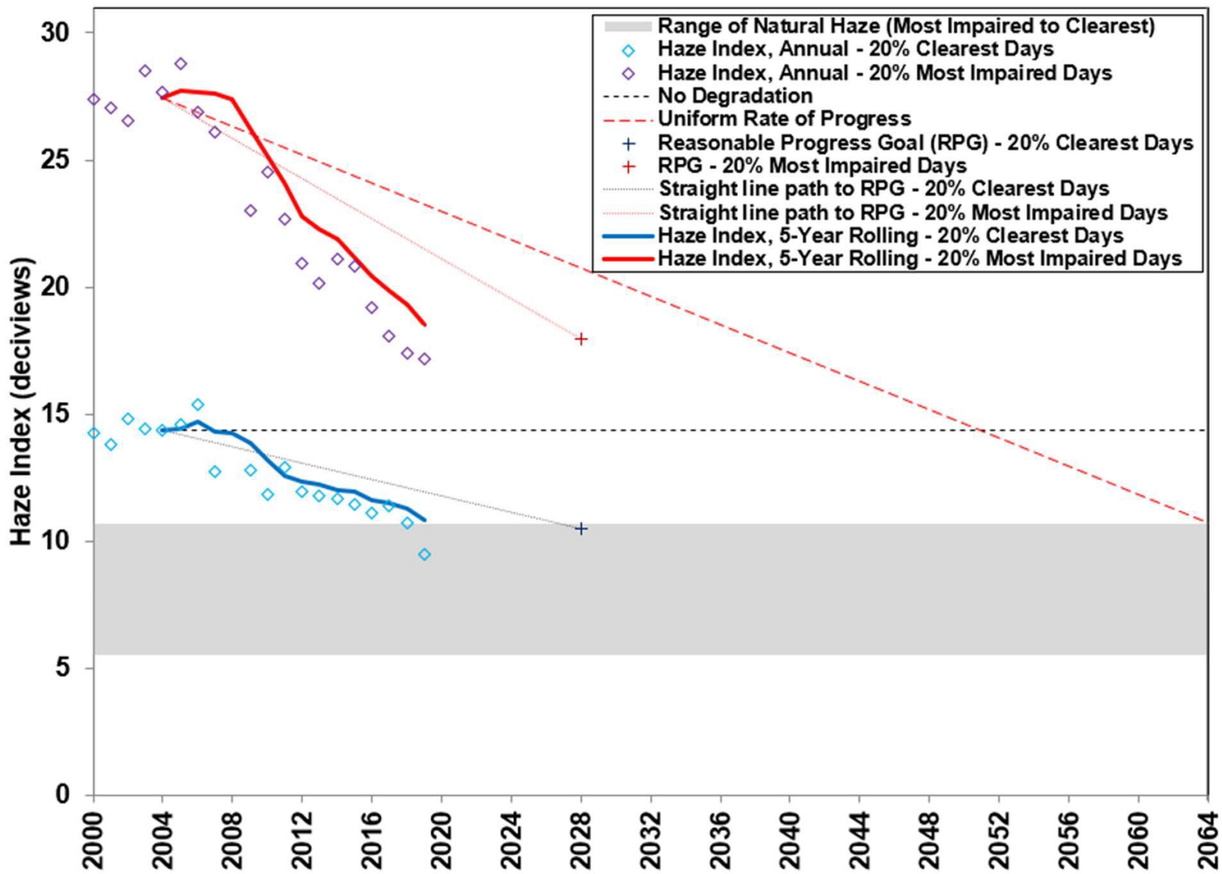


Figure 2-6: Visibility Metrics Levels at Brigantine Wilderness Area



Source for Figures 2-2-2-6: *Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2019 (2nd RH SIP Metrics)*. MANE-VU (prepared by Maine Department of Environmental Protection). January 21, 2021 revision. (Appendix 22)

3 Progress Report

3.1 Progress Report Requirements

40 CFR 51.308(f)(5) requires states to provide a progress report in its SIP revision for the second implementation period. 40 CFR 51.308(g) *Requirements for periodic reports describing progress towards the reasonable progress goals* are summarized below:

- (g)(1) A description of the status of the implementation of all measures included in the SIP for the first implementation period. This is addressed in this section.
- (g)(2) A summary of the emissions reductions achieved through implementation of the measures included in the SIP for the first implementation period. This is addressed in section 4.
- (g)(3) States with Class I areas must assess visibility changes. Rhode Island has no mandatory Class I area; a summary of visibility changes in the region is provided in Section 2 for reference.
- (g)(4) Tracking of the changes in emissions of pollutants contributing to visibility impairment from all sources and activities within Rhode Island by type of source or activity. Emissions trends data addressing

this requirement are presented in Section 4. Facility specific data from the EPA Air Markets Program Data (AMPD) system for 2019 (the most recent year available as required by (g)(4) are presented in section 4.

- (g)(5) An assessment of: (1) any significant changes in anthropogenic emissions within or outside Rhode Island; (2) whether or not these changes were anticipated in the SIP for the first implementation period; and (3) whether the changes have limited or impeded progress in reducing pollutant emissions and improving visibility. This is addressed in Section 4.

3.2 Rhode Island Regional Haze SIP for the First Implementation Period

Rhode Island's long-term strategy for the first implementation period (2008 – 2018) included:

- **A low sulfur fuel oil strategy.** For the first implementation period, MANE-VU determined that states could cost-effectively achieve significant reductions in SO2 emissions by requiring lower sulfur content in #2 distillate oil (home heating oil) and #4 and #6 residual oils (used in power plants and industrial and commercial boilers).
- **Outdoor Wood Boiler Regulations.** The adoption of controls on outdoor wood boilers.
- **Continued evaluation** of other possible control measures that would reduce haze-causing emissions in consultation with other MANE-VU states.

3.3 Status of Low Sulfur Oil Strategy

Effective June 24, 2014, RIDEM OAR finalized amendments to 250-RICR-120-05-8: Sulfur Content of Fuels to lower the sulfur content of fuel oil as shown below. This rule was fully implemented by July 1, 2018. Rhode Island continues to enforce the requirements of this regulation.

Rhode Island's Low Sulfur Fuel Limits and Schedule

- Distillate oil, biodiesel and alternative oil - 0.05% sulfur by weight (500 ppm) by July 1, 2014, and 0.0015% (15 ppm) by July 1, 2018, and
- Residual oil - 0.5 % sulfur by weight by July 1, 2018.

3.4 Status of Controls on Outdoor Wood Boilers

Rhode Island included in its first implementation period regulations to control emissions on outdoor wood boilers, 250-RICR-120-05-48, "Outdoor Wood Boilers." The regulation stipulates that, after July 1, 2011, all outdoor wood boilers imported, supplied, distributed, sold, or installed in the State must be certified or qualified by the EPA to meet a particulate matter emission standard of 0.32 pounds per million British Thermal Units output, which is the EPA's Phase II standard. RIDEM OAR continues to implement this regulation[14].

[14] 250-RICR-120-05-48 has not been incorporated into the RI SIP and is not federally enforceable.

4 Emissions Inventory and Trends

Rhode Island is required by 40 CFR Section 51.308(d)(3)(iv) to identify all anthropogenic sources of visibility impairment considered by the state in developing its long-term strategy. This process begins with the identification of key pollutants and source categories that contribute to visibility impairment at the Class I area(s) affected by emissions from the state.

Rhode Island is required by 40 CFR Section 51.308 (g)(4) to analyze trends in emissions of visibility impairing pollutants. In addition, Section 51.308(d)(4)(v) of EPA's Regional Haze Rule requires a statewide emissions inventory of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Class I area. This section explores the characteristics, origin, and quantity of visibility-impairing pollutants emitted in Rhode Island and the Eastern/Mid-Atlantic United States.

4.1 Analysis of Change in Emissions of Pollutants Contributing to Visibility Impairment

In this summary, Rhode Island has provided estimates for nitrogen oxides (NO_x), particulate matter less than 10 microns (PM10), particulate matter less than 2.5 microns (PM2.5), sulfur dioxide (SO_2), volatile organic compounds (VOC), and ammonia (NH_3), all of which have the potential to contribute to regional haze formation. Rhode Island summarized emissions of visibility impairing pollutants from all sources and activities within the state for the period from 2002 to 2017. The most recent year[15] for which Rhode Island has submitted emission estimates to fulfill the requirements of 40 CFR 51 Subpart A (also known as the Air Emissions Reporting Requirements (NEI).[16] NEI data categories include point sources, nonpoint sources, nonroad mobile sources, and onroad 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 NO_x and SO_2 are further broken down into EPA Air Markets Program Data (AMPD) sources and non-AMPD sources. The Rhode Island sources that report to EPA's AMPD are the five Electric Generating Units (EGUs) located in RI, Manchester Street, Ocean State Power I and II, Tiverton Power, RI State Energy Center, and Pawtucket Power (permanently shut down).

- 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 activity data such as population, employment, and fuel use. There is a wide range of area source categories, but examples include residential fuel combustion, consumer product use, paints and any stationary source emissions not included in the point source sector. As of 2008, the EPA includes emissions

[15] At the time of preparing this document the most recent complete air pollution inventory data available was 2017 National Emissions Inventory Data. 2020 data will be used for the Regional Haze 2nd Planning Period Progress Report due in 2025.

[16] https://www.epa.gov/air-emissions-inventories/emissions-inventory-system-eis-gateway

from the mobile source nonroad categories for commercial marine vessels and underway rail emissions in the nonpoint NEI. Prior to 2011, EPA included vehicle refueling at gasoline service stations in the area sector and beginning with 2011 it was included in the onroad sector.

- NEI Nonroad mobile sources represent vehicles and equipment that are not designed to operate on roadways. Examples include aircraft, ships, railroad locomotives, construction equipment, recreational boats and vehicles, and lawn & garden equipment. As discussed above, beginning in 2008 the NEI emissions from airports and railroad switch yards are inventoried as point sources and emissions from other railroad activities and commercial marine vessels are inventoried as nonpoint sources.

- NEI Onroad mobile sources represent vehicles that operate on roadways, including cars, trucks, buses, and motorcycles. Emissions were calculated with a new EPA model (MOVES) in 2007, 2011 and 2017, which was different than the model used for the 2002 inventory (MOBILE6). As of 2011 NEI v2, EPA includes vehicle refueling at gasoline service stations in the onroad sector instead of the area or nonpoint sector.

The data used to create the tables in Section 4.1 through 4.7 were taken from EPA's NEI. Under the Air AERR, states are required to submit estimates or model inputs for all emissions categories to EPA on a three-year cycle or accept EPA's estimates. 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, based on the EPA NEI grouping, is provided in the section for each pollutant. Inconsistencies due to changes in estimation procedures and grouping 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." For example, point source NO_x and SO_2 emissions from EGUs are reported to EPA's web-based application, AMPD. Rhode Island has provided a summary of NO_x and SO_2 emissions for AMPD sources for the years 2016 through 2019.

In addition to the Rhode Island-specific data, 2002 – 2017 summaries of emissions from all sectors, as well as summaries of NO_x and SO_2 emissions for AMPD sources are provided for all the Mid-Atlantic and Northeast Visibility Union (MANE-VU) states, including Connecticut (CT), Delaware (DE), the District of Columbia (DC), Maine (ME), Maryland (MD), Massachusetts (MA), New Hampshire (NH), New Jersey (NJ), New York (NY), Pennsylvania (PA), and Vermont (VT). Similar summaries are also shown for the states listed in the MANE-VU Inter-RPO Ask[17] 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

[17] Statement of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Concerning a Course of Action with MANE-VU toward Assuring Reasonable Progress for the Second Regional Haze Implementation Period (2018-2028).

(KY), Louisiana (LA), Michigan (MI), Missouri (MO), North Carolina (NC), Ohio (OH), Tennessee (TN), Texas (TX), Virginia (VA), and West Virginia (WV). This group of states is referred to hereinafter as the "Non-MANE-VU Ask states".

4.2 Nitrogen Oxides (NOx)

Table 4-1 shows a summary of NOx emissions from all NEI data categories – point, nonpoint, nonroad, and onroad for the period from 2002 to 2017 in Rhode Island. This summary is also shown graphically in Figure 4-1. Table 4-2 shows additional data years for Rhode Island's point sources that report to EPA's AMPD.

Table 4-1: NOx Emissions in Rhode Island 2002-2017 by Data Category (tons per year)

Category	2002	2008	2011	2014	2017	Reduction 2002 - 2017	Percent Reduction 2002 - 2017
AMPD Point	640	462	630	518	470	-170	-27%
Non-AMPD Point	2,699	1,169	1,200	1,148	1,348	-1,351	-50%
Nonpoint	2,525	3,456	6,950	7,568	4,539	2,014	80%
Nonroad	7,333	4,037	3,506	2,901	2,180	-5,153	-70%
Onroad	16,720	9,839	10,202	12,581	6,328	-10,392	-62%
Total	29,917	18,963	22,489	24,716	14,865	-15,052	-50%

Notes:
*Non-AMPD Point includes airports and railroad switch yards after 2002
**Nonpoint includes commercial marine vessels and underway railroad after 2002. Nonpoint includes Stage II refueling in 2002 through 2008 and excludes it after 2008.
***Nonroad includes airports, railroad and commercial marine vessels in 2002 and excludes them after 2002.
**** Onroad 2011 was subsequently revised in the EPA modeling platforms. See Table 4-31. Also, onroad includes Stage II refueling after 2008.

Figure 4-1 NOx Emissions in Rhode Island by Data Category 2002-2017

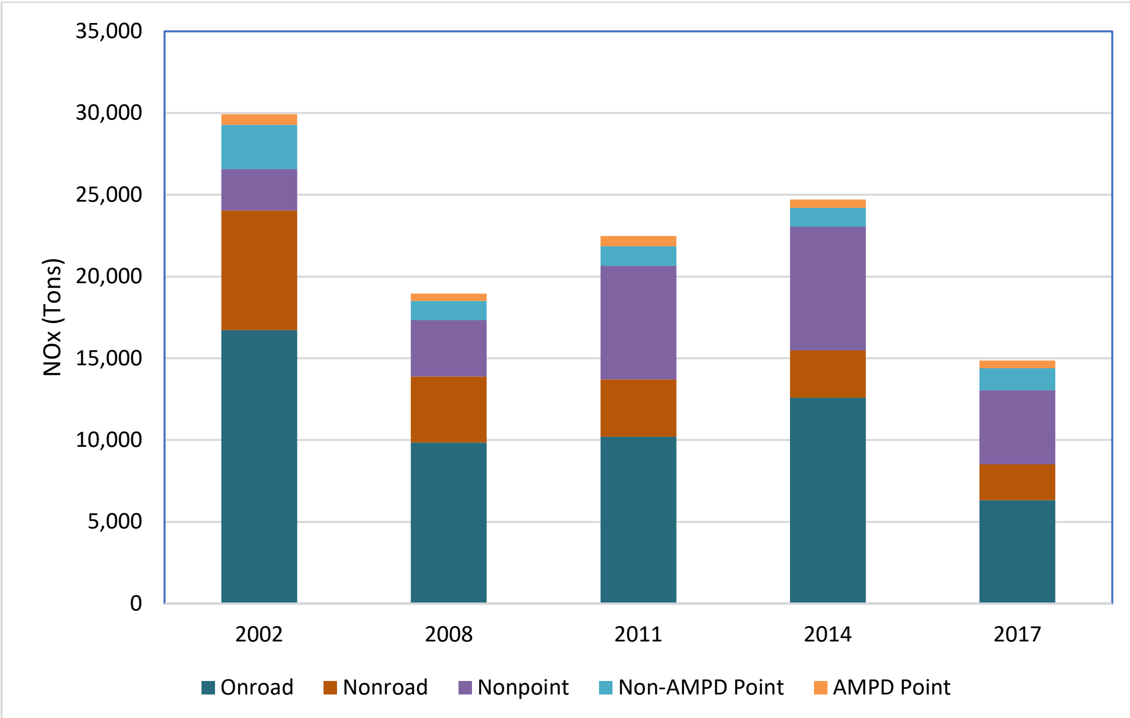


Table 4-2 NO_x Emissions from EPA AMPD Sources in Rhode Island 2016 – 2019 (Tons)

2016	2017	2018	2019
448	470	513	453

Overall NOx emissions in Rhode Island have declined 50% from 2002-2017. The majority of the NOx emissions reductions are from the on-road and nonroad sectors, accounting for 15,545 tons of NOx reductions. Reductions in nonroad emissions are due to new engine standards for nonroad vehicles and equipment as a result of a wide range of Federal rules to reduce emissions from nonroad vehicles and equipment. A few examples of regulatory programs that have reduced, and/or will continue to reduce, emissions from nonroad vehicles and equipment include *Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel*[18], *Control of Emissions from Air Pollution from Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters Per Cylinder*[19], and *Control of Emissions from Nonroad Spark-Ignition Engines and Equipment*[20]. Onroad mobile emission reductions are due in part to Rhode Island's adoption to the of the California Low Emission Vehicle (LEV) and Zero Emission Vehicle (ZEV) standards[21]. The California standards ensure that vehicles sold in the state meet increasingly stringent emissions requirements through time, driving emissions reductions in the onroad sector. Federal requirements for on-road mobile sources and fuels are being strengthened even further with the

[18] https://www.gpo.gov/fdsys/pkg/FR-2004-06-29/pdf/04-11293.pdf
[19] https://www.gpo.gov/fdsys/pkg/FR-2008-06-30/pdf/R8-7999.pdf
[20] https://www.gpo.gov/fdsys/pkg/FR-2008-10-08/pdf/E8-21093.pdf
[21] https://rules.sos.ri.gov/Regulations/Part/250-120-05-37

Tier 3 requirements[22]. More information on programs to control emissions from mobile sources can be found on EPA's Transportation, Air Pollution, and Climate Change website[23]. For both nonroad and onroad mobile sources, NO_x emissions are expected to continue to decrease as fleets turn over and older more polluting vehicles and equipment are replaced by newer, cleaner ones.

Starting in 2008, marine vessels and underway rail emissions were included in NEI nonpoint emissions instead of nonroad emissions. This is the main reason for the increase in nonpoint NO_x emissions in 2008 when compared to the 2002 levels. In future years these nonroad sources are showing decreases due to Federal rules for new engine standards for nonroad vehicles and equipment. Most nonpoint area source NOx emissions, approximately 75 percent, are from residential and commercial natural gas fuel combustion for heating purposes. Additional area source NOx emissions are from distillate fuel combustion, residential wood burning, prescribed burning and forest fires. Increases in emissions from 2011 to 2014 are due to increases in natural gas consumption and EPA methodology changes for fuel combustion emissions from boilers and engines, and for wildfires and prescribed burning.

Tables 4-3 and 4-4 and Figures 4-2 and 4-3 show a decline in NO_x emissions from 2002 to 2017 for all the MANE-VU states and the Non-MANE-VU Ask states. Much of this decline in NO_x emissions is due to the Federal control programs for nonroad and onroad mobile sources described earlier. Other sources of NO_x emissions reductions include individual states' rules for Reasonably Available Control Technology for NO_x (NO_x RACT).

Table 4-3 Total NO_x 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%**

[22] Tier 3 Motor Vehicle Emission and Fuel Standards, Final Rule (https://www.gpo.gov/fdsys/pkg/FR-2014-04-28/pdf/2014-06954.pdf)
[23] https://www.epa.gov/air-pollution-transportation

Figure 4-2 Total NOx Emissions in the MANE-VU States from All Data categories 2002-2017

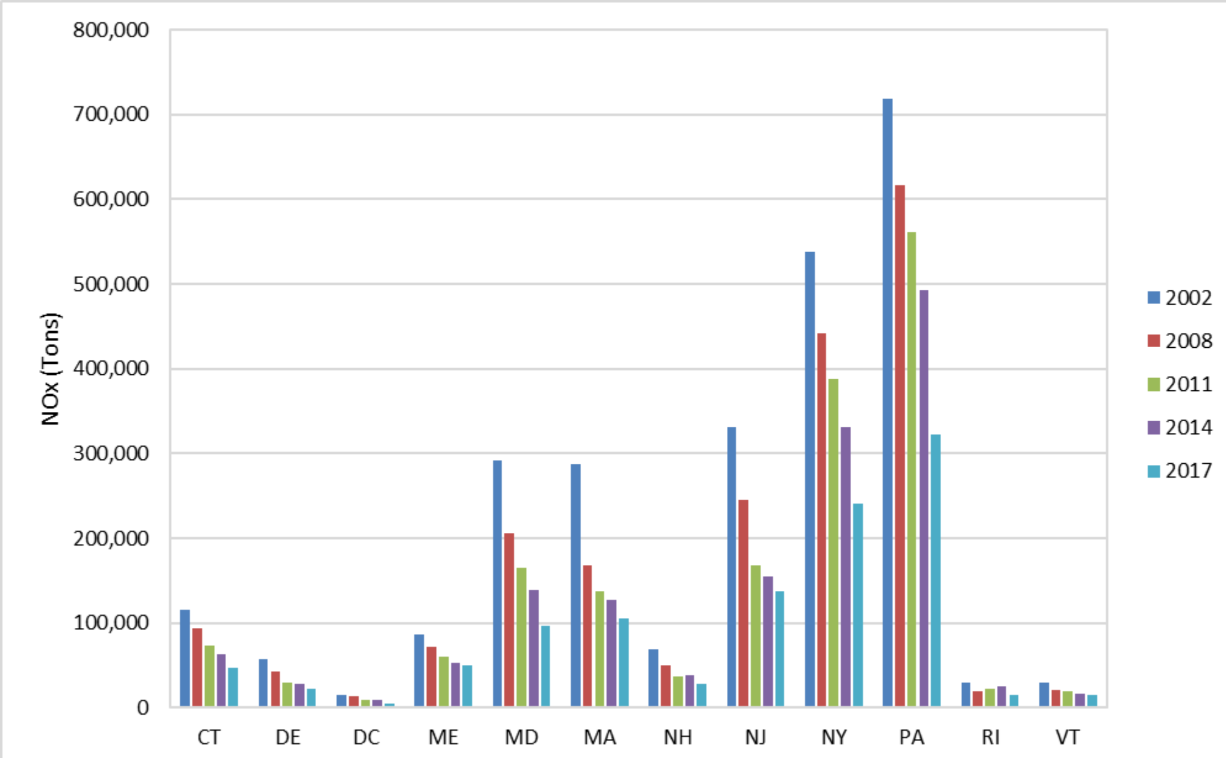


Table 4-4 Total NO_x Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017 (Tons)

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 4-3 Total NOx Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017

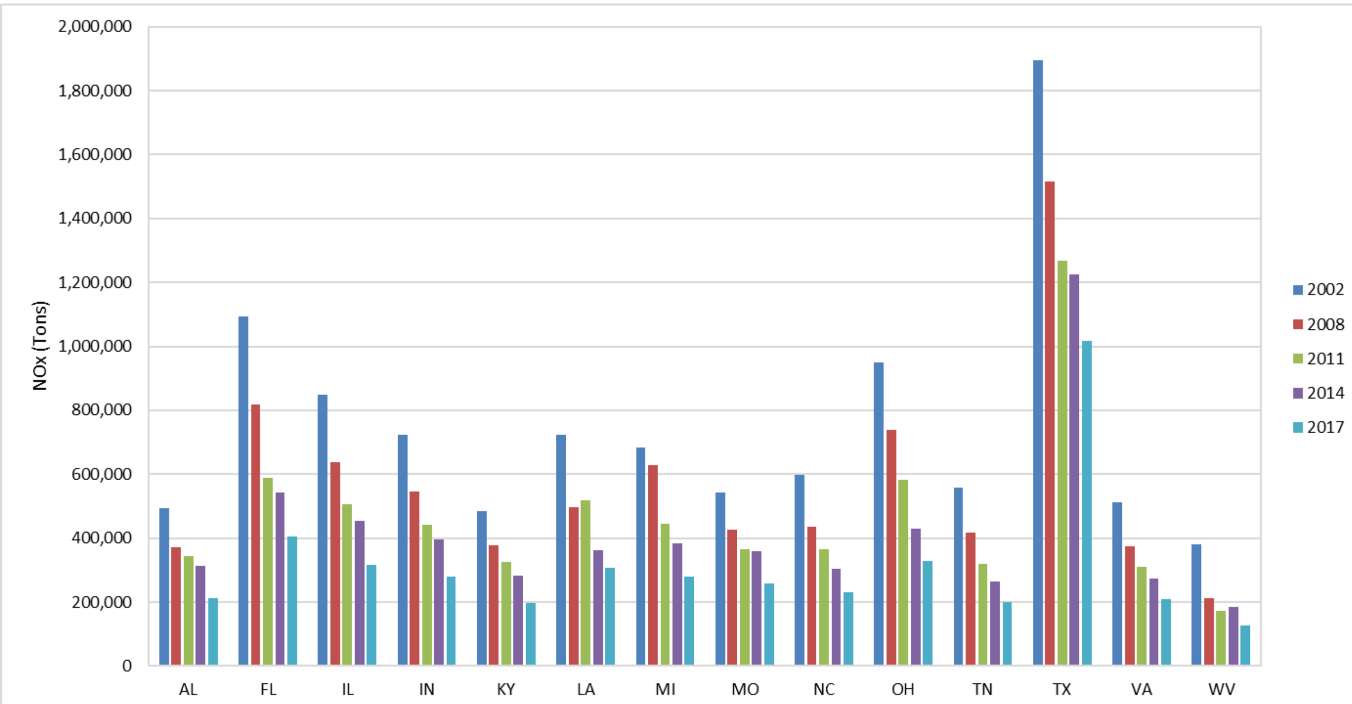


Table 4-5 and Figure 4-4 show AMPD NO_x data trends for the MANE-VU states from 2002 to 2019, and Table 4-6 and Figure 4-5 show AMPD NO_x data trends for the Non-MANE-VU Ask states from 2002 to 2019. Tables 4-5 and 4-6 show significant decreases in NO_x emissions for the AMPD sources between 2002 and 2019 for all states in MANE-VU as well as all the Non-MANE-VU Ask states. For applicable states, some of the reduction in AMPD NO_x since 2002 is attributable to the NO_x Budget Trading Program under the NO_x SIP Call and the Clean Air Interstate Rule. The Clean Air Interstate Rule, or CAIR, was replaced by the Cross-State Air Pollution Rule (CSAPR) in 2015. Other reductions are attributable to source retirements and fuel switching due to the availability of less expensive natural gas in recent years.

