Connecticut Regional Haze
State Implementation Plan Revision

Second Implementation Period (2018 – 2028)

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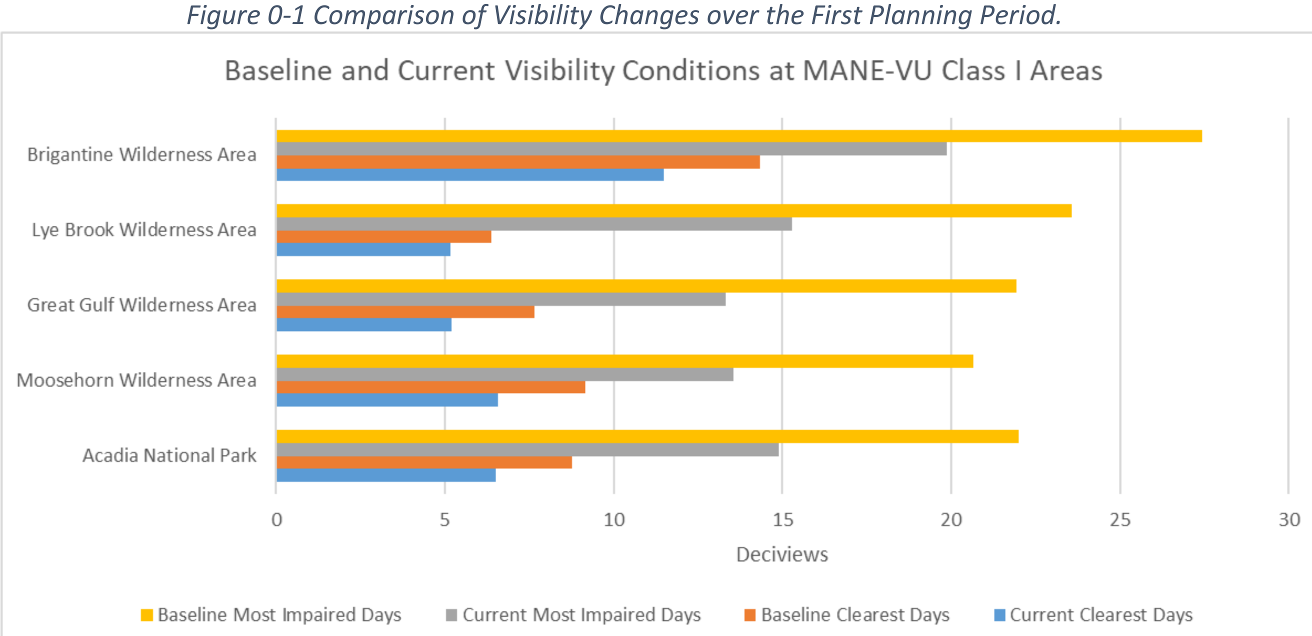
Executive Summary

The Connecticut Department of Energy and Environmental Protection (Department) proposes this implementation plan revision to satisfy the regional haze requirements of Clean Air Act (CAA) section 169A and the regional haze rule codified in Title 40 Code of Federal Regulations (CFR) Part 51 Subpart P. This report describes the regional haze planning process, visibility trends and goals, and the strategies the Department is incorporating into the 2018-2028 planning period.

As required by CAA section 169A(a)(1), Congress declared a national goal to prevent further deterioration and to remedy any existing visibility impairment due to man-made pollution in areas designated as mandatory Class I federal areas. Class I areas are federal areas, such as national parks and wilderness areas, designated to have important value regarding visibility.[1] The goal of the regional haze rule is to attain natural visibility conditions in the Class I areas and uses 2064 as a benchmark target date for achieving this goal.

This is the second of six ten-year plans required under the regional haze rule. The first planning period, 2007-2017, successfully achieved its goals in the Mid-Atlantic Northeast Visibility Union (MANE-VU) region.[2] Figure 0-1 shows the visibility improvements achieved from the baseline years (average 2000-2004) through the end of the first planning period (average 2013-2017). Across the MANE-VU region visibility improved an average of 7.7 deciviews (dv) during the first planning period.