Table 4-5 NOx Emissions in MANE-VU States from AMPD Sources 2002-2019 (tons per year)

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 4-4 NOx Emissions in MANE-VU States from AMPD Sources 2002-2019

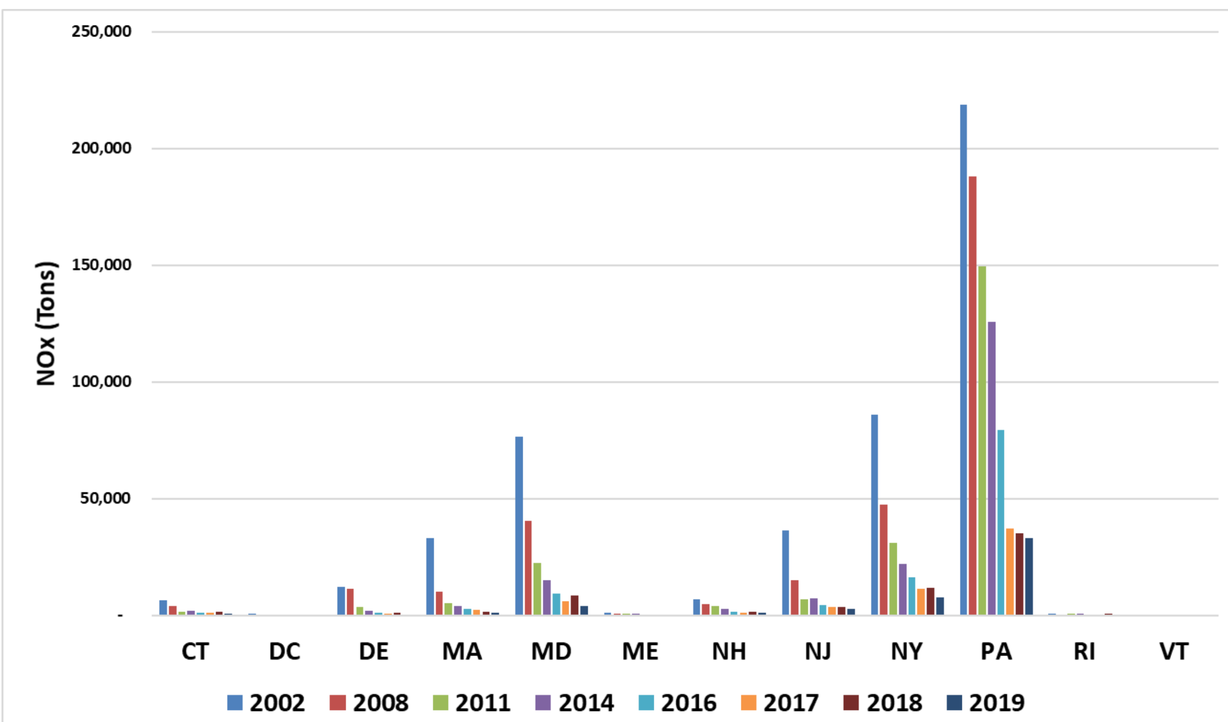
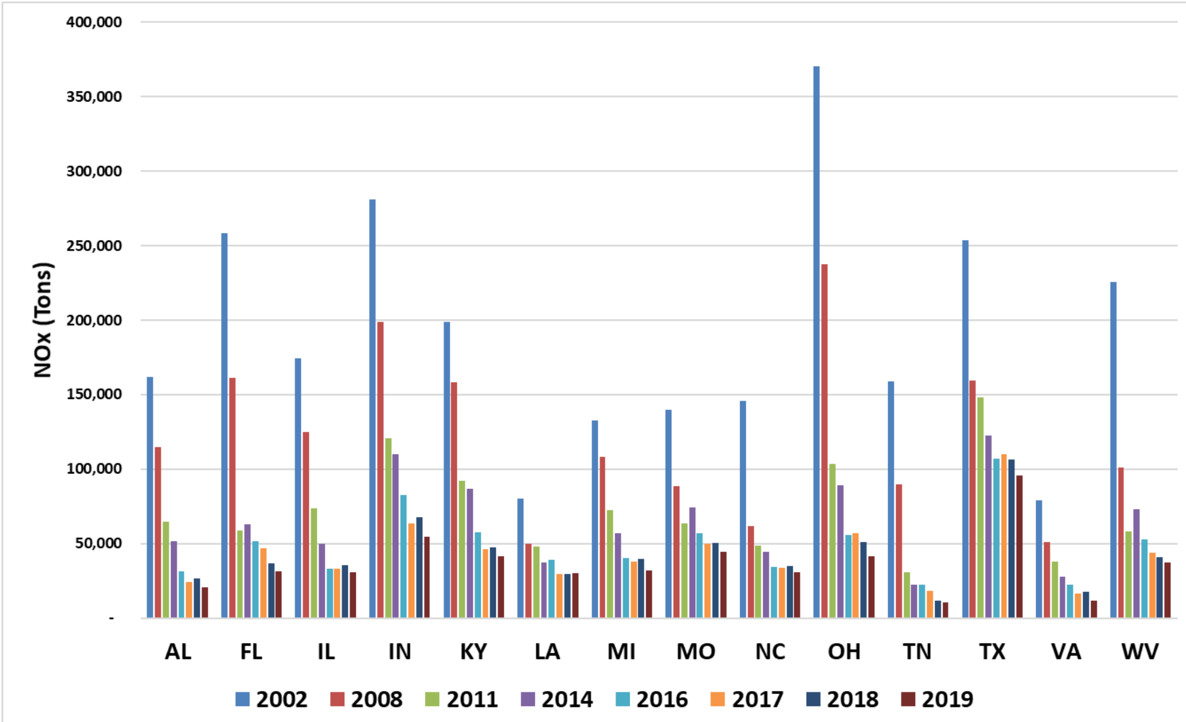


Table 4-6 NOx Emissions from AMPD Sources in the Non-Mane-VU Ask States 2002-2019 (Tons)

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	49084	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 4-5 NOx Emissions in Non-MANE_VU Ask States from AMPD Sources 2002-2019



4.3 Particulate Matter Less Than 10 Microns (PM10)

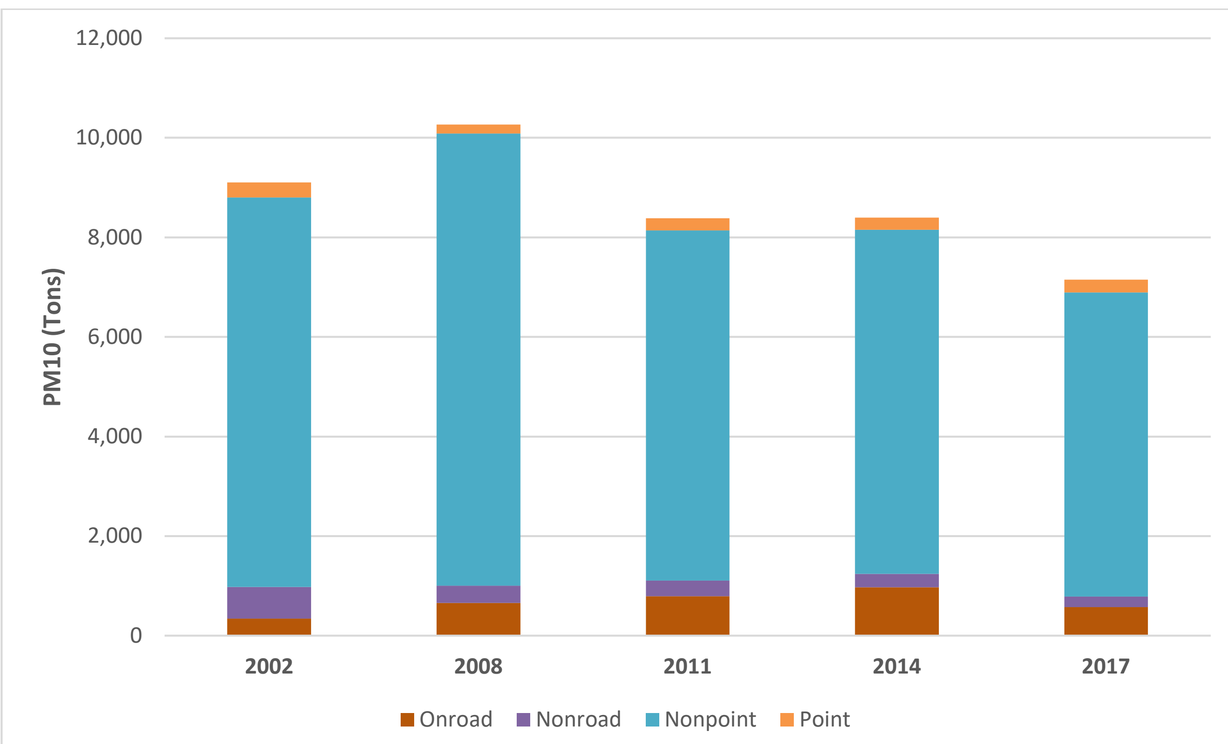
Table 4-7 shows a summary of PM10 emissions from Rhode Island for all data categories, point, nonpoint, nonroad, and onroad from 2002-2017. This summary is also shown graphically in Figure 4-6. Table 4-7 shows that there was an overall reduction in PM10 emissions of 21% from 2002-2017, most of which came from the nonpoint category due to fuel switching from oil to natural gas. RI submitted total particulate matter data in 2002 which was augmented by EPA for PM10. State data for total PM from point sources shows a 35% reduction in emissions from 2002 to 2017 that is not reflected in the PM10 emissions data shown here. Since 2017, Rhode Island has been submitting PM10 emissions data to the NEI. The data in Table 4-7 does not accurately reflect the reduction in PM10 emission in Rhode Island anticipated based on the large number of point sources and sources that would be in the nonpoint category for fuel combustion switching from oil to natural gas. Additionally, variation in emissions in the nonpoint category from 2002 to 2008 is due to changes in calculation methodologies for residential wood burning and fugitive dust categories, which have varied significantly. The variations in the onroad emissions are due to changes in emission inventory calculation methodologies, which resulted in higher particulate matter estimates in the other years than in 2002.

Table 4-7 PM10 Emissions in Rhode Island by Data Category 2002-2017 (tons per year)

NEI Category	2002	2008	2011	2014	2017	PM10 Change (2002 – 2017)	Percent PM10 Change (2002 – 2017)
Point*	303	177	248	245	253	-50	-16%
Nonpoint**	7,820	9,088	7,031	6,911	6,109	-1,711	-22%
Nonroad***	637	345	320	274	213	-423	-67%
Onroad****	343	656	789	970	573	230	67%
Total	9,103	10,267	8,387	8,400	7,148	-1,955	-21%

*Point source PM10 emissions were not submitted to AERR for all sources in 2002. 2002 data is based on augmented PM emissions data reported.
**Nonpoint includes commercial marine vessels and underway railroad after 2002. Nonpoint includes Stage II refueling in 2002 through 2008 and excludes it after 2008.
***Nonroad includes airports, railroad and commercial marine vessels in 2002 and excludes them after 2002.

Figure 4-6 PM10 Emissions in Rhode Island by Data Category 2002-2017



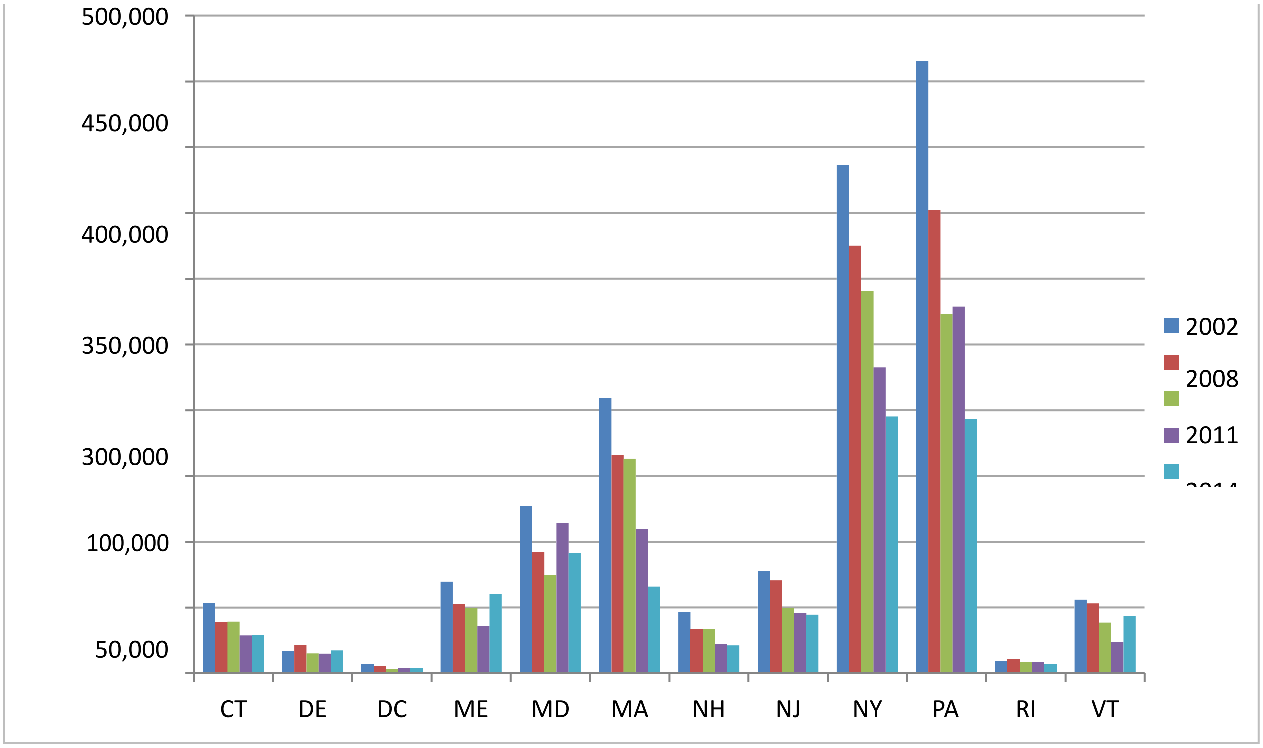
Tables 4-8 and 4-9 and Figures 4-7 and 4-8 show total PM10 emissions from all data categories in the MANE-VU states and Non-MANE-VU Ask states. PM10 emissions in the MANE-VU and Non-MANE-VU

Ask states show reductions of 49% and 32% respectively. PM10 emissions in the MANE-VU and Non-MANE-V Ask states show no particular pattern over the 2002 to 2017 period. Some of the large declines in PM10 emissions from 2002 to subsequent years, as well as some of the increases in 2014, are attributable to changes in estimation methodologies for categories such as yard waste burning, paved and unpaved road dust, and residential wood combustion.

Table 4-8 Total PM10 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 4-7 Total PM10 Emissions in the MANE-VU States from all NEI Data Categories, 2002 – 2017



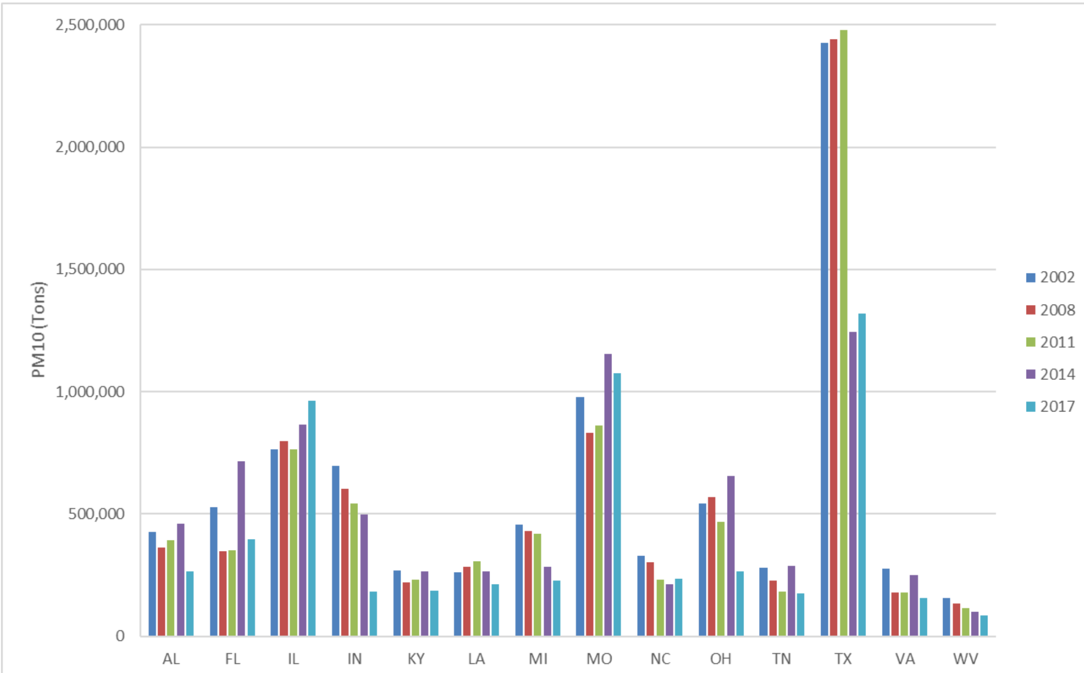
Notes:

1. Nonpoint includes unadjusted fugitive dust.

Table 4-9 Total PM10 Emissions in the Non-MANE-VU Ask States from all NEI 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%**

Figure 4-8 Total PM10 Emissions in the MANE-VU States from all NEI Data Categories, 2002 – 2017



4.4 Particulate Matter Less Than 2.5 Microns (PM2.5)

Table 4-10 shows a summary of PM2.5 emissions from all data categories from 2002-2017 in Rhode Island. This summary is also shown graphically in Figure 4-9. The data show that overall PM2.5 emissions were increased by 41% and, similar to PM10, the majority of this increase is due to RI not submitting PM2.5 data for point and nonpoint sources in 2002. RI submitted total particulate matter data in 2002 which was augmented by EPA for PM2.5. State data for total PM from point sources shows a 35% reduction in emissions from 2002 to 2017 that is not reflected in the PM25 emissions data shown here. Since 2017, Rhode Island has been submitting PM25 emissions data to the AERR. The data in Table 4-10 does not accurately reflect the reduction in PM25 emission in Rhode Island anticipated based on the large number of point sources and sources that would be in the nonpoint category for fuel combustion switching from oil to natural gas. The variations in the onroad emissions are due to changes in emission inventory calculation methodologies, which resulted in higher particulate matter estimates in the other years than in 2002.

Table 4-10 PM2.5 Emissions in Rhode Island by Data Category 2002-2017 (tons per year)

	2002	**2008**	**2011**	**2014**	**2017**	Change 2002-2017	% Change 2002-2017
Point	187	140	149	150	187	0	0%
Nonpoint	1,439	3,233	3,127	3,384	2,811	1,372	95%
Nonroad	599	328	303	260	202	-396	-66%
Onroad	209	462	370	517	241	32	15%
TOTAL	2,433	4,163	3,949	4,310	3,441	1,009	41%

Figure 4-9 PM2.5 Emissions in Rhode Island by Data Category 2002-2017

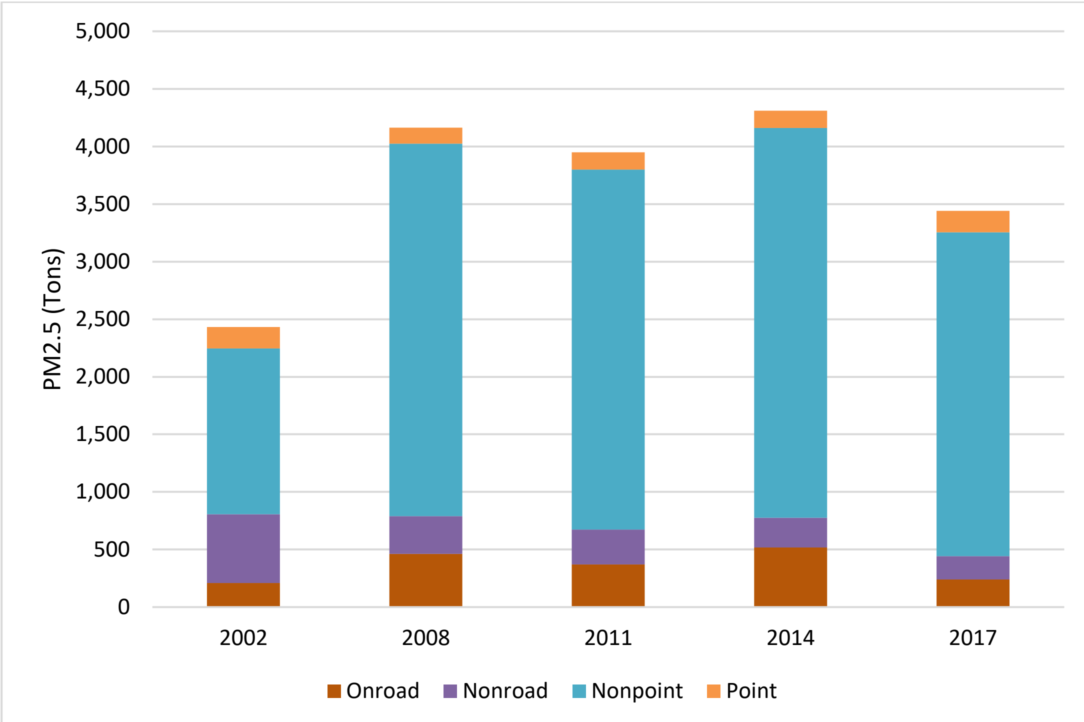


Table 4-11 and Figure 4-10 show PM2.5 emissions from all data categories in the MANE-VU states. Similarly, Table 4-12 and Figure 4-11 show PM2.5 emissions from all data categories in the Non-MANE-VU Ask states. PM2.5 emissions in the MANE-VU and Non-Mane-VU Ask states show no particular pattern over the 2002 to 2017 period. In some states, emissions have declined or remained constant; in others, there are increases. As with PM10, some of the large declines in PM2.5 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 4-11 Total PM2.5 Emissions in the MANE-VU States from all Data Categories, 2002 – 2017 (Tons)

State	2002	2008	2011	2014	2017	PM2.5 Change (2002 – 2017)	Percent PM2.5 Change (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%**

Figure 4-10 PM2.5 Emissions in MANE-VU States from all Data Categories 2002-2017

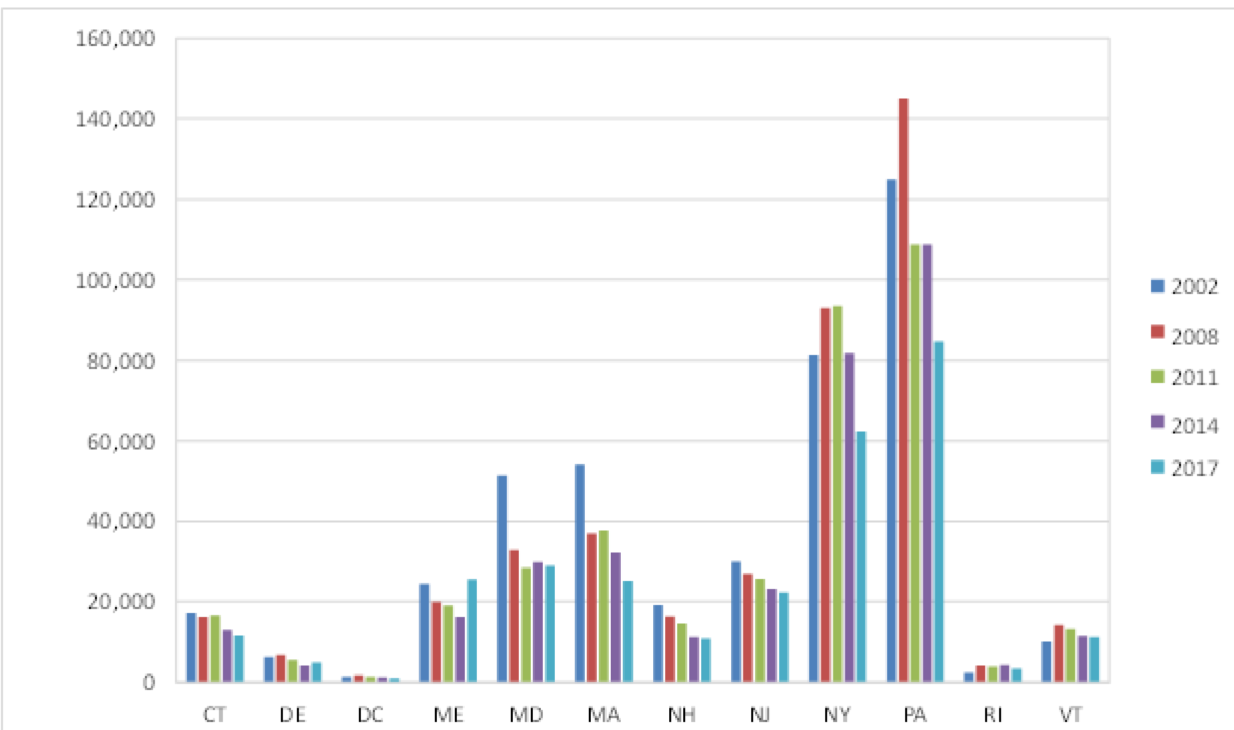
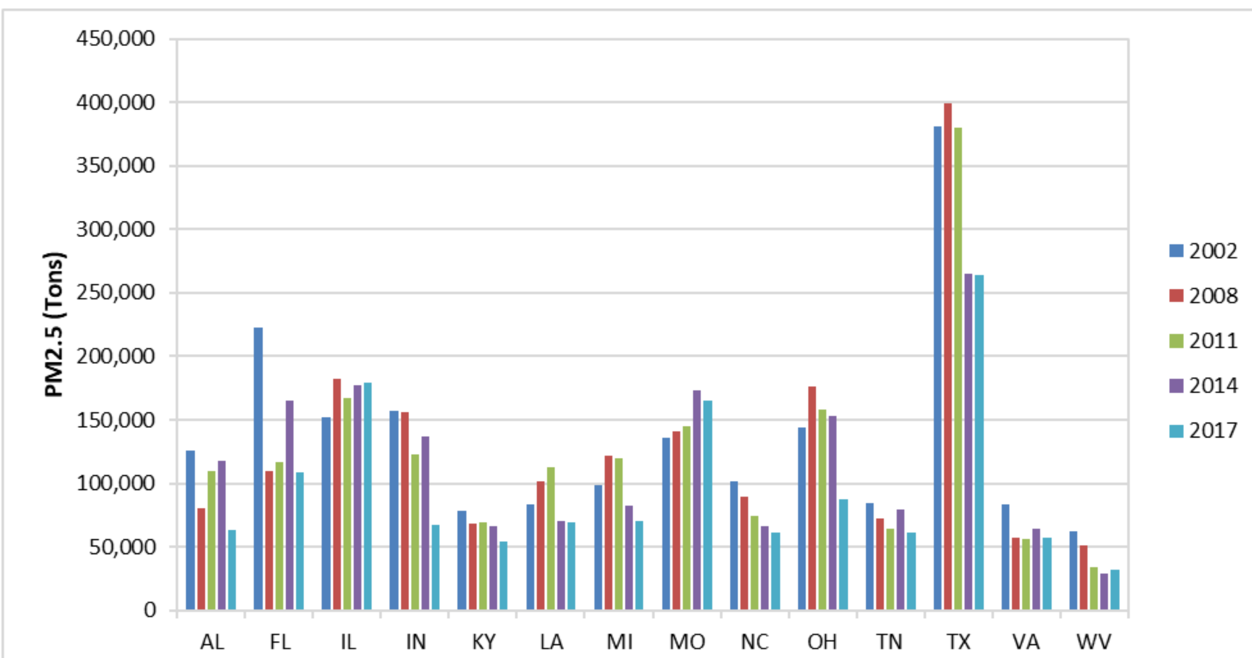


Table 4-12 Total PM2.5 Emissions in the Non-MANE-VU Ask States from all Data Categories, 2002 – 2017 (Tons)

State	2002	2008	2011	2014	2017	PM2.5 Change (2002 – 2017)	Percent PM2.5 Change (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 4-11 Total PM2.5 Emissions in the Non-MANE-VU Ask States from all Data Categories, 2002 – 2017



4.5 Sulfur Dioxide (SO2)

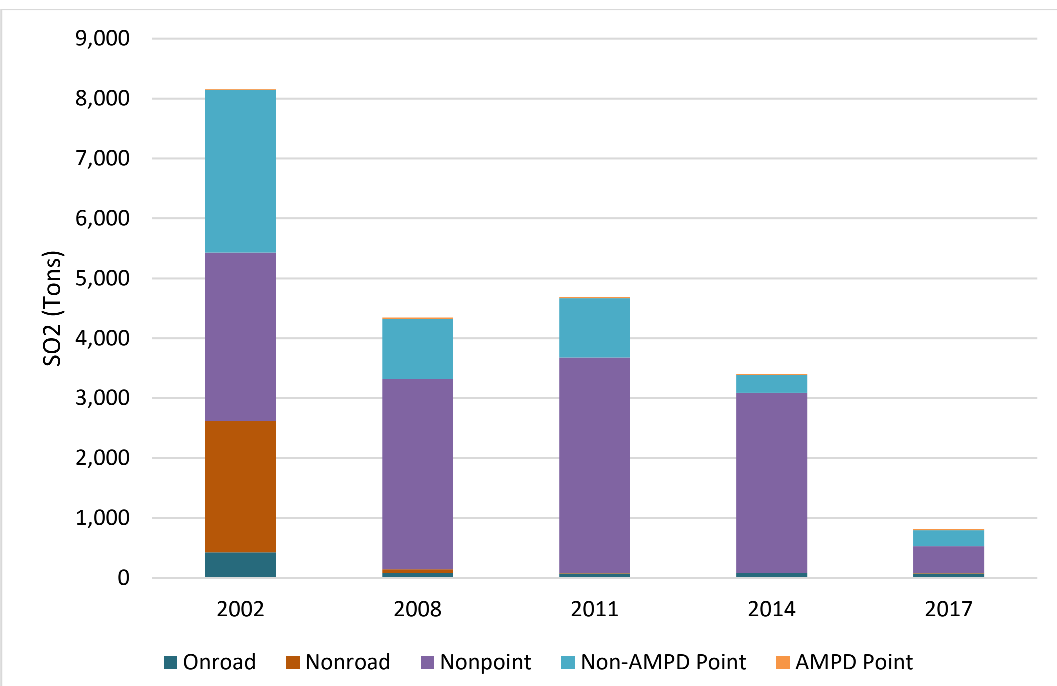
Table 4-13 shows SO2 emissions in Rhode Island from all data categories from 2002-2017. This data is also shown graphically in Figure 4-12.

Table 4-13 SO2 Emissions in Rhode Island by Data Category 2002-2017 (tons per year)

	2002	2008	2011	2014	2017	Change 2002-2017	% Change 2002-2017
AMPD Point	12	18	20	17	18	6	49%
Non-AMPD Point	2,717	1,004	988	296	271	-2,446	-90%
Nonpoint	2,815	3,178	3,593	3,005	448	-2,367	-84%
Nonroad	2,189	62	10	7	5	-2,184	-100%
Onroad	425	84	77	81	75	-351	-82%
TOTAL	8,158	4,345	4,689	3,406	816	-7,342	-90%

Notes:
*Non-AMPD Point includes airports and railroad switch yards after 2002
**Nonpoint includes commercial marine vessels and underway railroad after 2002. Nonpoint includes Stage II refueling in 2002 through 2008 and excludes it after 2008.
***Nonroad includes airports, railroad and commercial marine vessels in 2002 and excludes them after 2002.
**** Onroad 2011 was subsequently revised in the EPA modeling platforms. Also, onroad includes Stage II refueling after 2008.

Figure 4-12 SO2 Emissions in Rhode Island by Data Category 2002-2017



SO2 emissions have shown a significant decline in Rhode Island from 2002 to 2017, with a 90% overall decline since 2002. The reduction in point emissions is primarily due to the revision to 250-

RICR-120-05-8, Sulfur Content of Fuels. The rule used a phased in approach for switching distillate and residual oils to low sulfur oil. Rhode Island began tightening the sulfur standards for fuel in 2014 and continued to tighten those standards through 2018. The implementation of 25-RICR-120-05-8 in 2014 satisfied the MANE-VU goal of reduced fuel sulfur content as part of the long-term strategy for improved visibility.

The emission decreases in the nonroad sector from 2002 to 2008 are partly due to EPA moving the marine vessels and railroad emissions from the nonroad sector to the nonpoint. Decreases in nonpoint sector emissions are mostly due to Federal rules that reduced sulfur levels in nonroad mobile diesel fuel and due to increased use of low sulfur distillate oil for heating.

Table 4-14 and Figure 4-13 show total SO2 emissions from all NEI data categories in the MANE-VU states for 2002 to 2017. A steady decrease in SO2 emissions can be seen for each MANE-VU state over this period. In addition to the federal rules such as the acid rain program and rules to limit sulfur in fuel for mobile sources, some of these decreases are attributable to the MANE-VU low sulfur fuel strategy and the 90% or greater reduction in SO2 emissions at 167 EGU stacks (both inside and outside of MANE-VU) requested by MANE-VU for the first regional haze planning period[24]. Since some components of the MANE-VU low sulfur fuel strategy have milestones of 2014, 2016, and 2018, and as MANE-VU states continue to adopt rules to implement the strategy, SO2 emissions reductions are expected to continue well beyond the 2002 to 2017 timeframe shown. Other potential SO2 emission decreases are due to source shutdowns and fuel switching due to the availability of less expensive natural gas in recent years.

Table 4-14 Total SO2 Emissions in MANE-VU States for All Data Categories 2002-2017

State	2002	2008	2011	2014	2017	SO_2 Change (2002 – 2017)	Percent SO_2 Change (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%

[24] 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)

State	2002	2008	2011	2014	2017	SO_2 Change (2002 – 2017)	Percent SO_2 Change (2002 – 2017)
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%**

Figure 4-13 Total SO2 Emissions in MANE-VU States for All Data categories 2002-2017

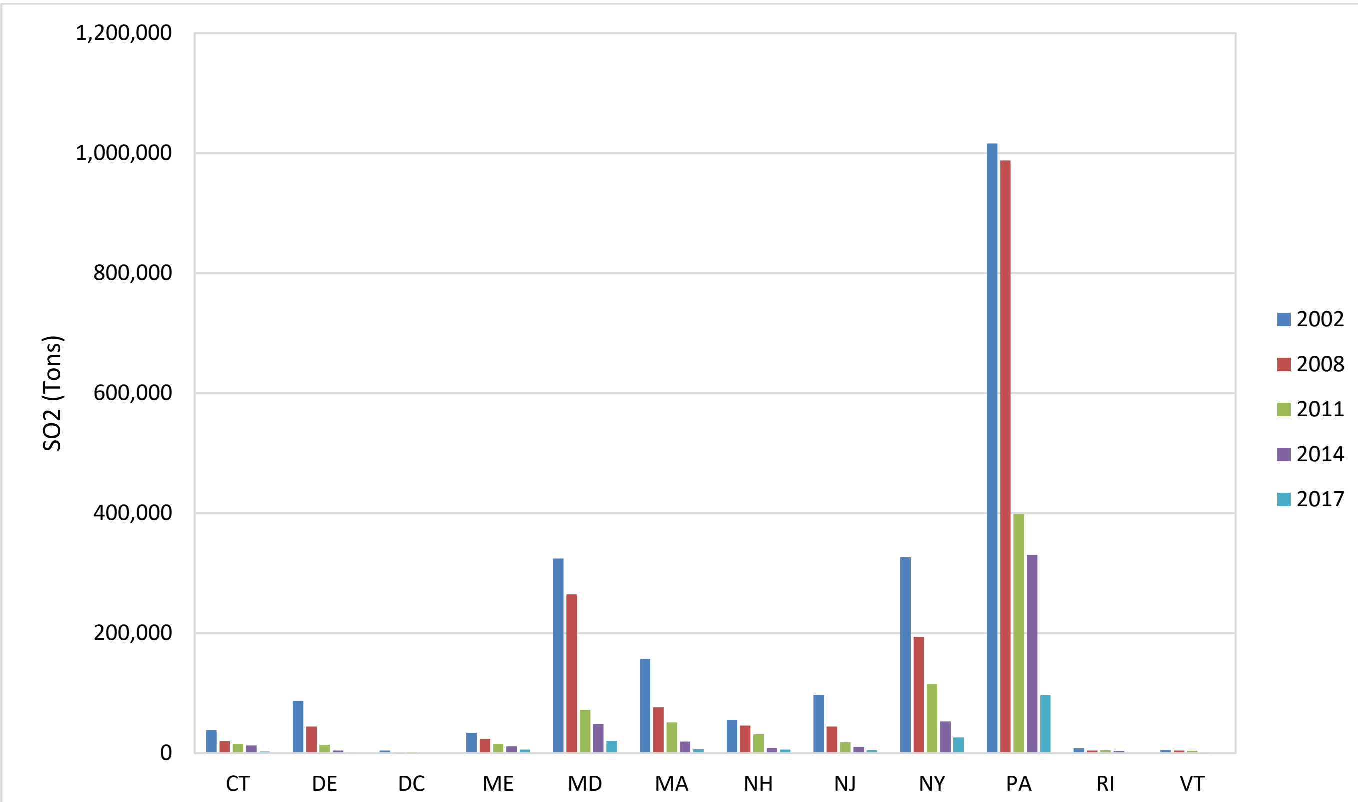


Table 4-15 and Figure 4-14 show total SO_2 emissions from all NEI data categories in the Non-MANE-VU Ask states for 2002 to 2017. Like MANE-VU states, decreases in SO_2 can be seen for all the Ask states over this period. In addition to the Federal rules, some of these decreases are attributable to the 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 Best Available Retrofit Technology (BART) requirements and a 90% or greater reduction in SO_2 emissions at 167 stacks inside and outside of MANE-VU.

Table 4-15 Total SO_2 Emissions in the Non-MANE-VU Ask States for all NEI 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 4-14 Total SO_2 Emissions in the Non-MANE-VU Ask States for all NEI Data Categories, 2002 – 2017 (Tons)

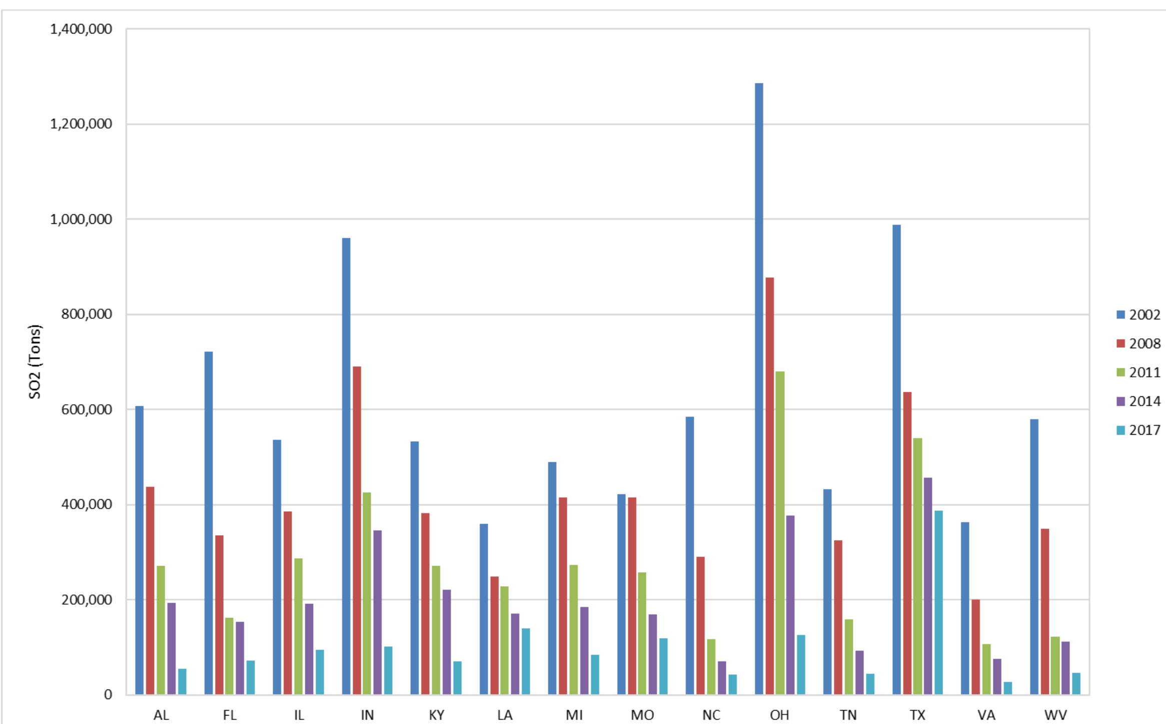


Table 4-16 and Figure 4-15 show AMPD SO_2 data trends for the MANE-VU states from 2002 to 2019, and Table 4-17 and Figure 4-16 show AMPD SO_2 data trends for the Non-MANE-VU Ask states from 2002 to 2019. Tables 4-16 and 4-17 show significant decreases in SO2 emissions for the AMPD sources between 2002 and 2019 for most states in MANE-VU as well as Non-MANE-VU Ask states. The slight increase in SO2 emissions in Rhode Island from 2002 to 2019 is primarily due to an increase in power generation at RI State Energy Center and Ocean State Power.

Overall reductions in SO2 are most likely due to the acid rain program, power plant consent decrees, specific state rules, CAIR, CSAPR[25] (formerly CAIR), which requires NO_x and/or SO_2 emissions reductions from EGUs in 27 states in the eastern and central US and source retirements and fuel switching due to the availability of less expensive natural gas.

Table 4-16 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%**

[25] https://www.epa.gov/csapr

Figure 4-15 SO_2 Emissions from AMPD Sources in the MANE-VU States, 2002 – 2019

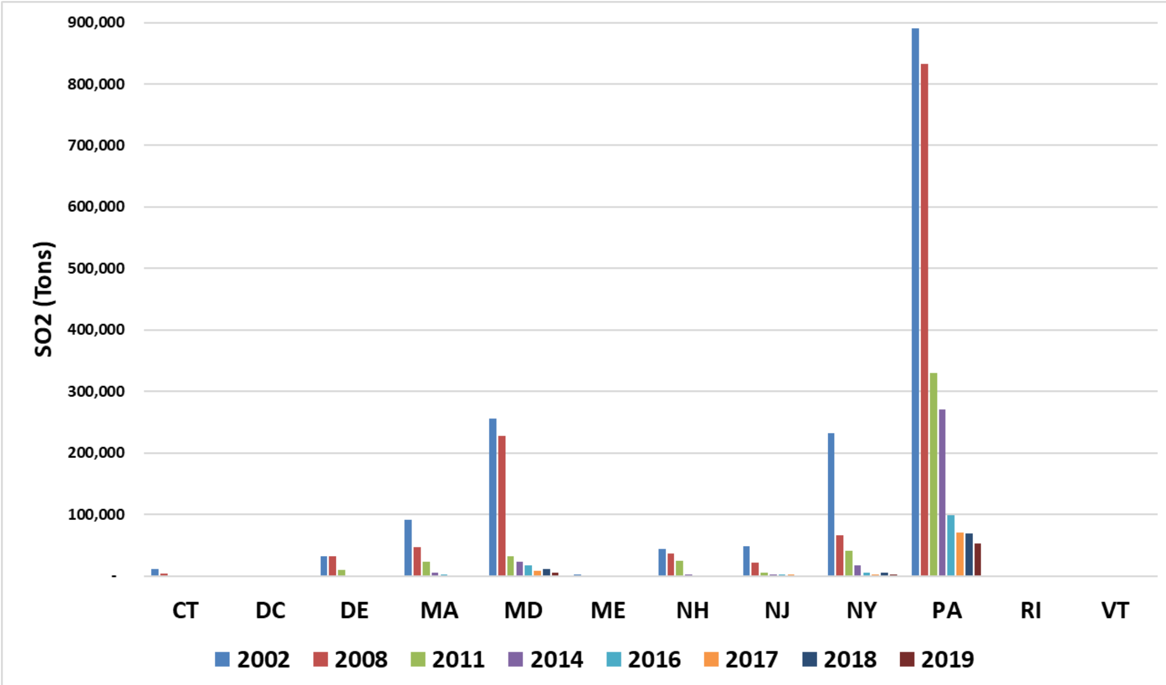
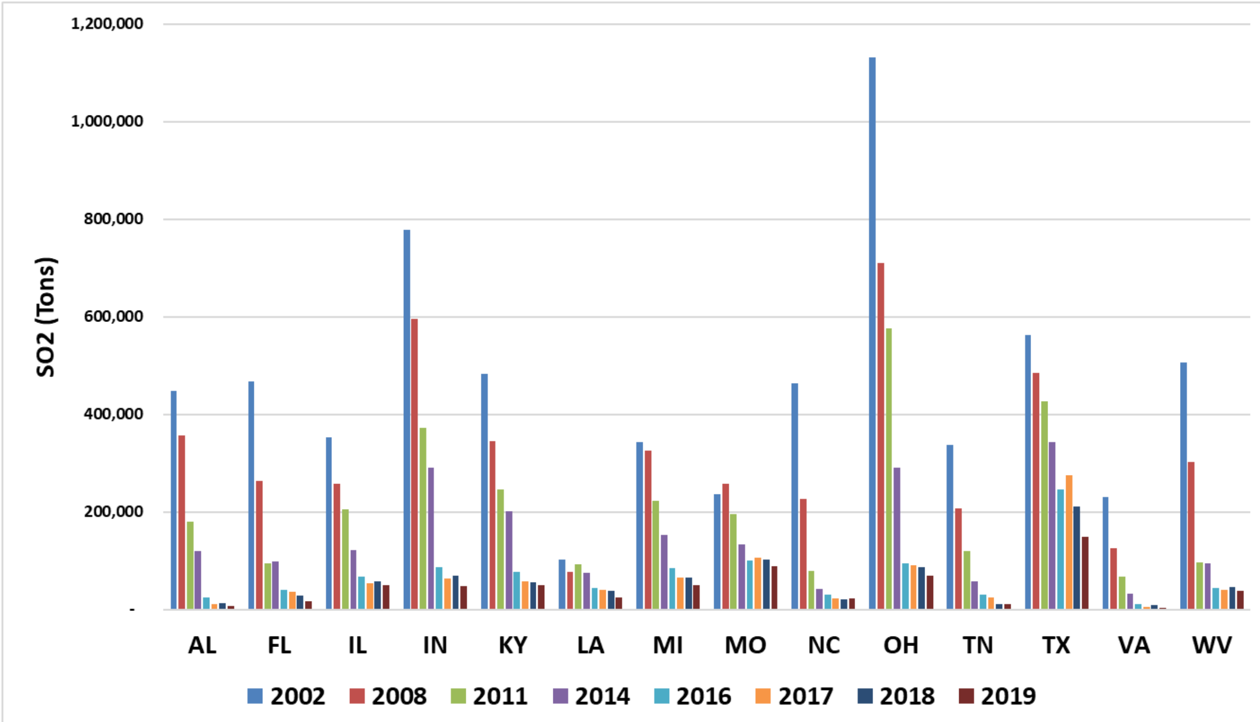


Table 4-17 SO_2 Emissions from AMPD Sources in the Non-MANE-VU Ask States, 2002 – 2019 (Tons)

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 4-16 SO_2 Emissions from AMPD Sources in the Non-MANE-VU Ask States, 2002 – 2019



4.6 Volatile Organic Compounds (VOC)

Table 4-18 shows VOC emissions from all data categories in Rhode Island from 2002-2017. The data is shown graphically in Figure 4-17. VOC emissions decreased for all sources by 57% (23,483 tons) since 2002. The reduction is due primarily to the 72% reduction in onroad emissions.

Table 4-18 VOC Emissions in Rhode Island by Data Category 2002-2017 (tons per year)

	2002	2008	2011	2014	2017	Change 2002-2017	% Change 2002-2017
Point	2,085	1,218	1,171	1,125	1,205	-880	-42%
Nonpoint	16,422	9,992	10,019	12,482	10,494	-5,928	-36%
Nonroad	8,576	6,329	5,174	3,850	2,300	-6,276	-73%
Onroad	14,366	6,231	6,822	6,042	3,968	-10,399	-72%
TOTAL	41,448	23,770	23,186	23,499	17,965	-23,483	-57%

Notes:
*Non-AMPD Point includes airports and railroad switch yards after 2002
**Nonpoint includes commercial marine vessels and underway railroad after 2002. Nonpoint includes Stage II refueling in 2002 through 2008 and excludes it after 2008.
***Nonroad includes airports, railroad and commercial marine vessels in 2002 and excludes them after 2002.
**** Onroad 2011 was subsequently revised in the EPA modeling platforms. See Table 9-31. Also, onroad includes Stage II refueling after 2008.