Figure 0-1 Comparison of Visibility Changes over the First Planning Period.

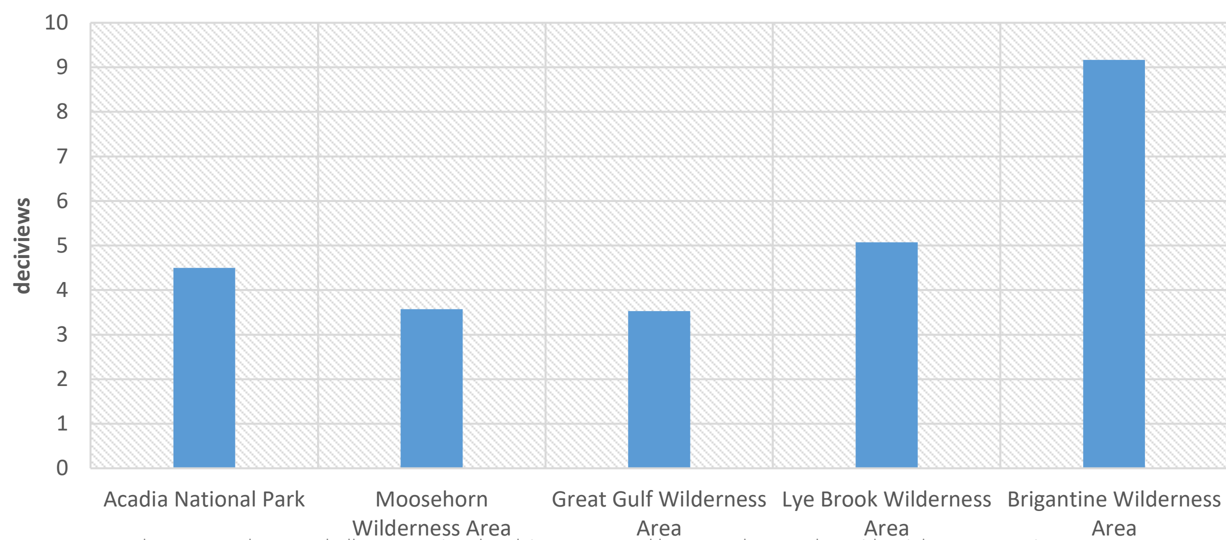


As seen in Figure 0-2, further reductions in visibility impairment are still needed at each of the region's Class I areas in order to achieve natural visibility conditions by 2064. Therefore, maintaining the

[1] Class I areas are codified in 40 CFR Part 81 subpart D.
[2] EPA defined regions for the purposes of collaborative planning. Connecticut (along with 10 other northeast and mid-Atlantic states, 2 tribal nations, and the District of Columbia) is a member of the MANE-VU region.

momentum and assuring that incremental progress continues to occur is important for this planning period.

Figure 0-2. Remaining Visibility Improvement Necessary to Achieve Natural Conditions in 2064 for 20% Most Impaired Days.



Note that Roosevelt Campobello International Park is represented by Moosehorn and Presidential Range Dry River Wilderness is represented by Great Gulf.

The goals for each planning period, referred to as the reasonable progress goals (RPGs) are determined by the states with Class I areas. Connecticut does not have any Class I areas, however, it contributes to the success of meeting RPGs by taking reasonable steps to reduce emissions of visibility impairing pollutants from sources within the State.

The MANE-VU states collaboratively develop the priority strategies to meet RPGs for each planning period through a regional consultation process[3]. The MANE-VU consultation process included Federal Land Managers (FLMs) from the National Park Service, the United States Fish and Wildlife Service and the Forest Service; the Environmental Protection Agency; a state representative from each MANE-VU state; and a representative from each state that reasonably contributes to visibility impairment at a Class I area within the MANE-VU region.

Each state is asked to address these priority strategies in their regional haze state implementation plans (SIPs). These priority strategies are commonly referred to as the "Ask". The Department describes and addresses each element of the Ask in section 5 of this document.