Figure 4-17 VOC Emissions in Rhode Island by Data Category 2002-2017

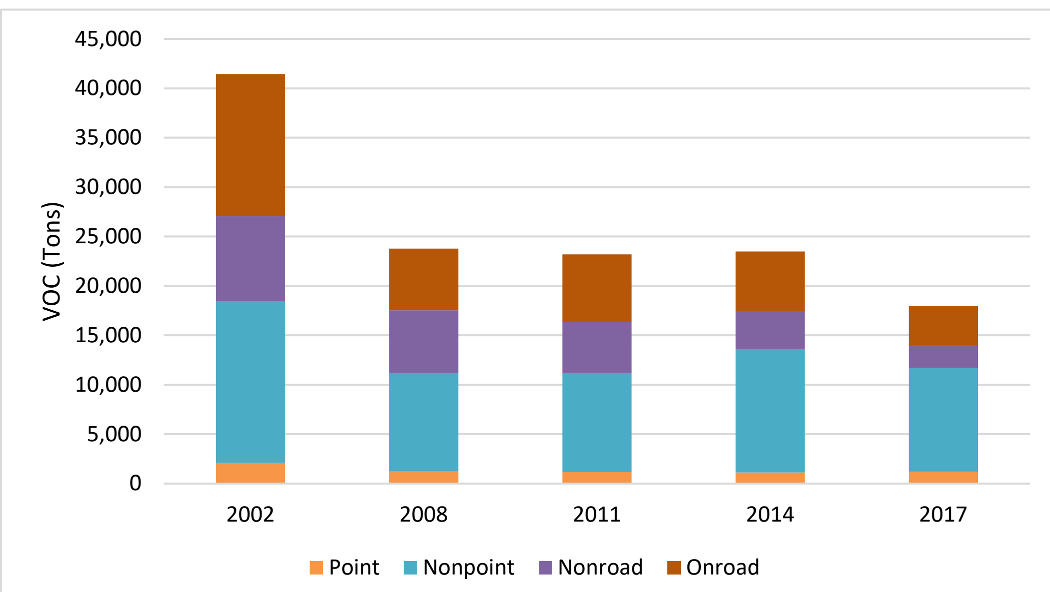


Table 4-19 and Figure 4-18 show VOC emissions from all data categories for MANE-VU states from 2002-2017. VOC emissions have declined in all MANE-VU states. The 57% reduction in Rhode Island is comparable to the overall reduction for MANE-VU of 49%. Note that the decrease may be overstated for many MANE-VU states because of improvements in estimation methodologies resulted in lower emissions in 2017 for nonpoint categories such as residential wood combustion.

Much of the decrease in VOC is due to federal and state rules for evaporative sources such as portable fuel containers; architectural, industrial, and maintenance coatings; consumer products; and solvent degreasing. Many states' rules for these categories are based on Ozone Transport Commission (OTC) Model Rules.[26] 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 state VOC RACT rules. Evaporative VOC emissions from onroad mobile sources have decreased due to state motor vehicle inspection and maintenance programs and the increasing prevalence of on-board refueling vapor recovery (ORVR) equipped vehicles in the fleet. VOC emissions from nonroad and onroad mobile sources are expected to continue decreasing as older, more polluting vehicles are replaced by newer, cleaner ones.

Table 4-19 VOC Emissions in MANE-VU States for all Data categories 2002-2017

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%**

[26] Ozone Transport Commission (OTC) model rule webpage: http://otcair.org/document.asp?Fview=modelrules

Figure 4-18 Total VOC Emissions from all NEI Data Categories in the MANE-VU States, 2002 – 2017

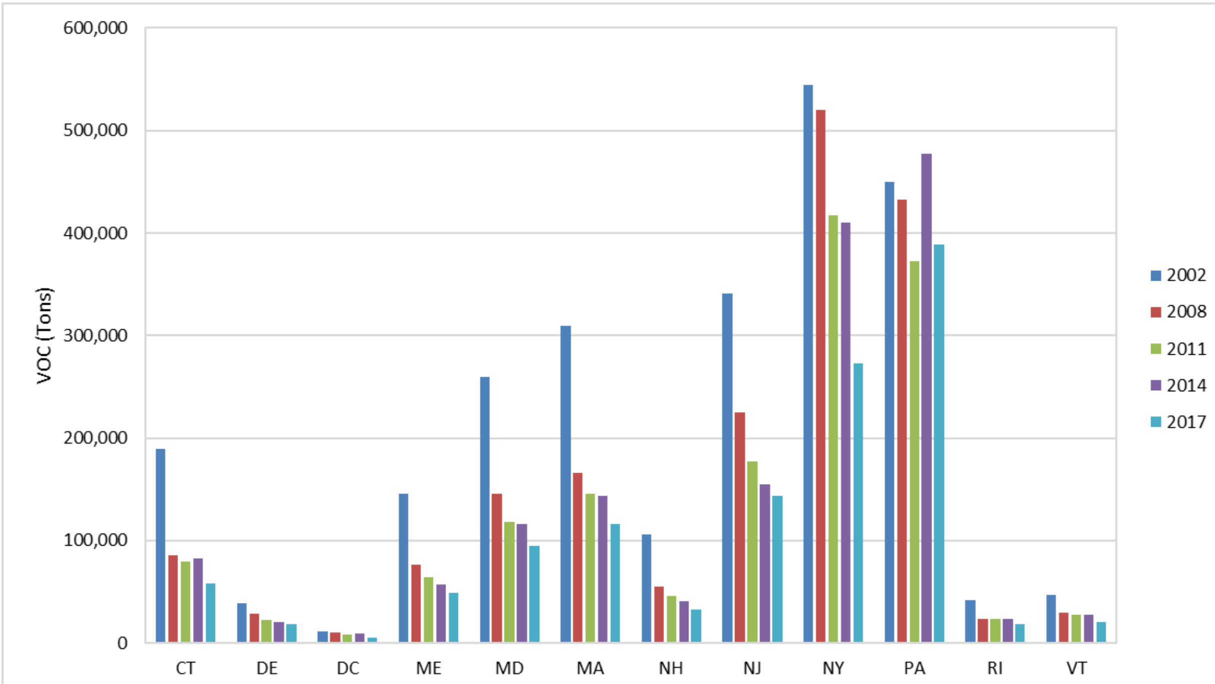


Table 4-20 and Figure 4-19 show total VOC emissions from all NEI data categories from the Non-MANE-VU Ask states. VOC emissions have declined from 2002 to 2017 in all of the Non-MANE-VU Ask states except TX and WV. Despite the increases in these states, overall total VOC emissions in the Non-MANE-VU Ask states to have declined from 2002 to 2017.

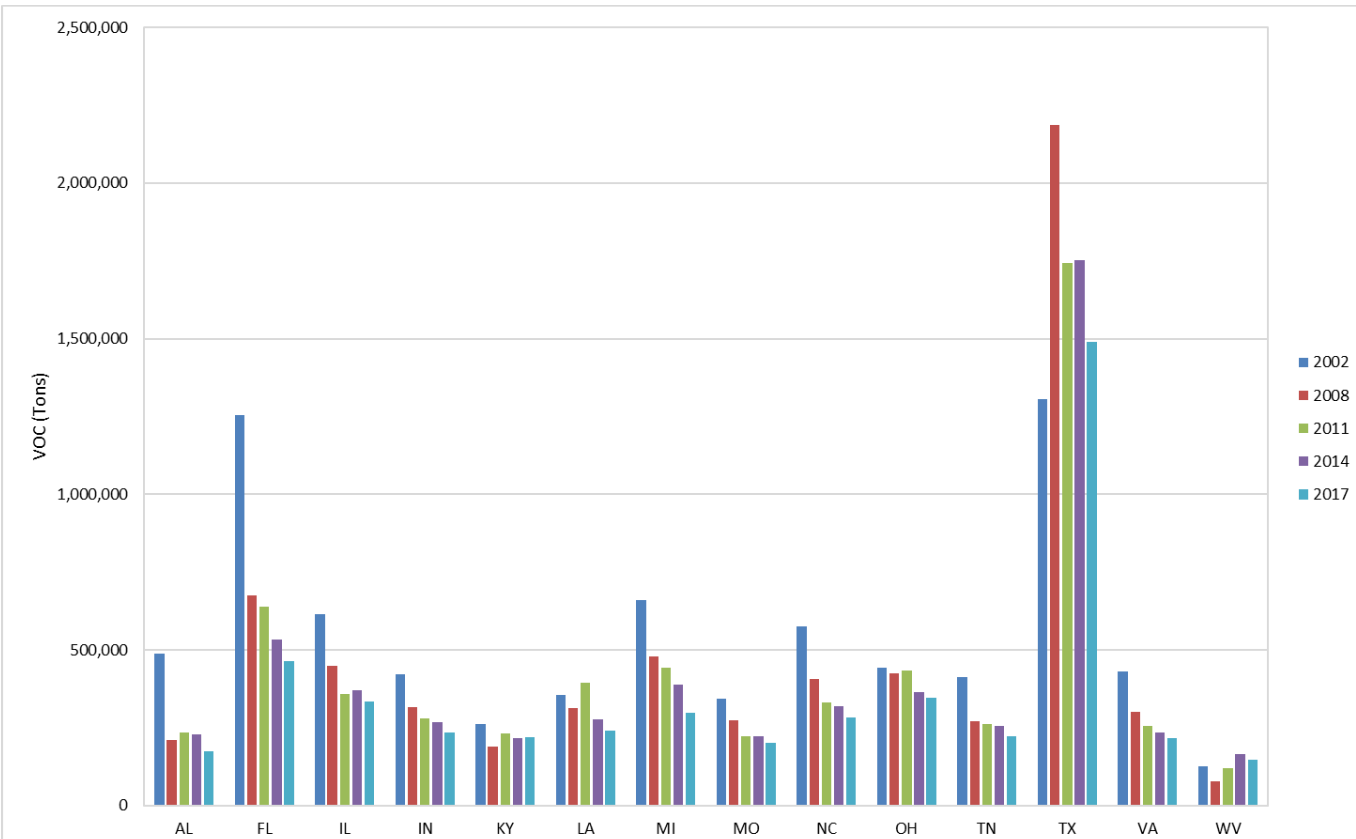
Increases in TX and WV are also most likely due to emissions generated from the oil and gas industry and drilling for natural gas and EPA's new tools to estimate these emissions.

Table 4-20 Total VOC Emissions from all NEI Data Categories in the Non-MANE-VU Ask States, 2002 – 2017 (Tons)

State	2002	2008	2011	2014	2017	VOC Redux (2002 – 2017)	% VOC Redux (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%

State	2002	2008	2011	2014	2017	VOC Redux (2002 – 2017)	% VOC Redux (2002 – 2017)
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 4-19 Total VOC Emissions from all NEI Data Categories in the Non-MANE-VU Ask States, 2002 – 2017



4.7 Ammonia (NH3)

Table 4-21 shows NH3 emissions from all data categories in Rhode Island for 2002- 2017. This is shown graphically in Figure 4-20. Although slight year to year variability can be seen in some categories, there is an overall downward trend in NH3 emissions in Rhode Island. The overall NH3 reduction in Rhode Islands from all sources combined is 27%; this is primarily due to a 73% reduction from onroad mobile sources and a 37% reduction from point sources.

NH3 emissions were not reported to Rhode Islands' emission statement program in 2002, therefore, they were estimated by EPA. Though ammonia decreases were achieved in the onroad sector due to Federal new engine standards for vehicles and equipment, increases and decreases for all categories are due to reporting, grouping and methodology changes. Additionally, in 2008 EPA included marine vessels and rail in the nonpoint category and airport emissions were moved from the mobile to the point source category.

Table 4-21 NH3 Emissions in Rhode Island from All Data categories 2002-2017 (tons per year)

	2002	2008	2011	2014	2017	Change 2002-2017	% Change 2002-2017
Point	105	119	100	85	66	-38	-37%
Nonpoint	239	588	629	505	575	336	140%
Nonroad	4	5	5	5	4	0	0%
Onroad	854	379	341	266	227	-627	-73%
TOTAL	1,202	1,092	1,075	862	873	-329	-27%

Figure 4-20 NH3 Emissions in Rhode Island from All Data categories 2002-2017

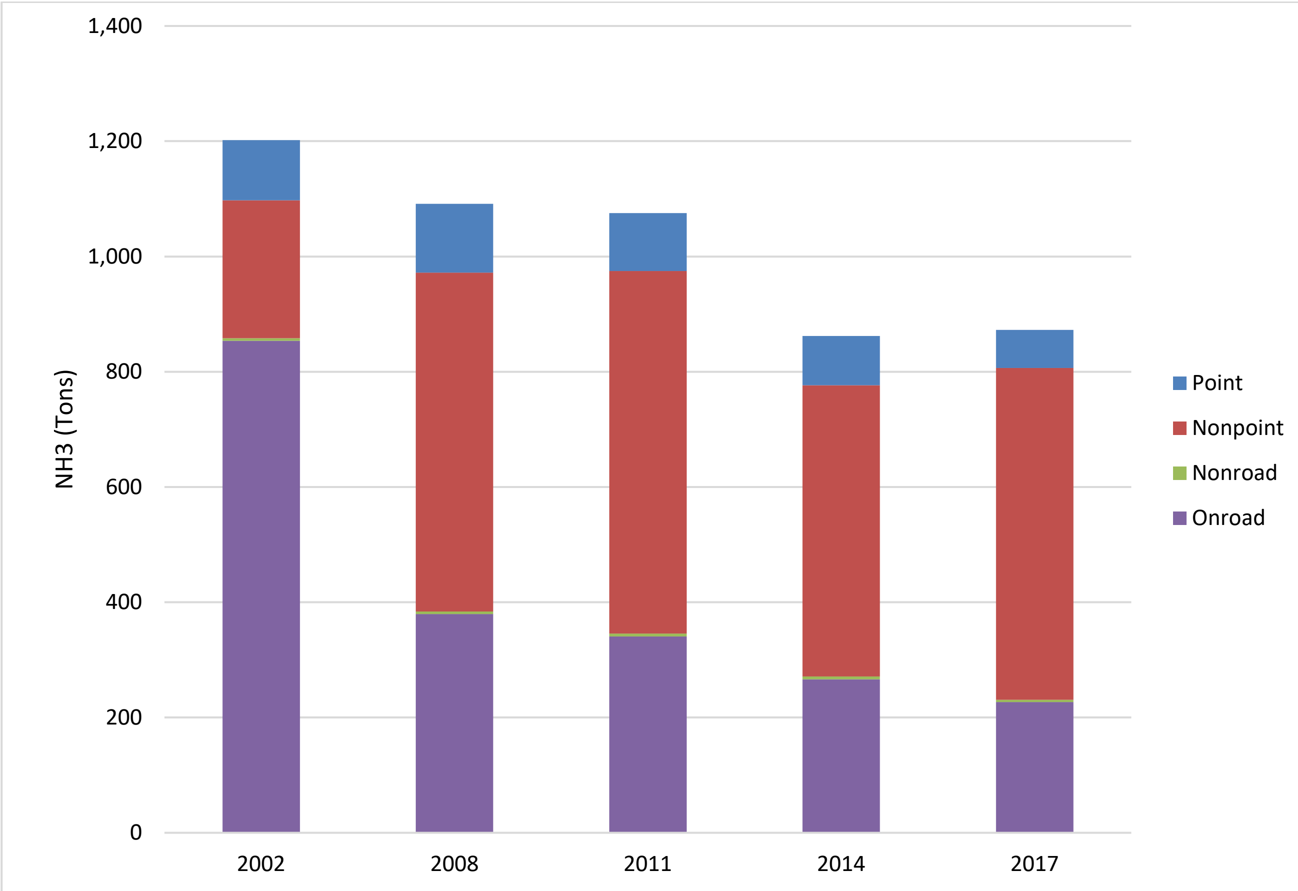


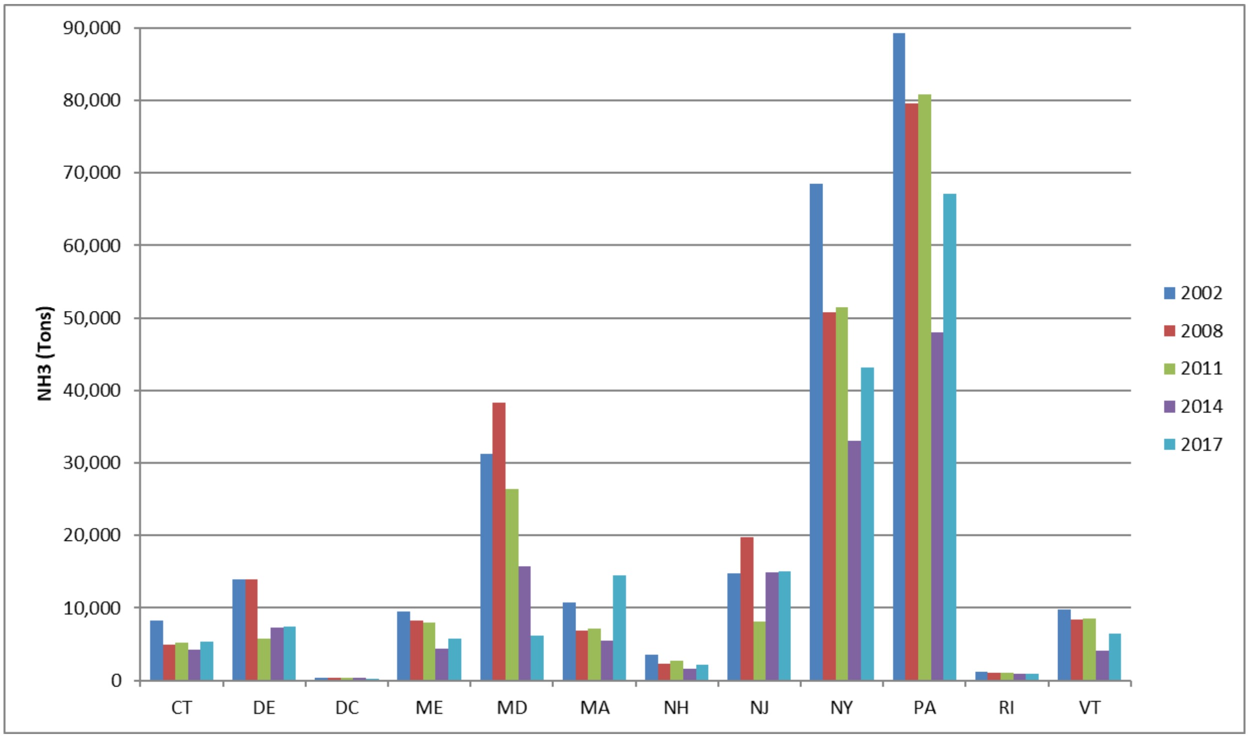
Table 4-22 and Figure 4-21 show total ammonia emissions for all NEI data categories combined for the MANE-VU states. Some year-to-year variability can be seen. However, for majority of MANE-VU states, ammonia emissions for 2017 are lower than they were for earlier years.

Table 4-22 Total NH_3 Emissions in the MANE-VU States from all NEI 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%

State	2002	2008	2011	2014	2017	NH_3 Reduction (2002 – 2017)	Percent NH_3 Reduction (2002 – 2017)
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 4-21 Total NH_3 Emissions in the MANE-VU States from all NEI Data Categories, 2002 - 2017 (Tons)

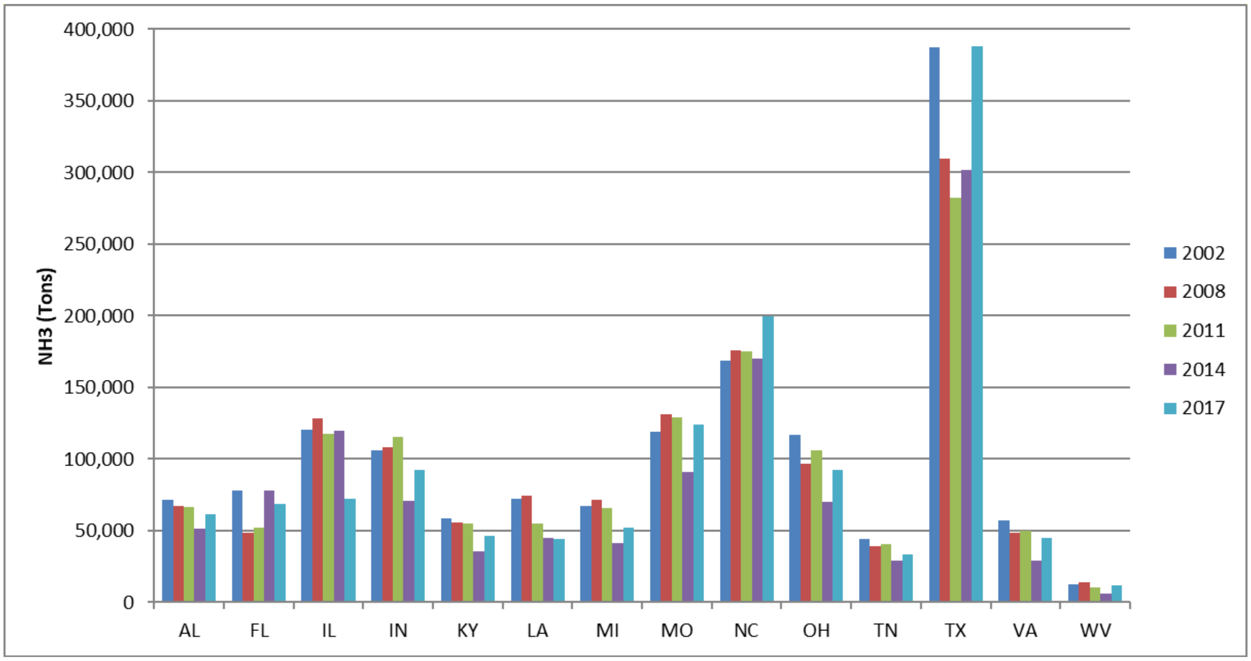


Total ammonia emissions for all NEI data categories for the Non-MANE-VU Ask states are shown in Table 4-23 and Figure 4-22. Again, some year-to-year variability in ammonia emissions can be seen. In most of the Non-MANE-VU Ask states, 2017 emissions are lower than they were for previous years.

Table 4-23 Total NH_3 Emissions in the Non-MANE-VU Ask States from all NEI 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	-20,298	-28%
FL	77,959	48,211	52,218	77,637	68,283	-322	0%
IL	120,222	128,348	117,209	119,481	71,951	-740	-1%
IN	106,354	108,301	115,038	71,036	92,297	-35,319	-33%
KY	58,406	55,558	55,265	35,476	46,390	-22,930	-39%
LA	72,094	74,188	55,272	44,703	44,395	-27,391	-38%
MI	66,954	71,406	65,507	41,500	52,261	-25,454	-38%
MO	119,101	131,113	128,753	90,853	124,221	-28,248	-24%
NC	168,398	176,143	175,127	169,777	199,395	1,379	1%
OH	117,152	96,512	105,793	69,854	92,404	-47,299	-40%
TN	43,831	39,213	40,364	29,237	33,574	-14,594	-33%
TX	387,228	309,529	282,413	301,772	388,408	-85,456	-22%
VA	57,150	48,462	49,935	29,151	44,768	-27,999	-49%
WV	12,832	14,100	10,668	6,162	11,815	-6,670	-52%
Total	**1,479,309**	**1,368,541**	**1,320,058**	**1,137,969**	**1,331,316**	**-341,340**	**-23%**

Figure 4-22 Total NH_3 Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017 (Tons)



4.8 Assessment of Changes in Emissions that Have Impeded Progress

40 CFR 51.308(g)(5) requires states to assess: (1) any significant changes in anthropogenic emissions within or outside the state that have occurred since the period addressed in the most recent plan (i.e., SIP revision) required under paragraph (f), (2) whether or not these changes were anticipated in that most recent plan, and (3) whether they have limited or impeded progress in reducing emissions and improving visibility. EPA guidance[27] indicates that a significant change could be either: (1) a significant unexpected increase that was not projected in the analysis of the previous SIP; or (2) a significant reduction in emissions projected in the previous SIP that did not occur.

The data presented in this section shows an overall decline in emissions of haze-causing pollutants and indicates that no significant changes have occurred that have impeded progress in reducing emissions and improving visibility since the previous RH SIP.

4.9 Baseline and Future Year Emission Inventories for Modeling

In accordance with 40 CFR 51.308(f)(2)(iii), Rhode Island is required to document the technical bases, including modeling, on which the state is relying to determine appropriate emissions reductions strategies. The baseline modeling inventory is intended to be used to assess progress in making future emission reductions. MANE-VU states used 2011 as the baseline year inventory. Future year

[27] General Principles for the 5-Year Regional Haze Progress Reports for the Initial Regional Haze State Implementation Plans (Intended to Assist States and EPA Regional Offices in Development and Review of the Progress Reports). EPA. April 2013.

inventories were developed for 2028 based on the 2011 base year. This future year emission inventory includes emissions growth due to projected increases in applicable source categories as well as the emissions reductions due to the implementation of control measures.

The MANE-VU regional haze emissions Gamma Inventory was used for modeling purposes. This inventory was developed by the Mid-Atlantic Regional Air Management Association (MARAMA), the Eastern Regional Technical Advisory Committee (ERTAC) EGU Workgroup, and EPA.

The 2011-based Modeling Platform is a combination of work performed by the State/Local/Tribal (S/L/T) air agencies and the EPA. Its basis is the 2011 NEI discussed above, with some slight variations. As the States, EPA and air agencies developed the modeling inventory, certain changes were made from the base NEI to reflect corrections or improvements. In some cases, EPA also made efforts to make those corrections or updates in later versions of the NEI. The future year 2028 inventory was developed using a combination of S/L/T data and methods for projecting emissions from stationary sources, including EGUs (ERTAC version 2.7), and EPA's 2028 "el" modeling platform.

More detailed information regarding the Gamma Inventory development and projections can be found in the *Technical Support Document Emission Inventory Development for 2011 and Projections to 2020 and 2023 for the Northeastern U.S. Gamma Inventory*, dated January 29, 2018[28], and the *Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2011 Based Modeling Platform Support Document – October 2018 Update*[29] which includes projections to 2028.

The following is a summary of the Gamma inventory.

4.9.1 Base Year 2011 and 2028 Projections

The following categories of data categories 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 wildfires and agricultural dust)

Tables 4-24 through 4-29 represent the MANE-VU 2011 Gamma emissions inventories and 2028 Gamma emissions projections for MANE-VU and Rhode Island. Detailed information regarding the inventories

[28] https://s3.amazonaws.com/marama.org/wp-content/uploads/2020/06/26122903/2011-Gamma-TSD-Northeast-Emission-Inventory-2018.pdf with additional documentation at https://marama.org/technical-center/emissions-inventory/2011-inventory-and-projections/
[29] https://otcair.org/upload/Documents/Reports/OTC%20MANE-VU%202011%20Based%20Modeling%20Platform%20Support%20Document%20October%202018%20-%20Final.pdf

and projections can be found in the *Technical Support Document Emission Inventory Development for 2011 and Projections to 2020 and 2023 for the Northeastern U.S. Gamma Inventory*, dated January 29, 2018[30], and the *Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2011 Based Modeling Platform Support Document – October 2018 Update*.

Table 4-24 2011 Gamma Emissions Inventory – MANE-VU States

	VOC	NOx	PM2.5	PM10	NH3	SO2
EGU Point	2,477	206,457	17,987	24,000	2,923	462,551
Non-EGU Point*	53,046	155,892	28,669	37,773	4,950	108,301
Area**	703,086	194,924	160,501	177,343	14,552	135,783
Nonroad***	369,537	344,671	27,442	29,073	378	25,477
Onroad****	362,357	717,012	27,133	52,081	18,094	4,793
Oil/Gas	29,028	53,405	1,676	1,766	14	2,102
Other	21,570	1,165	27,816	138,867	165,673	668
Anthropogenic Total	**1,541,101**	**1,673,526**	**291,225**	**460,903**	**206,584**	**739,675**
Biogenics	2,064,088	30,564				
TOTAL	**3,605,189**	**1,704,090**	**291,225**	**460,903**	**206,584**	**739,675**

Notes:
*Non-EGU point includes airports and railroad switch yards
**Area includes adjusted fugitive dust
***Nonroad includes commercial marine vessels and underway railroad
****Onroad includes Stage II refueling

[30]https://www.marama.org/images/stories/documents/TSD_GAMMA_Northeast_Emission_Inventory_for_2011_2023_20180131.pdf with additional documentation at https://www.marama.org/technical-center/emissions-inventory/2011-gamma-inventory-and-projections

Table 4-25: 2011 Gamma Inventory – Rhode Island[31]

	VOC	NOX	PM2.5	PM10	NH3	SO2
EGU	48	631	73	73	82	20
Non-EGU Point	1,108	1,205	172	73	18	990
NonPoint	10,381	5,735	2,511	2,396	331	3,084
Oil/Gas	16	27	3	3	0	1
Onroad	6,688	9,964	745	360	335	75
Nonroad	5,278	4,697	371	352	5	518
Other	164	15		230	309	7
Anthropogenic Total						
Biogenics	**18,617**	**166**				
Total 2011	**42,300**	**22,439**	**3,876**	**3,488**	**1,081**	**4,696**

Table 4-26: 2028 Gamma Emissions Projections Summary – MANE-VU States.

	VOC	NOx	PM2.5	PM10	NH3	SO2
EGU Point	4,871	85,182	15,060	19,115	3,114	196,760
Non-EGU Point*	54,371	148,416	28,329	37,522	5,123	82,813
Area**	659,063	177,995	150,922	167,001	13,641	28,159
Nonroad***	219,807	193,233	13,773	14,752	475	1,967
Onroad****	111,151	165,746	9,216	35,845	12,632	1,642
Oil/Gas	49,830	70,737	3,101	3,196	16	6,369
Other	22,084	1,384	29,956	147,913	169,064	771
Anthropogenic Total	**1,121,177**	**842,691**	**250,357**	**425,343**	**204,066**	**318,481**
Biogenics	2,064,088	30,564				
TOTAL	**3,185,265**	**873,256**	**250,357**	**425,343**	**204,066**	**318,481**

NOTES:

Non-EGU point includes airports and railroad switch yards

Area includes: adjusted fugitive dust, Stage I refueling and residential wood burning (does not include marine and rail as in the NEI summaries)

Nonroad includes commercial marine vessels and underway railroad Onroad includes Stage II refueling.

Other includes agricultural ammonia and fires, prescribed and wild-fires and adjusted fugitive dust.

[31] Rhode Island 2011 and 2028 Gamma Inventory from MANE-VU TSC Emissions Inventory Data and Report Template, September 11, 2018 at https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU_EI_NEI_NH3_09112018.zip

Source: Technical Support Document Emission Inventory Development For 2011 And Projections To 2020 And 2023 For The Northeastern U.S. Gamma Version. Mid-Atlantic Regional Air Management Association, Inc. (MARAMA). January 29, 2018. (Appendix 19) (http://marama.org/technical-center/emissions-inventory/2011-gamma-inventory-and-projections) https://marama.org/technical-center/emissions-inventory/2011-inventory-and-projections/#1590518138893-bfa06986-6adc

Table 4-27: 2028 Gamma Emissions Projections Summary – Rhode Island[32]

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
EGU	26	351	40	40	45	11
Non-EGU Point	1,173	1,286	189	74	20	881
NonPoint	9,424	3,927	2,201	2,101	305	125
Oil/Gas	18	26	3	3	0	1
Onroad	2,285	2,429	584	147	215	25
Nonroad	2,788	2,544	188	176	7	39
Biogenics	18,617	166				
Other	164	15	1,366	265	315	7
TOTAL	**34,495**	**10,745**	**4,571**	**2,807**	**907**	**1,089**

4.9.2 Woodsmoke Particulate Matter (PM)

Source apportionment documented in Appendix B of the original MANE-VU Contribution Assessment identified biomass combustion as a local source contributing to visibility impairment. Woodsmoke, a subset of biomass combustion, typically contributes more to visibility impairment in rural areas than in urban areas, with winter peaks in northern areas due to residential wood burning, 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*[33] 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, based on the MANE-VU 2011 Gamma emissions inventory, is shown in Table 4-29 and Table 4-30. The data shows that residential wood combustion represents approximately 33% of the annual average PM2.5 emissions in the MANE-VU region. In Rhode Island, residential wood combustion is estimated to be 42% of the 2011 inventory.

[32] Ibid.

[33] https://otcair.org/manevu/upload/publication/reports/smokemgmt_tsd_090106.pdf

Table 4-28 ***MANE-VU 2011 Gamma Residential Wood Combustion Emissions (Tons)***

State	CO	NH3	NOx	PM10-PRI	PM2.5-PRI	SO2	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	**647,397**	**4,921**	**8,945**	**95,561**	**95,519**	**2,169**	**118,471**
Total 2011 Emissions	**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%**

Table 4-29 MANE-VU 2011 Gamma State Level PM2.5 Residential Wood Emissions (Tons)

State	Res. Wood PM2.5	Total PM2.5	% of Total PM2.5 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%

5 Sources of Visibility-Impairing Pollutants

Section 5 identifies the visibility-impairing pollutants that contribute to regional haze at Class I and quantifies the potential impact from emissions sources in Rhode Island relative to other states and their sources.

5.1 Visibility-Impairing Pollutants

The pollutants responsible for fine particle formation (and thus regional haze) are SO2, NOx, VOC, NH3, PM10, and PM2.5. MANE-VU's Contribution Assessment for the first implementation period found that sulfate was the most important single constituent of haze- forming fine particle pollution and the principal cause of visibility impairment across the Northeast region.[34] Sulfate alone accounted for one-half to two-thirds of total fine particle mass on the 20% haziest days at MANE-VU Class I sites. This translates to about two-thirds to three- fourths of visibility extinction on those days. Organic carbon was the second largest contributor to haze. As a result of the dominant role of sulfate in the formation of regional haze in the Northeast and Mid-Atlantic Regions, for the first implementation period MANE-VU focused on regional SO2 control measures as the most effective emissions management approach to reduce haze.

Figure 5-1 illustrates the dominance of sulfate (bottom yellow bar) in visibility extinction during the 2000-2004 baseline period.

5.2 Second Implementation Period Analysis of Pollutants

For the second implementation period, MANE-VU examined speciation data to identify changes in the contributions of individual constituents to visibility impairment.[35] Results clearly showed a significant reduction in the contribution at all Class I areas from sulfates for the 20% most impaired days with varying levels of increases for other species. The reduction in visibility extinction due to sulfates from 2000-2019 ranged from 51-70%.[36]

Figures 5-2 and 5-3 illustrate these trends by comparing baseline speciated extinction (2000- 2004) with current (2015-2019) extinction levels for the 20% best and 20% worst (most impaired) days for all Class I sites. This shows that visibility improvement on all days was primarily due to sulfate reductions. As sulfate contributions declined the relative nitrate contributions increased at many sites. Also, during the winter, nitrate contributions to visibility impairment are much higher than summer. Because more winter days are now in the 20% worst days, the relative contribution of nitrates increased. Both trends are especially visible at the Brigantine Wilderness Class I area.

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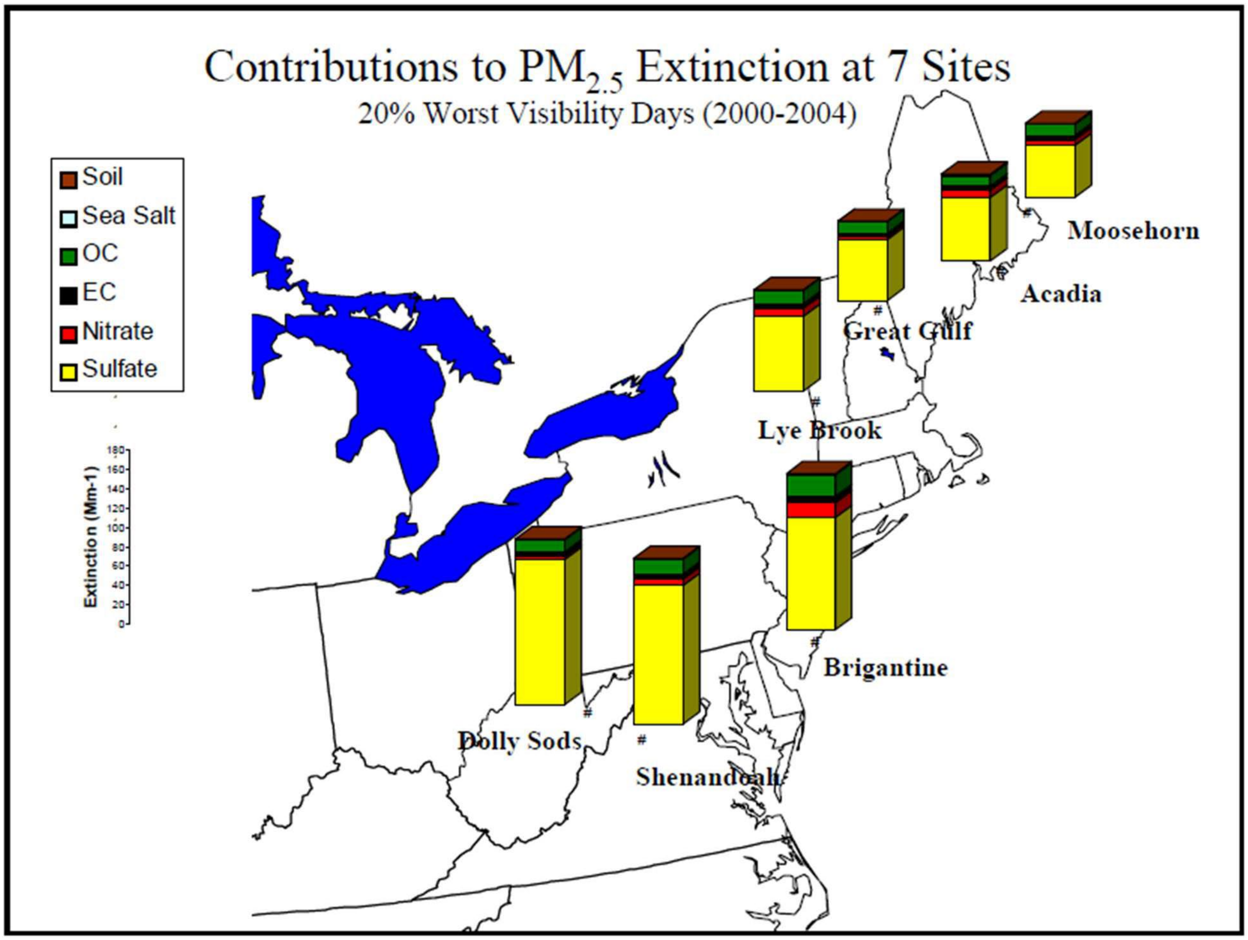
[34] Contributions to Regional Haze in the Northeast and Mid-Atlantic United States: Mid-Atlantic/Northeast Visibility Union (MANE-VU) Contribution Assessment. NESCAUM. August 2006. (Appendix 2)

[35] *Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2019 (2nd RH SIP Metrics)*. MANE-VU (prepared by Maine Department of Environmental Protection). January 21, 2020 revision. (Appendix 22)

[36] Source file: TD MANE-VU sites analysis 2000-19 summary 2nd SIP 1-21-21.xlsx (5-yr plot Data, 20% clearest day extinction (Mm-1))

Figure 5-1 Contributions to PM2.5 Extinction at Seven Class I Sites

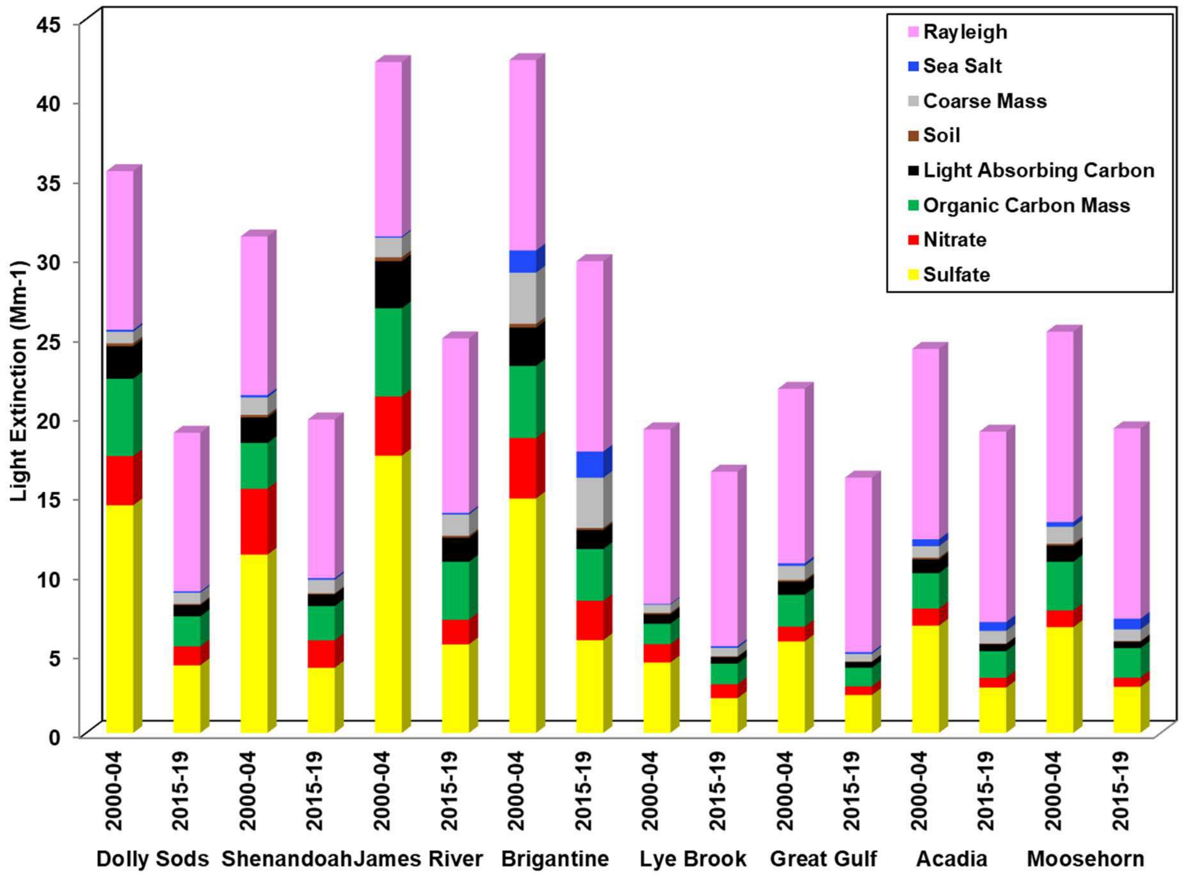


NOTE: Visibility extinction is a measure of the ability of particles (such as fine particles known as PM2.5) to scatter and absorb light. Extinction is expressed in units of inverse mega-meters (Mm-1). A speciation analysis divides light extinction impacts into the following components: sulfates, nitrates, coarse mass, organic carbon mass (OC), light absorbing carbon, soil, sea salt and Rayleigh scattering.

For the second implementation period, MANE-VU concluded that: (1) sulfates from SO2 emissions remain the most significant contributor to visibility impairment at all Class I areas in and adjacent to the MANE-VU region on the most impaired days; and (2) nitrates from NOx emission sources now are more significant than in the first implementation period.

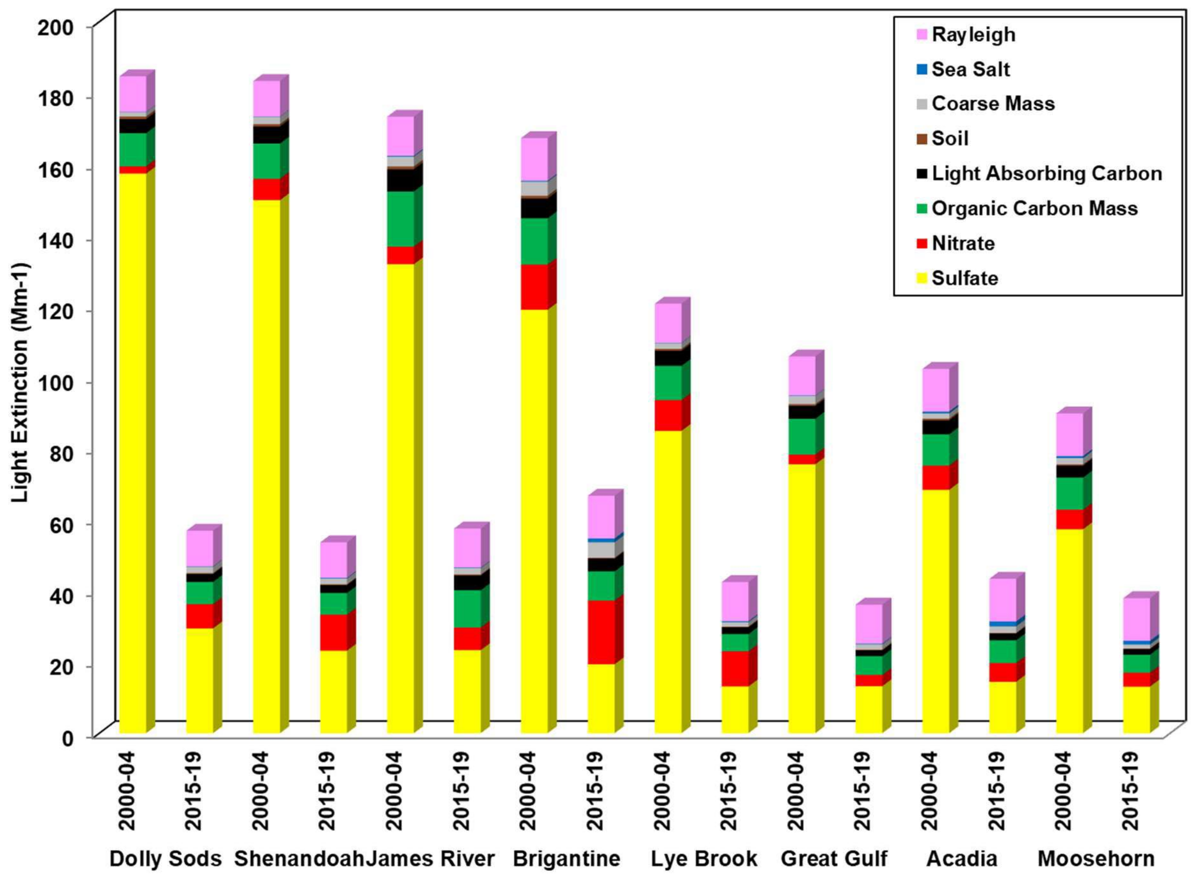
Based on these results, MANE-VU chose an approach for contribution assessments that continued to focus on sulfates and included nitrates when they could be included in a technically sound fashion.

Figure 5-2 Current (2015-19) and Baseline (2000-04) 5-Year Average Light Extinction at Class I Sites on 20% Clearest Visibility Days



Source: Mid-Atlantic/Northeast U.S. Visibility Data 2004-2019 (second RH SIP Metrics). MANE-VU (prepared by Maine Department of Environmental Protection). January 21, 2021. (Figure 3-9) (Appendix 22)

Figure 5-3 Current (2015-19) and Baseline (2000-04) 5-Year Average Light Extinction at Class I Sites on 20% Most Impaired Visibility Days



Source: Mid-Atlantic/Northeast U.S. Visibility Data 2004-2019 (second RH SIP Metrics). MANE-VU (prepared by Maine Department of Environmental Protection). January 21, 2021. (Figure 3-9) (Appendix 22)

5.3 Contributing Sectors, States, and Sources

For the second implementation period, MANE-VU assessed the contribution of states, sources, and sectors to visibility impairment.[37] This work produced a quantitative estimate of the impact of emissions from Rhode Island sources on Class I areas.

MANE-VU first examined emissions inventories to find sectors that should be considered for

[37] Selection of States for MANE-VU Regional Haze Consultation (2018). MANE-VU Technical Support Committee. September 5, 2017. (Appendix 16)

further analysis.[38]This analysis also included projections to 2018 that considered rules that were going into effect between 2011 and 2018 and known unit shutdowns and fuel switches. Since the proportion of impairment from winter nitrates has increased in several MANE-VU Class I areas, both SO2 and NOx emissions were considered. That analysis concluded that EGUs emitting SO2 and NOx and industrial point sources emitting SO2 were the point source sectors with emissions high enough to warrant further scrutiny. Heavy duty diesel vehicles also were found to be an important sector for NOx emissions.[39] Since power plants and mobile sources generally dominate state and regional NOx emissions inventories, only non-EGU sources emitting SO2 were selected for further analysis. MANE-VU analyzed the point sectors further as described below.

Although SO2 emissions from marine engines potentially have significant visibility impacts, MANE-VU did not further consider this sector because the implementation of 1000 ppm sulfur limits for marine fuel oil to comply with the North American Emission Control Area[40] were projected to reduce SO2 emissions from the sector substantially beginning in 2015. MANE-VU also did not carry forward NOx emissions from nonroad equipment because Tier 4 emission standards were projected to reduce NOx emissions from the sector substantially beginning in 2014.[41] SO2 emissions from residential fuel oil combustion was again determined to be important and confirmed the value of the MANE-VU low sulfur fuel oil strategy.

Next, MANE-VU screened states and sectors for contribution using two tools: Q/d and CALPUFF modeling.[42,43, 44] Q/d is the ratio of the quantity of emissions from a source to the distance from a Class I area (which was then multiplied by a factor to account for prevailing winds). MANE-VU previously employed Q/d for the first implementation period[45,46]

CALPUFF simulates atmospheric transport, transformation, and dispersion through the treatment of emissions from stacks or area sources as a series of discrete puffs. Results were then compared to air mass trajectories for the 20% most impaired days at MANE-VU Class I areas.

The screening was performed for selected Class I areas in MANE-VU states and nearby

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[38] Contribution Assessment Preliminary Inventory Analysis. Memo from MANE-VU Technical Support Committee. October 10, 2016. (Appendix 11)
[39] Mobile sources were addressed in the 2017 MANE-VU Ask to EPA rather than in the 2017 Ask for MANE-VU states.
[40] 75 FR 22896
[41] 40 CFR 1039.101
[42] Q/d performed by CTDEP and CALPUFF modeling performed by NHDES with meteorological inputs developed by VTDEC.
[43] MANE-VU Updated Q/d*C Contribution Assessment. MANE-VU Technical Support Committee. April 6, 2016. (Appendix 9)
[44] 2016 MANE-VU Source Contribution Modeling Report, CALPUFF Modeling of Large Electrical Generating Units and Industrial Sources. MANE-VU. April 4, 2017. (Appendix 8)
[45] Contribution to Regional Haze in the Northeast and Mid-Atlantic United States. NESCAUM. 2006. (http://www.nescaum.org/topics/regional- haze/regional-haze-documents)
[46] Contributions to Regional Haze in the Northeast and Mid-Atlantic United States: Preliminary Update through 2007. NESCAUM. 2012. (Appendix 2)

states (Dolly Sods, James River Face, Otter Creek, and Shenandoah). MANE-VU primarily considered emissions from EGUs and industrial/commercial/institutional (ICI) units, but also included state-wide emissions to account for the impact of area and mobile sources. Since the relative percent of impairment from winter nitrates has increased in several MANE-VU Class I areas, SO2 and NOx emissions were both considered. To ensure consideration of recent changes in the emissions inventory, MANE-VU used 2015 emissions directly or estimated 2015 emissions.