The Department has reviewed the Ask, identified those that are applicable to Connecticut's sources and identified additional strategies reasonably anticipated to contribute to reducing regional haze. To

[3] The consultation is documented in the *MANE-VU Regional Haze Consultation Report*, MANE-VU Technical Support Committee, July 27, 2018.

address the requirements of the regional haze rule, the Department is proposing to incorporate the following long-term strategies into the Connecticut Regional Haze SIP:

1. Implementation of a low sulfur fuel program as contained in Regulations of Connecticut State Agencies (RCSA) sections RCSA 22a-174-19a and 22a-174-19b and revised in 2014. The program is fully phased in as of July 1, 2018. Connecticut commits to maintain these SIP approved regulations;
2. Control of nitrogen oxides emissions from fuel-burning equipment at major stationary sources of nitrogen oxides as contained in RCSA section 22a-174-22e, adopted in 2016 and revised in 2019;
3. Control of nitrogen oxide emissions from high emission units at non-major sources of NOx as contained in RCSA section 22a-174-22f and adopted in 2016;
4. Control of emissions from Municipal Waste Combustors as required in RCSA section 22a-174-38 as revised in 2016.

Finally, Connecticut must conduct a consultation with the FLMs regarding Connecticut's long-term strategy for regional haze. Appendix A provides a summary of the consultation with FLMs and EPA on our proposed SIP. Most comments center on a desire for DEEP to require four factor analyses of sources in Connecticut. However, DEEP found no reasonable technical bases for requiring such analyses.

The Department has determined that this implementation plan revision satisfies all applicable regional haze rule requirements for the second planning period. Furthermore, to satisfy the requirements of 40 CFR 51.308(g), the Department commits to review the status and adequacy of the plan and submit a progress report by January 31, 2025.

1. Introduction

This State Implementation Plan (SIP) revision addresses Connecticut's long-term strategy to reduce regional haze for the 2018 through 2028 planning period. Required under Title 40 of the Code of Federal Regulations (CFR) section 51.308, the plan addresses Connecticut's role in achieving visibility goals set forth in section 169A of the Clean Air Act (CAA) for national parks and wilderness areas designated as Class I areas.

Figure 1-1. Class I Areas, Wilderness Areas and National Parks Protected by CAA Visibility Requirements.

1.1. Haze

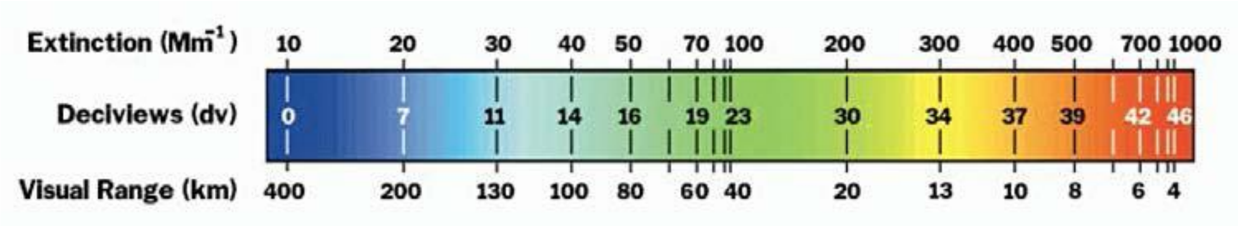
Small particles and certain gaseous molecules emitted to the atmosphere from natural and anthropogenic sources scatter and absorb light to reduce the visual information reaching an observer. Meteorological conditions affect the distribution of particles in the atmosphere to cause different forms of visibility impairment. Uniform haze results when high concentrations of well-mixed pollutants are present in the atmosphere. A sharply demarcated layer of haze will occur when a temperature inversion traps pollutants near the surface. Plume blight – the distinctly visible trail of pollution from a particular emission source – occurs under stable atmospheric conditions, where pollutants are slow to disperse.

Visibility impairment can be quantified using three different, but mathematically related measures: light extinction per unit distance (e.g., Mm^{-1})[4]; 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 such measure 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.