MANE-VU selected states that contributed 2% or more of the visibility impairment and had an average mass impact of over 1% (0.01µg/m3) for consultation as part of the regional SIP planning process. In addition, MANE-VU identified specific emissions units as significant contributors if their estimated impact on visibility at any Class I area was greater than 3 Mm-1.

CALPUFF – CALPUFF estimates for EGUs were based on 95th percentile daily NOx and SO2 emissions for 2015 and three years of meteorology (2002, 2011, and 2015) with the maximum value from the three years of meteorology used to assess contribution. Typical day emissions for 2011 from ICI units were modeled with the three years of meteorology because 2015 data was not available for those units.

Q/d – The Q/d analysis used state-wide 2011 SO2 emissions emanating from the state centroid. State-wide data were chosen to include emissions from mobile and area sources. The 2011 state- wide SO2 emissions were then scaled to 2015 levels for use in the impact analysis. Nitrate impacts were estimated from the ratio of NO3/SO4 taken from the 2015 CALPUFF statewide averages – this ratio was applied to the estimated 2015 SO4 Q/d results to yield the nitrate value. This ratio was chosen to approximate the differing chemistry between NO3 and SO4 formation which is captured in the CALPUFF results.

Contributions – Both techniques (Q/d and CALPUFF) provided estimates for potential visibility impacting masses. Rather than relying solely on one technique, MANE-VU included both by averaging each relative contribution calculation for NO3 and SO4. Since nitrates and sulfates produce similar visibility impairment for similar ambient air concentrations, they weighted equally in the impact calculations. The 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 5-1 provides average relative percent contributions of sulfate and nitrate contributions from each analyzed state to each of the five MANE-VU Class I areas.[47]The

[47] Selection of States for MANE-VU Regional Haze Consultation (2018). MANE-VU Technical Support Committee. September 5,

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% or more of the 36-state total contribution. States in the pink shade contribute 2-3%, and states in the green shade contribute less than 2%. The Maximum column provides the maximum percentage that a state contributes to any Class I area in MANE-VU. The farthest right column gives the average mass estimated by the four methods.

States estimated to contribute 2% or more to any of the five Class I areas were considered "contributing states." The 2% criteria were the same as was used by the MANE-VU states in the first implementation period SIPs. States were removed from consideration if their mass factor was below 1% (0.01 µg/m3).

To validate these results MANE-VU evaluated wind trajectories for the 20% most impaired days from 2002, 2011, and 2015. The wind trajectory data supported the findings from the modeling for the 14 states outside of MANE-VU that were identified as significant contributors to MANE- VU Class I areas.

Rhode Island Contributions – The results indicated that emissions from Rhode Island contributions consistently fall below 2% with contributions ranging between 0.1% and 0.5% across the MANE-VU region. Therefore, **Rhode Island is not reasonably anticipated to contribute to visibility impairment in any Class I area**. However, as a MANE-VU state, Rhode Island agreed to participate in the inter-RPO consultations and address the resultant "Ask" in its implementation plan.

2017. p.6-7. (Appendix 16) The contribution is the average of the four percentage contribution values from: CALPUFF SO4, CALPUFF NO3, Q/d SO4, and Q/d NO3 (estimated). The CALPUFF contributions were the maximum contribution from the 3 years of meteorology modeled. Data was 2015 (for EGUs) or 2011 scaled to 2015 (all other sources).

Table 5-1 Percent Mass-Weighted Sulfate and Nitrate Contribution for top 36 Eastern States to All MANE-VU Class I Areas

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

Maximum – consolidated maximum to any Class I area Mass Factor – average contributed mass in µg/m3 Contribution values sum to 100 (100%)

Source: Selection of States for MANE-VU Regional Haze Consultation (2018). MANE-VU Technical Support Committee. September 5, 2017. (Appendix 16) p.6-7 Table 7

6 Long-Term Strategy for Rhode Island

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. The LTS must include enforceable emissions limitations, compliance schedules, and other measures necessary to assure reasonable progress. These were already included in RIDEM OAR's 2009 Regional Haze SIP for the first implementation period and will continue into the second period.

RIDEM OAR's LTS for the second implementation period is based on the LTS in RIDEM OAR's Regional Haze SIP for the first implementation period. As a member of MANE-VU, RIDEM OAR adopted a regional approach for deciding which additional control measures to pursue for regional haze based on technical analyses developed by MANE-VU. RIDEM OAR adopted the analysis and determinations from that process including the course of action for member states to make reasonable progress for the second regional haze implementation period. The 2017 MANE-VU Statement (Appendix 15) documented the measures that MANE-VU considers reasonable for the 2018-2028 implementation period.

Rhode Island believes the MANE-VU approach is a reasonable assessment for quantifying the impact of Rhode Island emissions on downwind states. Rhode Island has brought forward no specific point sources for analysis of control measures to make reasonable progress, because the highest NOx and SO2 emitters in the state have already been controlled by issuance of enforceable state air permits, which require the use of ultra-low fuel oil, NOx RACT controls and/or other air pollution control technologies on a case-by-case basis and included in enforceable state permits.

40 CFR Section 51.308(f)(2)(ii) requires RIDEM OAR to consult with states containing Class I areas to develop the coordinated emission management strategies needed to make reasonable progress. RIDEM OAR must demonstrate that it has included all measures agreed to during state-to-state consultations or a regional planning process, or measures that will provide equivalent visibility improvement. RIDEM OAR must also consider the emission reduction measures identified by other states for their sources as being necessary to make reasonable progress. RIDEM OAR consulted with other states during the MANE-VU process to develop the 2017 Statement and has met the 2017 Statement as described in this section.

40 CFR Section 51.308(f)(2)(iii) requires RIDEM OAR to document the technical basis, including modeling, monitoring, cost, engineering, and emissions information, on which it is relying to determine the emission reduction measures that are necessary to make reasonable progress in

each Class I area it affects. RIDEM OAR is relying on the technical analyses developed by MANE-VU as included in this SIP and in the previous approved 2009 Regional Haze SIP.

Section 40 CFR 51.308(f)(2)(iv) requires that States must also consider the following factors when determining their long-term strategy:

1. Emissions reductions due to ongoing air pollution control programs;
2. Measures to mitigate construction activities;
3. Source retirement and replacement schedules;
4. Basic smoke management practices; and
5. The anticipated net effect on visibility due to projected changes in point area and mobile source over the planning period.

6.1 Long-Term Strategy Development Process

First Implementation Period – RIDEM OAR's 2009 Regional Haze SIP describes in detail the process by which the LTS for the first implementation period was developed. This work formed the basis for the LTS development process for the second implementation period and is summarized below.

Using information about emissions, costs, and potential impacts, the MANE-VU Reasonable Progress Workgroup for the first implementation period selected the following source categories for detailed analysis:[48]

- coal and oil-fired EGUs;
- point and area source ICI boilers;
- cement and lime kilns;
- low-sulfur heating oil; and
- residential wood combustion and open burning.

The analysis that produced this list is described in detail in the *Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas* (2007).[49] That report 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 considered the four factors to help MANE-VU members determine which emission control measures were needed to make reasonable progress in improving visibility.

[48] MACTEC Federal Programs, Inc., Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas, July 9, 2007. (Appendix to the 2012 RH SIP). Updated: 2016 Updates to the Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas. MARAMA. January 31, 2016. (Appendix 6)
[49] Included in RI 2009 RH SIP.

MANE-VU later extended that assessment with the *Addendum for Residual Oil* which provided a four-factor analysis for the low sulfur fuel oil strategy.[50]

MANE-VU then developed an interim list of control measures including beyond-CAIR sulfate reductions from EGUs, low-sulfur heating oil (residential and commercial), and controls on ICI boilers (both coal- and oil-fired), lime and cement kilns, residential wood combustion, and outdoor burning (including outdoor wood boilers). Member states determined that there were too few coal-fired ICI boilers in the MANE-VU states to be considered a “regional” control strategy but could be a sector pursued by individual states. They also determined that control of lime and cement kilns, of which there are few in the MANE-VU region, would likely be handled in each state’s BART determination process. Residential wood burning and outdoor wood boilers remained a strategy for those states where localized visibility impacts may be of concern (even though emissions from these sources are primarily organic carbon and direct particulate matter which are less important for regional haze). Finally, outdoor wood burning also was determined to be better left as a sector to be examined and controlled further by individual states due to issues of enforceability and penetration of existing state regulations.

These efforts led to the selection of the emission reduction strategies presented in the MANE-VU Statement for the first implementation period.[51] RIDEM OAR adopted those strategies (or equivalent alternatives) as its LTS,[52] which EPA approved in 2012. RIDEM OAR fully met the Statement for the first implementation period implementing a low- sulfur fuel oil regulation and adopting state regulations for outdoor wood boilers[53].

Second Implementation Period – For the second implementation period SIPs, MANE-VU began by examining how upwind states implemented control programs to address the Statement from the first implementation period[54] and specifically how the 167 stacks from the first implementation period reduced emissions[55]. MANE-VU then reviewed the measures outlined in *Beyond Sulfate: Maintaining Progress towards Visibility and Health Goals*[56] and carried several of them forward to further examine 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 6).[57] In that document MANE-VU updated and expanded the components listed below and considered the four factors required under the RHR.

[50] Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas: Methodology for Source Selection, Evaluation of Control Options and Four Factor Analysis – ADDENDUM FOR RESIDUAL OIL. MANE-VU. April 2011. (Appendix 1)
[51] See Rhode Island 2009 RH SIP for further details on the Ask for the first implementation period.
[52] RIDEM OAR along with other states adopted the Ask at the MANE-VU Board meeting on June 7, 2007.
[53] 250-RICR-120-05-48 has not been incorporated into the RI SIP. It is listed for informational purposes only.
[54] Miller, Paul. Overview of state and federal actions relative to MANE-VU Asks (March 28, 2013)
[55] 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. (Appendix 10)
[56] *Beyond Sulfate: Maintaining Progress towards Visibility and Health Goals*. NESCAUM. December 17, 2012. (Appendix 4)
[57] 2016 Updates to the Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas. MARAMA. January 31, 2016. (Appendix 6).

- Cost information in the following chapters: Chapter 2 - Source Category Analysis: EGUs; Chapter 4 - Source Category Analysis: Industrial, Commercial, and Institutional Boilers; Chapter 8 - Heating Oil; Chapter 9 - Residential Wood Combustion; Chapter 10 - Outdoor Wood Fired Boilers.

- Chapters on EGUs and ICI boilers (expanded to describe NOx emissions control options and costs).

MANE-VU conducted the Q/d and CALPUFF screening process (described in Section 5) to identify specific sources for further analysis and upwind states for consultation.

MANE-VU considered the results of the new work in light of the previous findings and previous Statement and developed a new Statement[58] to define the emissions management strategies that are necessary to make reasonable progress for the second implementation period. MANE-VU states agreed to this Statement in August 2017.

6.2 Satisfying the 2017 MANE-VU Statement "Asks"

This section lists the emission management strategies or "Asks" in the MANE-VU Statement (items 1-6) and how RIDEM OAR has addressed each of them. In developing the Statement as part of MANE-VU and in responding to the Statement, RIDEM OAR considered the reduction measures identified by other states as being necessary to make reasonable progress in all Class I areas. Since Rhode Island emissions had little or no impact in Class 1 areas RIDEM OAR's implementation of the 2017 MANE- VU Statement includes a continuation of the measures put in place in the 2009 SIP with no further regulatory action required at this time.

Ask 1*: Electric Generating Units (EGUs) with a nameplate capacity larger than or equal to 25 MW 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;*

MANE-VU observed that EGUs often only run NOx emissions controls to comply with ozone season trading programs and consequently, NOx sources may be uncontrolled during the winter and non-peak summer days. MANE-VU found that: (1) running existing installed controls [selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR)] is one of the

[58]MANE-VU developed three separate Asks, one each for states in MANE-VU, for states outside of MANE-VU that impact Class 1 areas in MANE-VU states, and for EPA and FLMs. This document only addresses the Ask relevant to Rhode Island as a state within MANE-VU (see Appendix 15). All of the Asks are available at the MANE-VU website: https://otcair.org/manevu/document.asp?fview=Formal%20Actions

most cost-effective ways to control NOx emissions from EGUs; and (2) that running existing controls year round could substantially reduce the NOx emissions in many of the states upwind of Class I areas in MANE-VU that lead to visibility impairment during the winter from nitrates.[59] MANE-VU included this as an emission management strategy because large EGUs had already been identified as dominant contributors to visibility impairment and the low cost of running already installed controls made it reasonable.

RIDEM identified five EGU's that meet the criteria of 25 MW or larger with installed controls. These sources are all Title V sources that were subject to PSD permitting requirements. A description of all permit requirements is listed in each sources Title V permit[60] and summarized in Table 6.1 below. The permits require facilities to operate their controls to meet the permit limits year-round except during start-up. The permits also require the performance of the unit and its controls to be verified. As each of these units are at Title V sources, the requirements and enforceability are reviewed at least once every five years, the sources are inspected every two years, and the permits are federally enforceable. Rhode Island currently satisfies the requirements of Ask 1.

Table 6-1 Rhode Island Electric Generating Units

Facility Name	Unit Size	Primary Fuel Type	Control Requirement
RI State Energy Center	596 MW	Natural Gas	SCR
Manchester Street Station	515 MW	Natural Gas (dual fuel capable distillate)	SCR
Ocean State Power	254.2 MW	Natural Gas (dual fuel capable distillate)	SCR
Ocean State Power II	254.2 MW	Natural Gas (dual-fuel capable distillate)	SCR
Tiverton	272.5 MW	Natural Gas	SCR
Pawtucket Power*	68.8 MW	Natural Gas (dual-fuel capable distillate)	SCR

*Permanently shut down

***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*

[59] Impact of Wintertime SCR/SNCR Optimization on Visibility Impairing Nitrate Precursor. MANE-VU Technical Support Committee. November 20, 2017. (Appendix 17)

[60] The most recent Title V permit for each source can be found at: https://dem.ri.gov/environmental-protection-bureau/air-resources/air-permits/operating-permits

(see attached listing[61]) - perform a four-factor analysis for reasonable installation or upgrade to emission controls;

After examining the visibility impact modeling results, described in Section 5, MANE-VU concluded that a 3 Mm-1 cutoff captured the group of sources contributing the largest percentage of visibility impairing pollutants to Class I areas. However, the determination of reasonability for controls on each unit was left to the individual states to allow for unit-specific consideration of the four factors.

The Statement identified no emission sources in Rhode Island 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 included in the "attached listing."[62]

Further analysis of the largest NOx and SO2 sources in RI was done to determine whether additional controls could be employed. Tables 6-2 and 6-3 list EGU and non-EGU sources in RI (2017 emissions) with SO2 with emissions greater than 10 tons per year and NOx emissions greater than 50 tons per year, respectively. A summary of emissions limitations and controls employed at each facility is given below and further summarized in Table 6-4. Also note that all sources identified are Title V sources with active operating permits.[63]

Table 6-2 SO2 Sources with emissions greater than 10 tpy (2017)

Facility	Jurisdiction	SO2 (tpy)
RHODE ISLAND HOSPITAL	PROVIDENCE	68.55
RHODE ISLAND LFG GENCO, LLC	JOHNSTON	48.42
RI RESOURCE RECOVERY CORPORATION*	JOHNSTON	20.54
NAVAL STATION NEWPORT	NEWPORT	15.36

*Draft permit under review

Table 6-3 NOx Sources with emissions greater than 50 tpy (2017)

Facility	Jurisdiction	NOx (tpy)
MANCHESTER STREET, LLC	PROVIDENCE	243.66
OCEAN STATE POWER	BURRILLVILLE	156.55
RHODE ISLAND LFG GENCO, LLC	JOHNSTON	77.57
RHODE ISLAND STATE ENERGY CENTER	JOHNSTON	67.71

[61] The listing can be found at: https://otcair.org/MANEVU/Upload/Publication/Formal%20Actions/MANE-VU%20Intra-Regional%20Ask%20Final%208-25-2017.pdf
[62] Ibid.
[63] The most recent Title V permit for each source can be found at: https://dem.ri.gov/environmental-protection-bureau/air-resources/air-permits/operating-permits

Facility	Jurisdiction	NOx (tpy)
R.I. CENTRAL POWER PLANT	CRANSTON	61.67
TORAY PLASTICS AMERICA, INC.	NORTH KINGSTOWN	60.08784
RHODE ISLAND HOSPITAL	PROVIDENCE	56.73311
TIVERTON POWER	TIVERTON	51.86794

Rhode Island Hospital
(Operating Permit RI-02-17)

Rhode Island Hospital operates 5 boilers that contribute the majority of the NOx and SO2 emissions. Boilers B002 (80.4 MMBTU/hr) and B003-B005 (62.6 MMBTU/hr each) are equipped with low-NOx burners, flue gas recirculation and an oxygen trim system, capable of burning #6 fuel oil and natural gas. Units B002 though B005 are subject to the applicable requirements of 40 CFR 63, Subpart A (General Provisions) and Subpart JJJJJJ (National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial and Institutional Boilers). B006 is an 89.66 MMBTU/hr boiler equipped with a low-NOx burner and flue gas recirculation, capable of burning natural gas only. B006 is subject to the applicable requirements of 40 CFR 60, Subparts A (General Provisions), and Dc (Small Industrial-Commercial-Institutional Steam Generating Units). Additionally, the facility operates 3 emergency/standby generators (1502 HP and 2-2847HP) burning natural gas. The operation of the units is limited to not more than 500 hours each in any 12-month period.

State of Rhode Island, Pastore Center
(Operating Permit RI-44-13)

The State of Rhode Island, Pastore center is a large campus operating several combustion units. B008 is a 142.7 MMBTU/hr boiler equipped with low-NOx burners and flue gas recirculation, capable of burning No. 2 fuel oil and natural gas. B008 is subject to the applicable requirements of the 40 CFR 60, Subparts A (General Provisions) and Db (Industrial-Commercial-Institutional Steam Generating Units). The facility also operates one portable boiler (B009) rated at 33.45 MMBTU/hr burning No. 2 oil. The portable boiler is subject to the requirements of the Federal 40 CFR Part 60 Subpart A (General Provisions) and 40 CFR Part 60 Subpart Dc (Small Industrial Commercial-Institutional Steam Generating Units).

The facility also operates two 51.1 MMBTU/hr turbines (G005 and G006) each equipped with 47.7 MMBTU/hr heat recovery steam generators and supplemental firing duct burners. All units are capable of burning No. 2 fuel oil and natural gas. The units are subject to the requirements of 40 CFR 60 Subpart A, “General Provisions” and Subpart GG (Stationary Gas Turbines). The duct burners are subject to the requirements of 40 CFR 60 Subpart A, “General Provisions” and Subpart Dc (Small Industrial Commercial-Institutional Steam Generating Units).

The facility also operates a several small emergency and emergency generators that burn diesel or propane fuel that are fully detailed in the operating permit. Emissions from these units are insignificant.

Ocean State Power

(Operating Permit RI-15-12)

Ocean State Power (I,II) (OSP) operates four 105 MW combustion turbines, capable of burning #2 fuel oil and natural gas equipped with selective catalytic reduction systems. Oil use is limited to that needed to maintain oil system readiness and times when natural gas is unavailable and, during the period 1 October to 30 April, on a discretionary basis as limited by the permit. Additionally, oil use is limited to 1200 hours in each of the turbines in any consecutive 12-month period for conditions where natural gas is deemed unavailable and the combined quantity of fuel oil combusted during discretionary oil burning is limited to 4,539,000 gallons or less for any consecutive 12-month period. The units are subject to the requirements of 40 CFR 60 Subpart A, (General Provisions), Subpart Da (Electric Utility Steam Generating Units) and GG (Stationary Gas Turbines)

Insignificant emissions of NOx and SO2 are generated by four 749 HP emergency/standby engines burning diesel fuel. These units are limited to 500 hours each, in any 12- month period. Additionally, OSP operates one 235 HP emergency fire pump that is subject to the requirements of 40 CFR 63.1-15, Subpart A, “General Provisions” [as indicated in Table 8 to Subpart ZZZZ of 40 CFR 63] and 40 CFR 63, Subpart ZZZZ “National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines”.

Rhode Island LFG, Genco

(Operating Permit RI-41-09 (R2))

Rhode Island LFG, Genco operates nine 2400 HP Waukesha/Dresser Industries engine – generator sets which burn landfill gas. The emission rate of nitrogen oxides from the nine engines combined is limited to 14,166 lbs per month. The facility also operates four 2229 HP engine - generator sets also burning landfill gas.

Rhode Island State Energy Center

(Operating Permit RI-46-15)

Rhode Island State Energy Center operates two natural gas fired combustion turbine (CT) units each of which discharges exhaust gas through an associate heat recovery steam generator (HRSG). Each HRSG is equipped with duct firing capability. The facility is authorized to operate either or both CT’s independently of one another, and either or both sets of duct burners independently of one another. The turbines are 185 MW each and equipped with 102.5

MMBTU/Hr (HHV) duct burners in each of the HRSG. They are equipped with SCR systems. All units burn natural gas. The combined quantity of natural gas combusted in the two duct burners in the two heat recovery steam generators shall not exceed 564,466,000 ft3 per year (12-month rolling average). The total quantity of nitrogen oxides discharged to the atmosphere from the entire facility shall not exceed 312,000 lbs. in any consecutive 12-month period.

The facility operates one 265 HP emergency diesel fire pump engine which burns #2 fuel oil. The unit is subject to the requirements of 40 CFR 63.1-15, Subpart A, "General Provisions" and 40 CFR 63, Subpart ZZZZ "National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines".

Manchester Street Station
(Operating Permit RI-22-13)

Manchester St Station operates three 119.05 MW combustion turbines capable of burning #2 fuel oil and natural gas equipped with an SCR system**.** The combined quantity of fuel oil combusted during discretionary oil burning to 6,615,000 gallons or less for any consecutive 12-month period. The turbines are subject to the requirements of 40 CFR 60 Subpart A, (General Provisions) and GG (Stationary Gas Turbines).

Tiverton Power
(Operating Permit RI-26-13)

Tiverton operates a 190.55 MW combustion turbine combined cycle unit which burns natural gas. It is equipped with an SCR system and subject to applicable requirements of the Federal New Source Performance Standards 40 CFR 60 Subpart A, (General Provisions) and Subpart GG (Stationary Gas Turbines). Additionally, the facility operates a 235 HP internal combustion engine which burns #2 fuel oil. The engine is subject to the requirements of 40 CFR Part 63.1-15, 40 CFR Part 63, Subpart A, (General Provisions) and 40 CFR Part 63, Subpart ZZZZ (National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines).

Rhode Island Resource Recovery Corporation (RIRRC)
(Operating Permit RI-XX-XX)

The sulfur emissions noted at RIRRC for 2017 were generated from a flare[64] used for control of landfill gas emissions. The flare is to be operated at all times when collected landfill gas is routed to the system and shall have no visible emission. The operating permit for this source is under review. The facility will be subject to the requirements of 40 CFR 60 Subpart A, (General Provisions) and XXX (Standards of Performance for Municipal Solid Waste Landfills that Commenced Construction, Reconstruction, or Modification After July 17, 2014).

[64] RIRRC transferred operation of the flares to a private entity after 2017.

Naval Station Newport

(Operating Permit RI-25-21)

Naval Station Newport is a large campus operating several large boilers throughout the facility. Boiler 7CC -B1 and B2 are two large boilers which have the maximum capacity of 92.5 MMBTU/hr when burning #4 fuel oil or 96.2 MMBTU/hr when burning natural gas. Each boiler is equipped with low-NOx burners, flue gas recirculation and an oxygen trim system. Annual fuel usage is limited to 7,590,000 gallons in any consecutive 12-month period. The boilers are subject to the requirements of 250-RICR-120-05-27, "Control of Nitrous Oxide Emissions," as applicable, 40 CFR 63, Subpart A (General Provisions and Subpart JJJJJJ (National Emissions Standards for Hazardous Air Pollutants for Industrial, Commercial and Institutional Boilers), as applicable.

Boiler 7CC-B3 has a maximum capacity of 32.21 MMBTU/hr when burning #4 fuel oil or 31.16 MMBTU/hr when burning natural gas. Each boiler is equipped with low-NOx burners, flue gas recirculation and an oxygen trim system and annul fuel oil usage is limited to 491,486 gallons in any consecutive 12-month period. The boiler is subject to the requirements of 40 CFR 60, Subpart A (General Provisions), 40 CFR 60 Subpart Dc (Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units), and Subpart JJJJJJ (National Emissions Standards for Hazardous Air Pollutants for Industrial, Commercial and Institutional Boilers), as applicable.

Boiler 7CC-B4 has a maximum capacity of 95.8MMBTU/hr when burning natural gas or 92.4 MMBTU/hr when burning #2 fuel oil. The boiler is equipped with low-NOx burners with flue gas recirculation and annual fuel oil usage is limited to 3,000,000 gallons in any consecutive 12-month period. The boilers are subject to the requirements of 250-RICR-120-05-27 "Control of Nitrogen Oxide Emission," 40 CFR 60, Subpart A (General Provisions), 40 CFR 63, Subpart A (General Provisions) and Subpart JJJJJJ (National Emissions Standards for Hazardous Air Pollutants for Industrial, Commercial and Institutional Boilers), as applicable.