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

Figure 1-2. Units of Measure Used for Visibility.

This figure shows the relationship between three different haze metrics: visible range in kilometers (km), deciviews (dv), and light extinction (b_{ext}) measured in inverse mega meters (Mm^{-1}). Source: [Technical Support Document, Revised Recommendations for Visibility Progress Tracking Metrics for the Regional Haze Program, USEPA, July 2016.]



The particles that commonly cause hazy conditions in the eastern United States 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 are secondary pollutants that form in the atmosphere from precursor pollutants, primarily sulfur dioxide (SO_2), nitrogen oxides (NO_X), and volatile organic compounds (VOCs), respectively. By contrast, soot, 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 (i.e., 0.1 to 1 micrometer).

The constituents of haze are capable of being transported great distances while in the atmosphere. Therefore, a regional approach is necessary to reducing haze. Visibility-impairing pollutants also form ozone, another pollutant of regional concern. Therefore, regional reduction of visibility impairing pollutants will not only improve visibility and reduce the negative health effects of particulate pollution, but will also aid Connecticut in attaining the National Ambient Air Quality Standards (NAAQS) for ozone.

1.2. The Planning Process

This SIP is the second of what will be a series of SIP revisions. Each SIP in this series covers a ten-year planning period. These regional haze SIPs define and outline the incremental progress toward remedying visibility impairment in federal parks and wilderness areas designated as Class I areas. Though there are no Class I areas in Connecticut, due to the ability of haze causing pollutants to affect distant Class I areas regional haze SIPs are required of every state.

States formed Regional Planning Organizations (RPOs) to support the development of these SIPs. Connecticut is a member of the Mid-Atlantic / Northeast Visibility Union (MANE-VU) RPO. Connecticut worked with the other MANE-VU states to assess visibility in each of the Class I areas within and nearby the MANE-VU RPO.

States with Class I areas are primarily responsible for establishing visibility goals for each planning period. They also lead consultations with federal land managers (FLMs) and states affecting their Class I areas. Using these visibility goals and analyses, all states are required to plan and to implement emissions reductions strategies outlined in each state's SIP and consult with FLMs regarding the SIP.

It is common practice for MANE-VU to consult with the FLMs throughout the entire process, from data collection to SIP development. This consultative process is explained further in Section 5.

1.3. Regulatory Requirements

The requirements for a regional haze SIP are contained in 40 CFR 51.308. Connecticut's original regional haze SIP, submitted to EPA on November 18, 2009, addressed the core requirements of 40 CFR 51.308(d)(1)-(4) and best available retrofit technology (BART) requirements of 40 CFR 51.308(e). The November 2009 SIP was approved by EPA on July 10, 2014 (79 FR 39322).

This SIP revision addresses the requirements in 40 CFR 51.308(f) for periodic comprehensive revisions of implementation plans for regional haze for the second implementation period (2018-2028) and is due by July 31, 2021. As Connecticut has no Class I areas within its borders, certain elements of 40 CFR 51.308(f) do not apply to this SIP.

Figure 1-3. Map of Regional Planning Organizations.

2. Monitoring and Visibility Assessment

The Interagency Monitoring of Protected Visual Environments (IMPROVE) program was established in 1985 to assess visibility impairment and track changes in visibility in the National Parks and Wilderness Areas. The IMPROVE network of monitors is used to establish the fundamental metrics for evaluating regional haze. These metrics: the baseline, uniform rate of progress and natural conditions, are required SIP elements under 40 CFR 51.308(f)(1) and are included in this section.