Boiler 27ACHI B1 and B2 are 16.76 MMBTU/hr boilers capable of firing natural gas and No 2 fuel oil. The boilers are subject to the tune-up procedures in 250-RICR-120-05-27 "Control of Nitrogen Oxide Emission." The boilers are subject 40 CFR 60, Subpart A (General Provisions), 40 CFR 60 Subpart Dc (Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units), 40 CFR 63, Subpart A (General Provisions), and Subpart JJJJJJ (National Emissions Standards for Hazardous Air Pollutants for Industrial, Commercial and Institutional Boilers), as applicable.

The facility also operates twenty smaller boilers throughout that are all less than 4 MMBTU/hr and all burn #2 fuel oil. The sulfur content of the oil used in the boilers must be less than 0.0015% by weight. Additionally, there are thirty-seven natural gas fired boilers all less than 10 MMBTU/hr operating at the facility. The boilers are subject to the requirements of in 250-RICR-120-05-27 "Control of Nitrogen Oxide Emissions," 40 CFR 63, Subpart A (General Provisions and

Subpart JJJJJJ (National Emissions Standards for Hazardous Air Pollutants for Industrial, Commercial and Institutional Boilers), as applicable.

Insignificant emissions units at Naval Station Newport include nine burners using liquified petroleum gas for fire fighter trainer and thirty-one small emergency generators/fire pumps burning diesel or propane. All emergency generators/fire pumps are limited to 500 hours each during any consecutive 12-month period. The facility is subject to the requirements of 40 CFR 63, Subpart A (General Provisions and Subpart ZZZZ (National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines), as applicable.

Additional insignificant emissions units at the facility include five emergency generators burning natural gas and range in size from 107HP to 402HP and 14 emergency generators burning diesel fuel ranging in size from 85 HP to 685HP. All units are limited to 500 hours each in any consecutive 12-month period. The natural gas fired units are subject to the requirement of 250-RICR-120-05-43, General Permits for Smaller-Scale Electric Generation Facilities," 40 CFR 60, Subpart A (General Provisions), and Subpart JJJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines), as applicable. The diesel fired units are subject to the requirement of 250-RICR-120-05-43, General Permits for Smaller-Scale Electric Generation Facilities," 40 CFR 60, Subpart A (General Provisions), and Subpart III (Standards of Performance for Stationary Compression Internal Combustion Engines), as applicable.

Toray
(Operating Permit RI-28-20)

Toray operates one 93.6 MMBTU/hr (oil) / 98.5 MMBTU/hr (natural gas) boiler equipped with low NOx burners with flue gas recirculation. The facility also operates a natural gas fired 40.4 MMBTU/hr boiler with a low NOx burner. The units are subject to the applicable requirements of 40 CFR 60, Subparts A (General Provisions), and Dc (Small Industrial Commercial-Institutional Steam Generating Units). The larger unit is subject to the applicable requirements of 40 CFR 63, Subparts A (General Provisions), and JJJJJJ (National Emissions Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources).

Toray also operates a 5 MW Kawasaki lean-burn engine which burns natural gas with an SCR/Oxidation Catalyst System using urea injection and a 7.5 MW lean-burn engine which burns natural gas and is equipped with an SCR/Oxidation Catalyst System using urea injection. subject to the requirements of 40 CFR 60, Subpart A (General Provisions) and Subpart JJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines).

Th facility has a 97 MMBTU/hr turbine-generator which burns natural gas and low sulfur fuel oil and is equipped with a SoLoNOx lean-premixed combustion system for NOx. The total combined quantity of fuel oil combusted in the combustion turbine to 46,200 gallons for any consecutive 12-month period. The units are subject to the requirements of 40 CFR 60, Subpart A (General Provisions) and Subpart GG (Stationary Gas Turbines).

As discussed above all of the units analyzed are required to comply with all applicable Federal and State regulations as identified in each sources enforceable permit. Required source testing and reporting submittals (annual, semiannual, quarterly, and/or stack test) are reviewed by RIDEM OAR as applicable, sources are inspected biennially for compliance with these requirements, and the Title 5 permits are updated and renewed every five years with a public comment period required. Appropriate control equipment has been employed by all sources analyzed as required by Federal and State Requirements. No further controls are warranted for these sources.

Table 6-4 EGU's and Largest NOx and SO2 Facility Summary[65]

Facility	**Pollutant**	**Emission Limitations**[1] **(lb/hr) (Fuel type)**				**Controls**	**Emission Units**
		Natural Gas	**#2 Fuel Oil**	**Co-firing NG+Oil**	**Landfill Gas**		
Ocean State Power (I/II)	NOx [9]	37.4[2]	81.6	see note 5	--	SCR There shall be no bypassing of each SCR system during startup, operation, or shutdown. The SCR systems shall be operated according to their design specifications.	**4 x 105 MW combustion turbines**[6,7,8]
		53[3]	4000[4]				
	SO2	3.1[2]	1.85	see note 5	--		
		4.2[3]					
Manchester Street Station	NOx[13]	47.5	78.78	--	--	SCR The SCR systems shall be operated according to their design	**3 x 119.5 MW combustion turbines**[12,14]
		300[16]	300[16]				

[65] Summary information as of 1/17/2025 https://dem.ri.gov/environmental-protection-bureau/air-resources/air-permits/operating-permits.

Facility	Pollutant	Emission Limitations[1] (lb/hr) (Fuel type)				Controls	Emission Units
		Natural Gas	**#2 Fuel Oil**	**Co-firing NG+Oil**	**Landfill Gas**		
			4000[10]			specifications whenever the turbines are in operation or are emitting air contaminants.	
	SO2[13]	73.13[15]	63.8	--	--		
			3211.2[11]				
Tiverton Power	NOx [20]	27.47 (1-hr average)	--	--	--	SCR There shall be no bypassing of the SCR system during startup, operation, or shutdown. Ammonia will not be injected during start-up or shutdown unless the catalyst bed is at or above 400oF. The SCR system shall be operated according to its design specifications whenever the turbine is in operation or is emitting air contaminants.	**1 x 190.55 MW combustion turbine**[17,18,22]
		22.76 (24-hr block avg)					
		317[16]					
	SO2[21]	12.78	--	--	--		
		12.78[16]					
RI State Energy Center (Entergy)	NOx[20]	16.2[23]	--	--	--	SCR There shall be no bypassing of each SCR system during startup, operation, or shutdown.	**2 x 185 MW combustion turbines**, each equipped with an associated heat recovery steam generator having a 102.5 MMBtu/hr duct burner[14,25,26,27]
		17[24]					
		195[29]					

Facility	Pollutant	Emission Limitations[1] (lb/hr) (Fuel type)				Controls	Emission Units
		Natural Gas	#2 Fuel Oil	Co-firing NG+Oil	Landfill Gas		
		129[30]				The SCR systems shall be operated according to their design specifications whenever the turbines are in operation or are emitting air contaminants.	
	SO2[28]	11.8[23]	--	--	--		
		12.4[24]					
RI LFG Genco	NOx[34]	--	--	--	2.46	Air-fuel ratio control system[33]	**4 x 2229 HP engine-generator sets[31],[32,36,41]**
	SO2	--	--	--	--	Flare[35]	
	NOx	--	--	--	7.95[40]	SCR Each SCR system shall be operated at all times that the inlet temperature of the SCR catalyst is 600º F or greater. Each SCR system shall be operated according to its design specifications whenever the combustion turbines are in operation or is emitting air contaminants.	**4 x 6 MW combustion turbines[31],[36,37,41,42]**
		--	--	--	24.4[43] (lbs per event)		
		--	--	--	18.3[44] (lbs per event)		
		--	--	--	6.0[45] (lbs per event)		
		--	--	--	5.5[46] (lbs per event)		
	SO2	--	--	--	2.70[38,39]		
RI Hospital	NOx	0.1 lbs/MMBTU				Low-NOx burners, flue gas recirculation and an oxygen trim system, capable of burning #6	**3x62.6 MMBTU/hr boiler**
	SO2		**[47]				

Facility	Pollutant	Emission Limitations[1] (lb/hr) (Fuel type)				Controls	Emission Units
		Natural Gas	#2 Fuel Oil	Co-firing NG+Oil	Landfill Gas		
						fuel oil and natural gas When fired with residual oil, each boiler shall be equipped with low-NOx burners and flue gas recirculation (with a minimum of 10% flue gas recirculation	
	NOx	3.31 lb/hr	--	--	--	low-NOx burner and flue gas recirculation, capable of burning natural gas only	**1x 89.66 MMBTU/hr boiler**
	SO2	--	--	--	--		
	NOx	--	**[47]	--	--	m/a	**1x1502 NP engine generator set, 2 x 2847 HP non-emergency engine-generator sets.**[48,49,50]
	SO2	--	**[47]	--	--		
	NOx	--	41.87	--	--		**1 x 2937 HP non-emergency engine-generator set.**[48,51,52]
	SO2	--	0.03	--	--		
State of Rhode Island Pastore Center (RI Department of Administration)	NOx	0.036 lbs/MMBTU or 5.14 lbs/hr	0.1 lbs/MMBTU or 14.3 lbs/hr			Low-NOx burners, flue gas recirculation, capable of burning #2 fuel oil and natural gas. All fuel burned shall contain no more than 0.3 percent sulfur by weight.	**1 x 142.7 MMBTU/hr boiler**
	SO2		45.9 lb/hr				
	Emissions limitations dependent on firing configuration as follows:						**2x 51.1 MMBTU/HR**

Facility	**Pollutant**	**Emission Limitations[1] (lb/hr) (Fuel type)**				**Controls**	**Emission Units**
		Natural Gas	**#2 Fuel Oil**	**Co-firing NG+Oil**	**Landfill Gas**		
	1 -Turbines firing natural gas with duct burners not fired • NOX - 48.6 lb/hr. • SO2 - Sulfur content may not be in excess of 0.8 percent by weight. 2. Turbines firing fuel oil with duct burners not fired. • NOx – 19.9 lb/hr • SO2 – 16.4 lb/hr and all fuel oil burned in the turbine shall contain no more than 0.30 percent sulfur by weight 3. Turbines firing natural gas with duct burners firing natural gas • NOx – 13.85 lb/hr • SO2 - - Sulfur content may not be in excess of 0.8 percent by weight 4. Turbines firing natural gas with duct burners firing No. 2 fuel oil • NOx – 14.8 lb/hr • SO2 – 14.82 lb/hr, all fuel oil burned in the turbine shall contain no more than 0.30 percent sulfur by weight, and sulfur content of the natural gas may not be in excess of 0.8 percent by weight 5. Turbines firing fuel oil with duct burners firing No. 2 fuel oil • NOx – 26.1 lb/hr • SO2 – 31.9 lb/hr and all fuel oil burned in the turbine shall contain no more than 0.30 percent sulfur by weight 6.Turbines firing fuel oil with duct burners firing natural gas • NOx – 25.15 lb/hr • SO2 – 16.43lb/hr and all fuel oil burned in the turbine shall contain no more than 0.30 percent sulfur by weight						**combustion turbine, 2x 47.7 MMBTU/hr heat recovery steam generators[53]**
Toray	NOx	3.23 lbs/hr	7.10 lbs/hr			Low-NOx burners NG only unit and flue gas recirculation on larger unit, capable of burning #2 fuel oil and natural gas.	**Boilers1 x 40.4 MMBTU/hr 1x 93.6 MMBTU/hr (oil) / 98.5 MMBTU/hr (natural gas**
	SO2	--	4.77 lb/hr				

<table>
<tr><th>Facility</th><th>Pollutant</th><th colspan="4">Emission Limitations[1] (lb/hr)
(Fuel type)</th><th>Controls</th><th>Emission Units</th></tr>
<tr><td></td><td></td><td>Natural Gas</td><td>#2 Fuel Oil</td><td>Co-firing NG+Oil</td><td>Landfill Gas</td><td></td><td></td></tr>
<tr><td></td><td colspan="5">Emissions limitations dependent on firing configuration as follows:
1 -Turbines firing natural gas with duct burners not fired
• NOX - 8.2 lb/hr.
• SO2 - Sulfur content may not be in excess of 0.8 percent by weight.
2. Turbines firing fuel oil with duct burners not fired.
• NOx – 31.4 lb/hr
• SO2 – 2.4 lb/hr and all fuel oil burned in the turbine shall contain no more than 0.30 percent sulfur by weight
3. Turbines firing natural gas with duct burners fired
• NOx – 12 lb/hr
• SO2 - - Sulfur content may not be in excess of 0.8 percent by weight
4. Turbines firing fuel oil with duct burners fired
• NOx – 35.3 lb/hr
• SO2 – 4.1 lb/hr and all fuel oil burned in the turbine shall contain no more than 0.30 percent sulfur by weight</td><td></td><td>97 MMBTU/HR heat recovery steam generators[53]</td></tr>
<tr><td rowspan="2">Naval Station Newport</td><td>NOx</td><td>0.01 lb3/MMBTU</td><td>--</td><td>--</td><td>--</td><td rowspan="2">Low-NOx burners, flue gas recirculation and an oxygen trim system</td><td rowspan="2">Boiler 7CC -B1 and B2 -92.5 MMBTU/hr when burning #4 fuel oil or 96.2 MMBTU/hr Nat Gas</td></tr>
<tr><td>SO2</td><td>--</td><td>--[47]</td><td>--</td><td>--</td></tr>
<tr><td></td><td>NOx</td><td>1.16 lb/hr</td><td>15.58 lb/hr (#4 fuel oil)</td><td>--</td><td></td><td rowspan="2">Low-NOx burners, flue gas recirculation and an oxygen trim system</td><td rowspan="2">Boiler 7CC-B3 32.21 MMBTU/hr when burning #4 fuel oil or 31.16 MMBTU/hr Nat Gas</td></tr>
<tr><td></td><td>SO2</td><td>--</td><td>16.69 lb/hr(#4 oil)</td><td></td><td></td></tr>
<tr><td></td><td>NOx</td><td>3.45 lb/hr</td><td>7.21 lb/hr (#4 fuel oil)</td><td></td><td></td><td rowspan="2">Low-NOx burners, flue gas recirculation</td><td rowspan="2">Boiler 7CC-B4 95.8MMBTU/hr when burning natural gas or 92.4 MMBTU/hr #4 oil</td></tr>
<tr><td></td><td>SO2</td><td>--</td><td>28.1 lb/hr (#4 fuel oil)</td><td></td><td></td></tr>
<tr><td></td><td>NOx</td><td>2.01 lb/hr</td><td>4.19 lb/hr (#2 oil)</td><td></td><td></td><td rowspan="2"></td><td rowspan="2">Boiler 27ACHI B1 and B2 are 16.76 MMBTU/hr</td></tr>
<tr><td></td><td>SO2</td><td>--</td><td>1.026 lb/hr (#2 oil)</td><td></td><td></td></tr>
</table>

Notes (table 6.4)	
1	Emission limitations (in lb/hr) are for each emissions unit, if multiple units listed. If emissions limits are in different units, it is listed next to the emissions limitation.
2	Emissions from each flue shall not exceed this value when both turbines in 2-turbine combined cycle system are operating.
3	Emissions from each flue shall not exceed this value when 1-turbine in 2-turbine combined cycle system is operating.
4	Total NOx emissions from the 4 turbines combined, during discretionary oil firing, shall not exceed 4000 lbs/month based on 12-month rolling average.
5	When firing natural gas and fuel oil simultaneously, the emission limitation for NOx and SO2 shall be determined by the following equation:
5 (cont)	$E_{co} = (E_{gas})(H_{gas}) + (E_{oil})(H_{oil})/(H_{gas} + H_{oil})$ where: E_{CO} = emission limitation (lb/hr)during co-firing of natural gas and fuel oil E_{gas} = emission limitation (lb/hr)during natural gas firing H_{gas} = heat input from the combustion of natural gas (MMBtu) E_{oil} = emission limitation (lb/hr) during fuel oil firing H_{oil} = heat input from the combustion of fuel oil (MMBtu)
6	In no event shall the hours of operation on oil exceed 1200 hours in either turbine in any consecutive 12 month period for conditions where natural gas is deemed unavailable.
7	The permittee shall limit the combined quantity of fuel oil combusted during discretionary oil burning to 4,539,000 gallons or less for any consecutive 12-month period.
8	The duct burners shall be fired with natural gas only.
9	The permittee shall certify, operate, and maintain, in accordance with the requirements of 40 CFR Part 75, a NOx continuous emission monitoring system to measure NOx emission rate and fuel flow meters for natural gas and fuel oil to measure heat input rate.
10	Total NOx emissions from the 3 turbines combined, during discretionary oil firing, shall not exceed 4000 lbs/month based on 12-month rolling average.
11	Total SO2 emissions from the 3 turbines combined, during discretionary oil firing, shall not exceed 3211.2 lbs/day.
12	The permittee shall limit the combined quantity of fuel oil combusted during discretionary oil burning to 6,615,000 gallons or less for any consecutive 12-month period.
13	Continuous Emission Monitoring Systems (CEMS) shall be operated and maintained in the exhaust stream of each turbine for nitrogen oxides and sulfur dioxide.
14	The permittee shall continuously measure natural gas and fuel oil flows to each turbine. The permittee shall determine and record the heat input to each turbine for every hour or part of an hour any fuel is combusted following the procedures in 40 CFR 75, Appendix F.
15	When firing natural gas, the permittee shall calculate the sulfur dioxide emissions for each hour of operation as follows:

Notes (table 6.4)	
	$M_{SO2g} = ER_{SO2} \times HI_g$ $$HI_g = Q_h \left[\frac{(100 - \%H_2O)}{100\ F_c}\right]\left[\frac{\%CO_{2d}}{100}\right]$$ where: M_{SO2g} =Hourly mass of SO_2 emissions from the combustion of pipeline natural gas, lb/hr. ER_{SO2} = SO_2 emission rate of 0.0006 lb/MMBTU for pipeline natural gas. HI_g = Hourly heat input of pipeline natural gas calculated using the procedures in Appendix F of 40 CFR 75, in MMBTU/hr. Q_h = Hourly average volumetric flow rate, wet basis, scfh F_c = 1040 scf CO_2/MMBTU $\%H_2O$ = Moisture content of gas in the stack, percent $\%CO_{2d}$ = Hourly concentration of CO_2, percent CO_2 dry basis (see 40 CFR 75 Appendix F, Section 5.2.2)
16	Emission limits during startup/shutdown conditions for each turbine.
17	Natural gas shall be the only fuel fired in the turbine.
18	Natural gas consumption in the turbine shall not exceed 15,300 million standard cubic feet in any consecutive 12-month period.
19	Turbine operation shall be limited to 8,322 hours in any consecutive 12-month period.
20	Continuous emission monitoring equipment shall be operated and maintained for nitrogen oxides and ammonia.
21	The permittee shall certify, operate, maintain and record the output of fuel flow meters for natural gas and calculate the sulfur-dioxide emissions for each hour of operation as follows:
	$M_{SO2g} = ER_{SO2} \times HI_g$ where: M_{SO2g} =Hourly mass of SO_2 emissions from the combustion of pipeline natural gas, lb/hr. ER_{SO2} = SO_2 emission rate of 0.0006 lb/MMBTU for pipeline natural gas. HI_g = Hourly heat input of pipeline natural gas calculated using the procedures in Section 3.4.1 of Appendix D of 40 CFR 75, in MMBTU/hr. HIg = (Qg x GCVg)/10000 [Equation D-6 of section 3.4.1 of Appendix D to Part 75] where: Qg = Fuel consumption in 100 scf/hr. GCVg = Gross calorific value of natural gas fuel in BTU/scf provided by natural gas supplier on a monthly basis.
22	Natural gas flow to the combustion turbine shall be continuously measured.
23	Emission limitations from each turbine with NO duct burners firing.
24	Emission limitations from each turbine with duct burners firing.
25	Natural gas shall be the only fuel fired in the turbines and the duct burners.
26	The combined quantity of natural gas combusted in the two duct burners in the two heat recovery steam generators shall not exceed 564,466,000 ft3 per year (12-month rolling average)
27	The permittee shall operate and maintain a continuous on-line gas chromatograph to measure the gross calorific value (GCVg) of the natural gas in accordance with the manufacturer's instructions.

Notes (table 6.4)	
28	The permittee shall certify, operate, maintain and record the output of fuel flow meters for natural gas and calculate the sulfur-dioxide emissions for each hour of operation as follows: $M_{SO2g} = ER_{SO2} \times HI_g$ where: M_{SO2g} =Hourly mass of SO_2 emissions from the combustion of pipeline natural gas, lb/hr. ER_{SO2} = SO_2 emission rate of 0.0006 lb/MMBTU for pipeline natural gas. HI_g = Hourly heat input of pipeline natural gas calculated using the procedures in Appendix F of 40 CFR 75, in MMBTU/hr. HIg = (Qg x GCVg)/10000 where: Qg = Fuel consumption in 100 scf/hr. GCVg = Gross calorific value of natural gas fuel in BTU/scf as measured by a continuous on-line gas chromatograph, provided on an hourly basis.
29	Emission limits during turbine startup.
30	Emission limits during turbine shutdown.
31	The landfill gas shall be filtered, de-watered, and compressed prior to use in the engines and turbines in accordance with the provisions of 40 CFR 60.752(b)(2)(iii)(C).
32	Only landfill gas shall be used as an engine fuel.
33	The permittee shall continuously monitor the actual charge density of the air/fuel mixture.
34	The permittee shall generate a graph that tracks actual charge density, desired charge density, engine load and nitrogen oxides emissions through one complete cycle of 100 percent load to 0 percent load to 100 percent load during each performance test. The permittee shall record emissions factor, specific heat ratio, and the flash file (combustion control software) serial number during each performance test.
35	Excess landfill gas, not used as a fuel in an engine, must be flared.
36	The permittee shall install and maintain an automatic fail-safe block valve on each engine and each turbine listed in this section. The fail-safe block valve must stop the flow of landfill gas in the event of an engine failure and in the event of a combustion turbine failure.
37	Landfill gas shall be the primary fuel for the combustion turbines listed in this section. The use of propane as an auxiliary fuel shall be limited to startup only.
38	The permittee shall monitor the total sulfur content of the landfill gas being fired in each combustion turbine listed in this section daily.
39	The permittee may develop a custom schedule for determination of the total sulfur content of the landfill gas following the requirements in 40 CFR 60.4370(c).
40	Performance testing shall be conducted annually to determine compliance with the nitrogen oxide emission limitation.
41	Excess landfill gas, not used as a fuel in a combustion turbine listed in this section, must be flared or combusted in the engines.
42	The maximum heat input rate to each of the combustion turbines listed in this section shall not exceed 80.04 million BTUs per hour at 0ºF.
43	Emission limitation from each turbine during cold startup operations.
44	Emission limitation from each turbine during warm startup operations.
45	Emission limitation from each turbine during hot startup operations.
46	Emission limitation from each turbine during shutdown operations.
47	Subject to 250-RICR-120-05-8 Sulfur Content of Fuels .0015%sulfur by weight (15ppm)
48	All diesel fuel burned in each engine-generator set shall contain no more than 0.0015 % sulfur by weight (15 ppm)
49	The maximum firing rate for each engine-generator set shall not exceed 144.5 gallons per hour.
50	Each engine-generator set shall not operate more than 500 hours in any 12-month period.

Notes (table 6.4)	
51	The maximum firing rate for the engine/generator set shall not exceed 138.9 gallons per hour.
52	The engine-generator set shall not operate more than 300 hours in any consecutive 12-month period.
53	Each turbine-generator set is subject to the requirements of 40 CFR 60 Subpart A, “General Provisions” and Subpart GG (Stationary Gas Turbines). The duct burners are subject to the requirements of 40 CFR 60 Subpart A, “General Provisions” and Subpart Dc (Small Industrial Commercial-Institutional Steam Generating Units)

Rhode Island satisfies the requirements of Ask 2.

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*

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

As described in Section 3, RIDEM OAR met the requirements of Ask 3 during the first implementation period by adopting low-sulfur oil regulations (250-RICR-120-05-8, “Sulfur Content of Fuels”) that were fully implemented July 1, 2018. Rhode Island continues to enforce this rule and has satisfied the requirements of Ask 3.

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.*

MANE-VU chose this measure because the lower cost of natural gas had made switching to natural gas reasonable for many facilities resulting in significant visibility improvements. Also, the FLMs had recommended during consultation that MANE-VU secure these visibility gains. The threshold of 250 MMBTU per hour heat input was based on prior BART analysis.

There are no large coal burning units or non-EGU units having a heat input capacity larger than 250 MMBtu/hr in Rhode Island, therefore this Ask would only pertain to EGU’s having a heat input capacity greater than 250 MMBtu/hr. Table 6-1 identifies three EGU’s meeting this threshold with the ability to burn both natural gas and oil; Ocean State Power, Ocean State Power 2, and Dominion Manchester St Station. These EGUs are all subject to Title V permitting requirements under 250-RICR-120-05-29 "Operating Permits." These sources are reviewed every five years, and the permits specify allowable operating scenarios, including fuels fired. A change in fuel type that may increase emissions, or is not otherwise allowed by permit, triggers requirements for a new or modified permit. The most recent operating permits for these sources listing permitted emission rates for SO2, NOx, and PM under different operating scenarios can be found at https://dem.ri.gov/environmental-protection-bureau/air-resources/air-permits/operating-permits. Additionally, this information has been summarized in Table 6-4.

Rhode Island satisfies the requirements of Ask 4.

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.*

High electric demand days 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 megawatts 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;

MANE-VU found a correlation between high electric demand days (HEDDs) and the 20% most impaired days at Class I areas.[66] Because smaller turbines have the ability to respond to peak electrical demand and some of these units are not well controlled by existing rules (i.e., have a higher emission rates per unit of energy), MANE-VU found that controlling these units (or providing equivalent reductions on HEDDs) was a reasonable strategy for reducing NOx emissions on the most impaired days.

[66] High Electric Demand Days and Visibility Impairment in MANE-VU. December 20, 2017. (Appendix 18)

RIDEM OAR reviewed permit files, air pollution inventory files, RI Office of Energy Resource data, and Energy Information Administration data found on EIA Form 860[67] and found no units that met the requirements of this Ask. Therefore, RIDEM OAR has not identified any turbines rated at 15 MW or higher that were operational prior to 2007 that sold electricity to the grid and that operated less than an average of 1752 hours per year during 2014-2016.

Rhode Island satisfies the requirements of Ask 5.

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.*

Energy Efficiency

Rhode Island is a nationally recognized leader in energy efficiency and was ranked the seventh most energy-efficient state in the country in 2022 with energy efficiency programming achieving savings of 1.8% of electricity consumption and 0.74% of natural gas consumption, based on 2021 data.[68] Rhode Island's Office of Energy Resources continuously develops, administers, and monitors a variety of programs designed to promote energy efficiency, renewable energy, alternative fuels, and energy assurance. Major programs are discussed below.

Lead by Example, Executive Order 23-06 directs "State Agencies to Lead by Example in Energy Efficiency and Clean Energy." This Executive Order updates the targets and responsibilities of the "Lead by Example" program within the Office of Energy Resources (OER) "to oversee and coordinate efforts at State agencies to reduce energy consumption and greenhouse gas emissions".

The **Public School Energy Equity Program**, a vital part of the "Lead by Example" (LBE) initiative, has rapidly evolved into a key driver for energy-efficient practices in the public sector. In an ambitious endeavor to enhance energy efficiency across Rhode Island's public schools, particularly focusing on high-need communities, the program encompassed ten school districts, integrating additional initiatives like the Building Automation Accelerator and the Heat-Pump Water Heater Accelerator. These expansions build upon the foundational success of the initial Lighting Accelerator, illustrating the program's adaptability and responsiveness to evolving energy needs.

[67] Data from EIA Form 860 was Evaluated for RI sources operating 2014-2016 and prior to 2007. https://www.eia.gov/electricity/data/eia860/

[68] 2022 Annual Report. https://energy.ri.gov/resources

The program's success is measured in concrete terms: significant reductions in energy consumption and costs, creation of clean energy jobs, and the transformation of school environments with better lighting and temperature control. Achieving these milestones has been possible due to the comprehensive support offered by the program, encompassing technical assistance, procurement support, implementation oversight, and substantial financial incentives, often fully covering project costs. A testament to the program's impact is the improvement of 28 schools, encompassing an area of 2,298,983 square feet. These improvements have led to a lifetime estimated energy saving of 43,238,884 kWh.[69]

The Efficient Buildings Fund established under Rhode Island General Laws, Chapter 46-12.24.2 is jointly administered by the Office or Energy Resources and the Rhode Island Infrastructure Bank. The fund provides financing to municipalities, schools, and quasi-governmental agencies pursuing cost-effective energy efficiency and/or renewable energy projects. As of 2022 the fund has provided approximately 70 million dollars for energy efficiency and renewable energy projects.[70]

Electric vehicle programs include the **Electrify RI** program, an electric vehicle (EV) charging station incentive program that seeks to make more charging stations accessible to Rhode Island drivers. Increasing the availability of charging stations encourages residents and businesses to make the switch to electric vehicles and will reduce transportation-related carbon emissions and pollutants. The **DRIVE EV** program offers rebate incentives for the purchase of electric vehicles. The DRIVE EV Rebate program was expanded to include electric bicycles, **Erika Niedowski Memorial Electric Bicycle Rebate Program**, making them more affordable and accessible to Rhode Islanders. These successful electric vehicle programs contribute to reductions in transportation related emissions.

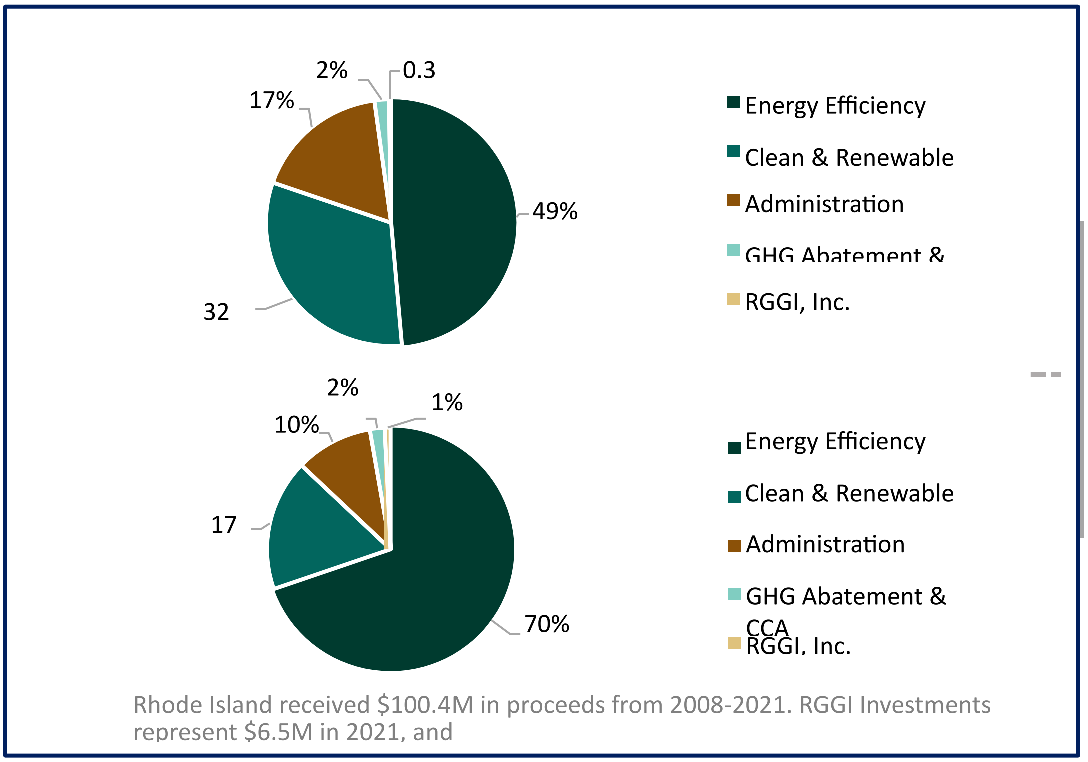
The **Regional Greenhouse Gas Initiative (RGGI)** is a cooperative, market-based effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector. It represents the first cap-and-invest regional initiative implemented in the United States. The program allows for the auctioning and trading of CO2 allowances among fossil fueled EGUs (25 MW) in the member states. Starting in 2009, each state set a declining CO2 budget to reduce the overall amount of combustion required for electricity generation in the state. States then invested the proceeds from the CO2 allowance auctions in programs to improve energy efficiency and accelerate the deployment of renewable energy technologies. Rhode Island is a charter member of RGGI, and its regulations are at 250-RICR-120-05-46, CO2 Budget Trading Program, 250-RICR-120-05-47, "CO2 Budget Trading Allowance Distribution, and RIGL 23-82, "Implementation of the Regional Greenhouse Gas Initiative Act."

[69] "The Investment of RGGI Proceeds in 2022." July, 2024. www.rggi.org
[70] Ibid

As a whole, the RGGI states have reduced power sector CO2 pollution over 50% since 2005, while the region's gross domestic product has continued to grow.[71] MANE-VU found that RGGI will result in substantial reductions in emissions of SO2 and NOx and that member states will likely achieve greater emissions reductions through RGGI than those envisioned in other portions of the 2017 Ask.[72]

As a member of the RGGI since 2009, Rhode Island has invested approximately 93 million dollars into energy efficiency and programs for renewable resources. These investments will continue as Rhode Island maintains its membership in the RGGI cooperative. RGGI Investments by category are shown in Figure 6-1.

Figure 6-1 Rhode Island RGGI Investments by Category[73]



Renewable Energy

Rhode continues to promote renewable energy and climate change emissions reduction programs. The **2021 Act on Climate** sets mandatory, enforceable climate emissions reduction

[71] The Investment of RGGI Proceeds in 2021. RGGI. June 2023. https://www.rggi.org/investments/proceeds-investments)
[72] Statement of the Mid-Atlantic / Northeast Visibility Union (MANE-VU) Concerning a Course of Action with MANE-VU toward Assuring Reasonable Progress for the Second Regional Haze Implementation Period (2018-2028). MANE-VU. August 25, 2017. (Appendix 15)
[73] Ibid., 71

goals leading the state to achieve netzero emissions economy-wide by 2050. The net results of the Act on climate will be a significant reduction in greenhouse gas and pollutant emissions.

The **Rhode Island Renewable Energy Standard (RES) Act** was established in 2004 through Rhode Island General Laws §39.26-1-10. The original goal was to achieve 16% renewable energy by 2019, however in 2016 that statewide target was revised to 38.5% renewable energy by 2035. RES compliance does not involve the physical procurement of power produced by renewable energy facilities. Instead, electricity providers meet the requirements of the RES mandate by purchasing renewable energy certificates (RECs), which represent 1 MWh of renewable energy generated and delivered to the electric grid.

The renewable energy industry is rapidly growing in Rhode Island. Strong programs such as the **Renewable Energy Growth Program** are stimulating the deployment of wind and solar projects throughout the state. As of 2022, the state has counted approximately 1152 MW of clean energy generation capacity. Of that 1152 MW total, 529 MW is solar, 430 MW is offshore wind, 148 MW is onshore wind, 35 MW is landfill gas/anaerobic digestion, and 10 MW is small-scale hydroelectric power.[74]

The **RI Agricultural Energy Program (RI AgEP)** offers financial incentives to farms in Rhode Island of up to $20,000 for energy efficiency and renewable energy projects. spring 2022 funding round awarded six farms for solar projects, with one farm undertaking a solar & battery storage. Since 2016 over 78 projects have been funded with over 1 megawatt of awarded capacity.

Distributed Generators (DG) and Combined Heat and Power (CHP)

Several small emergency generators operating in Rhode Island have submitted permit applications to convert to distributed generators allowing them the ability to sell energy to the grid as needed. The units are capped at 500 hours per year and subject to federal emissions standards as required by permit. Table 6-5 list current distributed generators and controls.

Table 6-5 Distributed Generators

Facility	Size	Year installed	Control
Providence Housing Authority	60 kW	2009	--
Providence Housing Authority	60 kW	2009	--
Boston Scientific	75 kW	2016	NSCR
Aspen Aerogels	1300kW	2018	SCR and oxidation catalyst

[74] https://energy.ri.gov/renewable-energy/ris-clean-energy-portfolio

Facility	Size	Year installed	Control
Warwick Hotel Associates	150 kw	2017	NSCR
JSC Management Group	80 kW	2022	NSCR
JSC Management Group	80kW	2022	NSCR

There are currently four combined heat and power plants operating in RI generating approximately 40 MW of electricality. Table 6-6 identifies current CHP plants.

Table 6-6 Combined Heat and Power

Facility	Size	Fuel	Control
Toray	20 MW	Natural gas	SCR
RI Hospital	10 MW	Diesel (.0015% S)	Oxidation catalyst
RI Central Power Plant (Pastore)	11 MW	Natural Gas/distillate	Oxidation catalyst/distillate limits
Narraganset Bay Commission -East Providence	0.644 MW	Digester Gas	--

Continued growth is expected in both distributed generation and combined heat and power plants.

6.3 Technical Basis for Long-Term Strategy

40 CFR 51.308(f)(2)(iii) requires states to document the technical basis (including modeling, monitoring, cost, engineering, and emissions information) on which it relied to determine the emission reduction measures that are necessary to make reasonable progress in each Class I area it affects. RIDEM OAR relied on the technical analyses developed by MANE-VU to determine the emission reduction measures that are necessary to make reasonable progress as allowed for in the Regional Haze Rule[75]. The MANE-VU technical documents for the second implementation period are included as appendices to this SIP revision.

6.4 Emission Reductions Due to Ongoing Air Pollution Controls

[75] 40 CFR 51.308(f)(2)(C)(iii) provides the option for a state to address the technical basis for its long-term strategy requirement through a regional analysis.

40 CFR 51.308(f)(2)(iv)(A) requires states to consider emission reductions due to ongoing air pollution control programs. RIDEM OAR considered these reductions as part of the MANE-VU process that generated emission inventories and projections that reflect ongoing programs and were incorporated into the modeling for the RPGs (see Appendix 5 for controls included in the inventories and Section 2 for the RPGs). These also were considered in the emissions rates used in the CALPUFF and Q/d screening models.

In December 2024, Rhode Island adopted amendments to 250-RICR-120-37 “Rhode Island’s Low Emission and Zero Emission Vehicle Program”, which incorporate by reference California’s motor vehicle emission standard regulations including the California Advance Clean Cars II, Advanced Clean Trucks, Low NOx Heavy-Duty Omnibus and the Phase 2 Greenhouse Gas rules. These rules will be incorporated into the RI SIP in 2025 and further support Rhode Island’s commitment to reduce mobile source emissions that may impact visibility, both in Rhode Island other states.

6.5 Measures to Mitigate the Impacts of Construction Activities

40 CFR 51.308(f)(2)(iv)(B) requires that states consider measures to mitigate the impacts of construction activities for the long- term strategy. A description of how MANE-VU considered measures to mitigate the impacts of construction for the first implementation period can be found in the MANE-VU document entitled, *Technical Support Document on Measures to Mitigate the Visibility Impacts of Construction Activities in the MANE-VU Region* (Mane-Vu, September 2006)[76].

Rhode Island regulation 250-RICR-120-05-5, “Fugitive Dust” regulates dust from construction and demolition activities. Section 5.6(A) off the rule states, “No person shall cause or permit any materials, including but not limited to sand, gravel, soil, aggregate and any other organic or inorganic solid matter capable of releasing dust, to be handled, transported, mined, quarried, stored or otherwise utilized in any way so as to cause airborne particulate matter to travel beyond the property line of the emission source without taking adequate precautions to prevent particulate matter from becoming airborne.”

RIDEM OAR concluded that its regulations are sufficient to mitigate the impacts of construction activities. EPA approved this portion of the 2009 RIDEM OAR RH SIP based on the discussion above.[77] There has been no large positive or negative change in construction activity since then nor has RIDEM OAR adopted any significant measure to mitigate impacts of construction activity since the previous SIP revision.

[76] 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
[77] Approval and Promulgation of Air Quality Implementation Plans; Rhode Island; Regional Haze.EPA. 5/22/12 77 FR 30214). https://www.federalregister.gov/d/2012-12289

The new MANE-VU speciation analyses[78] and contribution assessment[79] for the second implementation period found that crustal material does not play a major role in visibility impairment at Class I areas. In addition, the RIDEM OARs 2017 inventory shows PM2.5 emissions from construction dust totaled 183 tons, or only 5% of the RIDEM OAR total PM2.5 emissions inventory. Because the contribution to visibility impairment from construction dust is small, RIDEM OAR has determined that no change in its regulatory program for construction dust is necessary to make reasonable progress.

6.6 Source Retirement and Replacement Schedules

40 CFR Section 51. 308(f)(2)(iv)(C) requires RIDEM OAR to consider source retirement and replacement schedules in developing its LTS. RIDEM OAR considered source retirement and replacement in developing the emissions inventories described in Section 4 and as described in the Gamma Inventory technical support documentation in Appendix 19, and in RIDEM OAR's implementation of the 2017 MANE-VU Statement.

Title V sources in Rhode Island that were shut down after the 2011 base year and therefore not included in the 2028 inventory are listed in Table 6-7.

Table 6-7 Title V Sources Shut Down Since 2011

State	FIPS	EIS ID	Facility Name	2011 SO_2 (tons/yr)	2011 NO_x (tons/yr)	2011 $PM_{2.5}$ (tons/yr)
44	003	16151511	Arkwright	0.02	3.15	0.2
44	007	2875411	ACN	0.01	1.46	1.86
44	009	7936211	Block Island Power[80]	0.39	4.83	1.72
44	009	5458511	Bradford Dye	23.20	11.04	1.9
44	007	2875311	NEPTCO	0.01	0.82	.02
44	007	4102111	Osram	0.28	36.10	0.53
44	003	6546111	Stanley Bostitch	1.97	2.6	0.25

6.7 Agricultural and Forestry BSMPs and Smoke Management Programs

[78] Regional Haze Metric Trends and HYSPLIT Trajectory Analyses. MANE-VU. May 2017. (Appendix 13) p.51: "Organic mass carbon, sea salt, coarse mass, light absorbing carbon, and soil contribution changes from the base period were all less than 5% at all Class I sites."

[79] Selection of States for MANE-VU Regional Haze Consultation (2018). MANE-VU Technical Support Committee. September 5, 2017. (Appendix 16)

[80] On May 1, 2017 Block Island Power connected to the mainland power grid through National Grid's Sea2Shore submarine cable. The diesel engines previously generating power have been removed.

40 CFR Section 51. 308(f)(2)(iv)(D) requires RIDEM OAR to consider basic smoke management practices (BSMPs) for prescribed fire used for agricultural and wildland vegetation management purposes and smoke management programs in developing its long-term strategy. MANE-VU's analysis of smoke management in the context of Regional Haze SIPs can be found in the MANE-VU Smoke Management TSD entitled, *Technical Support Document on Agricultural and Forestry Smoke Management in the MANE-VU Region* developed for the first implementation period SIP.

This TSD concluded that emissions from agricultural, managed, and prescribed burning are minor source categories (totaling 1.34% of $PM_{2.5}$ emissions in the MANE-VU region[81]). It noted that source apportionment results showed that wood smoke was a moderate contributor to visibility impairment at some Class I areas in the MANE-VU region, but that smoke is not an especially important contributor to MANE-VU Class I areas on either the 20% best or 20% worst visibility days. It concluded that most of the wood smoke is attributable to residential wood combustion, and it is unlikely that fires for agricultural or forestry management cause large impacts on visibility in any of the Class I areas in the MANE-VU region. The report observed that while, on rare occasions, smoke from major fires degrades the air quality and visibility in the MANE-VU area, these fires are generally unwanted wildfires that are not subject to BSMPs.

For the second implementation period, the MANE-VU technical analyses confirmed the primary sources of visibility impairment found in the first implementation period (see Section 5). The 2017 emissions inventory confirmed that prescribed forest and agricultural fires emissions estimates remain a small portion of the total Rhode Island $PM_{2.5}$ and PM_{10} inventories (0.84% and 0.47%).[82] Therefore, RIDEM OAR concludes that no substantial change has occurred that would alter the conclusions of the previous SIP regarding the sources of visibility impairment, and therefore no change to Rhode Island's smoke management practices is needed to make reasonable progress.

Rhode Island does not currently have a Smoke Management Program (SMP). However, SMPs are required only when smoke impacts from fires managed for resource benefits contribute significantly to regional haze. The emissions inventory presented in the above-cited document indicates that agricultural, managed, and prescribed burning emissions are very minor; the inventory estimates that, in Rhode Island, those emissions from those

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[81] Table 2. Technical Support Document on Agricultural and Forestry Smoke Management in the MANE-VU Region. MANE-VU. September 1, 2006.

[82] Prescribed fires. January 2021 version https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data#dataq.

source categories totaled 34 tons of PM_{10}, 29 tons of $PM_{2.5}$ and 4 tons of SO_2 in 2017, which constitute 0.84%, 0.47% and 0.51% of the total inventory for those pollutants, respectively.

6.8 Anticipated Net Effect on Visibility

40 CFR 51.308(f)(2)(iv)(E) requires RIDEM OAR to consider in developing the LTS the anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the LTS (i.e., 2018 - 2028). MANE-VU developed inventory projections and modeling for visibility impact for 2028 that incorporated the "Asks" for MANE-VU states as well as the Asks developed for upwind states and EPA/FLMs. These projections and modeling incorporated the RIDEM OAR LTS from the first implementation period with no additional regulatory action for the second implementation period. The results of that modeling are shown as RPGs on the graphs in Section 2 and detailed in the presentation of RPGs in the MANE-VU visibility report.[83]

The 2028 inventory projections (see section 4.9) demonstrate a substantial reduction in emissions. The modeling shows that projected visibility at all potentially impacted Class I areas will remain well below the URP line in 2028 for the most impaired days and that there will be no degradation in visibility for the least impaired days (see Section 2).

6.9 Federally Enforceable Components of the Long-Term Strategy

40 CFR 51.308(f)(2) requires RIDEM OAR to include in its LTS "the enforceable emissions limitations, compliance schedules, and other measures that are necessary to make reasonable progress . . ." The federally enforceable components of the LTS are listed below.

Table 6-8: Federally Enforceable Components of the Long-Term Strategy

Pawtucket Power Retirement	Revocation of Title V permit
Low sulfur fuel	250-RICR-120-05-8
NOX RACT	250-RICR-120-05-27[84]

7 Consultation

[83] *Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2017 (2nd RH SIP Metrics)*. MANE-VU (prepared by Maine Department of Environmental Protection). December 18, 2018 revision (Appendix 22)

[84] 250-RICR-120-05-27 applies to sources having the potential to emit more than 50 tpy NOx, rule effective Feb 1. 1994. RI continues to enforce this rule with limitations specified in enforceable permits.

7.1 Consultation with Other States/Tribal Nations

40 CFR Section 51.308(f)(2)(ii) requires RIDEM OAR to consult with other states/tribal nations to develop coordinated emission management strategies and measures to make reasonable progress to improve visibility. RIDEM OAR consulted with other states and tribes through participation in the MANE-VU consultations and processes that developed the technical information necessary for the coordinated strategies and measures. This consultation process is documented in the *MANE-VU Regional Haze Consultation Report* (Appendix 20).[85]

7.2 Consultation with Federal Land Managers on Long-Term Strategy

40 CFR Section 51.308(i) requires RIDEM OAR to consult with Federal Land Managers (FLMs) responsible for managing Class I areas that are potentially affected by emissions from Rhode Island. Specifically, it provides that:

(2) The State must provide the Federal Land Manager with an opportunity for consultation, in person at a point early enough in the State's policy analyses of its long- term strategy emission reduction obligation so that information and recommendations provided by the Federal Land Manager can meaningfully inform the State's decisions on the long-term strategy.

The relevant FLMs for this SIP are National Park Service (NPS), U.S. Forest Service (USFS), and U.S. Fish and Wildlife Service (FWS). RIDEM OAR and other MANE-VU states provided FLMs with this consultation in part through the opportunity for the FLMs to participate throughout the MANE-VU planning process, including regular meetings/calls of the MANE-VU Technical Support Committee (which provides oversight and guidance to that process). In addition, MANE-VU conducted webinars specifically for additional FLM consultation early in the SIP planning process concurrent with state-to-state consultations that began in February 2017, well before public hearings or other public comment opportunities for individual state SIPs. The FLMs were invited to attend the intra- and inter-RPO consultations among states and did attend seven intra-RPO meetings and all inter-RPO meetings. In addition, a consultation webinar with the FLMs was held on April 21, 2017, prior to the in-person consultation at the May 2017 MANE-VU Air Directors meeting. A briefing document was provided to the FLMs prior to the last webinar held on March 23, 2018, reviewing the technical and policy progress to date. This consultation process with the FLMs is documented in the *MANE-VU Regional Haze Consultation Report* (Appendix 20).[86]

7.3 Consultation with FLMs on Draft RH SIP

[85] MANE-VU Regional Haze Consultation Report. MANE-VU Technical Support Committee. July 27, 2018. (Appendix 20)
[86] Ibid.

In addition to consulting with FLMs on the development of the long-term strategy for the Regional Haze SIP, 40 CFR Section 51.308(i)(2) requires RIDEM OAR to consult with FLMs on its implementation plan no less than 60 days prior to any public hearing or other public comment opportunity. On July 30, 2024, RIDEM OAR sent its pre-proposal draft SIP revision to the FLMs for review and consultation and requested comments by October 1, 2024. Comments were received by the United States Department of Agriculture (USDA) and the National Park Service (NPS) and attached in Appendix 23.

The USDA offered supportive comments of the RH SIP, acknowledging that they were satisfied with the documents, as provided, and offer no suggestions for change. They appreciated the opportunity to work closely with our State through the initial evaluation, development, and subsequent review of this plan. They also complimented us on our hard work and dedication to significant improvement in our nation's air quality values and visibility.

The NPS also offered supportive comments on the regional haze SIP thanking us for providing the consultation opportunity. The NPS stated " Emissions from Rhode Island facilities have not been identified as impairing visibility at any National Park Service managed Class I areas. We appreciate your work for clean air and clear views across the region and do not intend to provide further conclusions and recommendations."

The FLMs did not identify any Rhode Island sources or measures for four-factor analysis.

7.4 Continuing Consultation with FLMs

40 CFR Section 51.308(i)(4) requires RIDEM OAR to provide procedures for continuing consultation with the FLMs on the implementation of its RH SIP, SIP revisions, progress reports, and on the implementation of other programs having the potential to contribute to impairment of visibility in Class I areas. RIDEM OAR will continue to consult with the designated visibility protection program coordinators for the FLMs through the following processes:

- MANE-VU's planning process, including participation in regular Technical Support Committee meetings that include FLM participation in the development of progress reports and the regional strategy for future RH SIP revisions.
- RIDEM regulatory and permit notification emails that provide notification of air quality regulation amendments, SIP revisions, major new source review permits, ambient air monitoring plans.

8 List of Appendices[87]

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