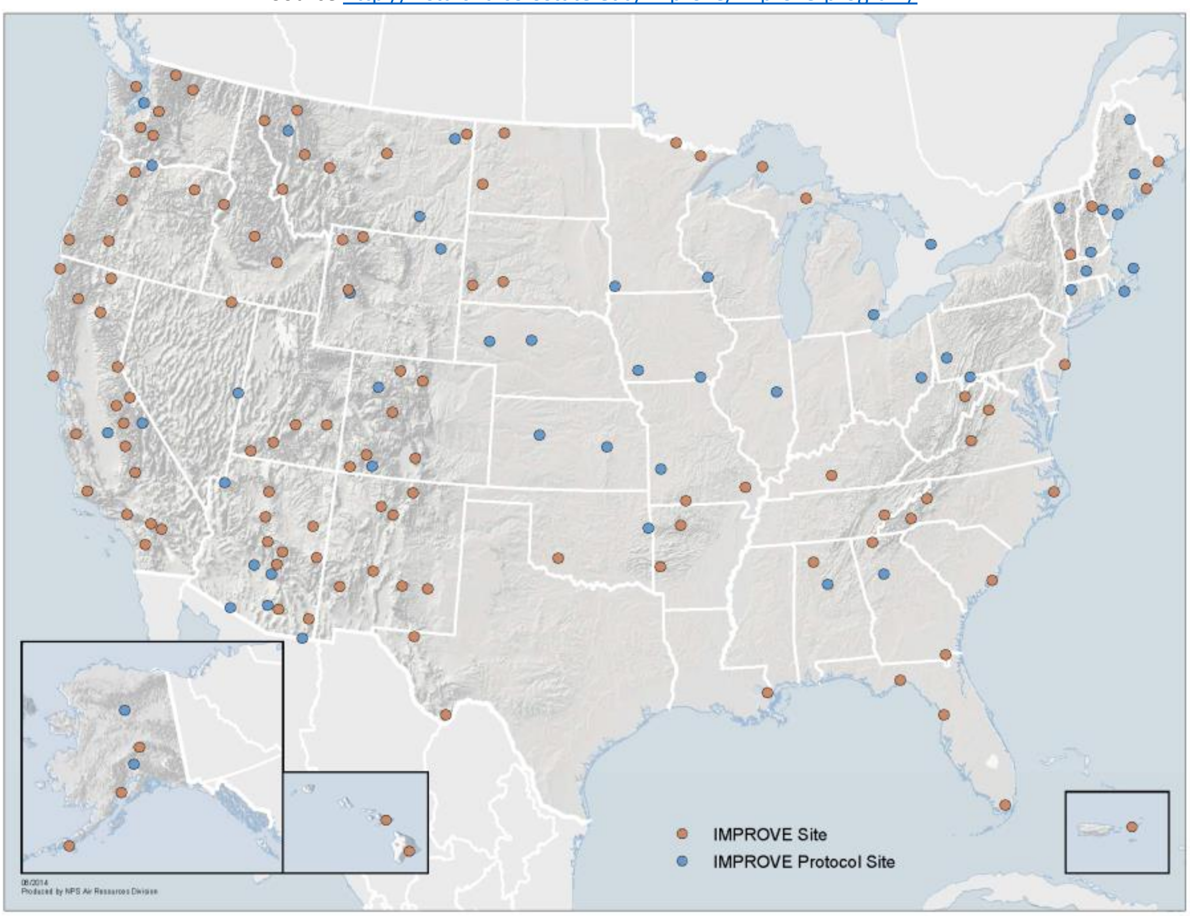
This section also supplements the requirement of 40 CFR 51.308(f)(5) for inclusion of a progress report assessing and tracking visibility trends as specified in 40 CFR 51.308(g). Assessment of the individual pollutants that contribute to visibility impairment also provides information to guide the long-term strategy required under 40 CFR 51.308(f)(2) to establish compliance measures necessary to achieve reasonable progress goals.

2.1 The IMPROVE Monitoring Network

The IMPROVE network is used to assess representative visibility at the Class I areas. Additional sites, using the same instrumentation and protocols, monitor regional haze outside of Class I areas and are referred to as protocol sites. IMPROVE protocol sites do not represent Class I areas. The full network allows for improved quality assurance, emissions source evaluations and model evaluation. Connecticut maintains one protocol site at the Mohawk Mountain air quality station in Cornwall, Connecticut.

Figure 2-1. IMPROVE Monitoring Network as of 2016.

Source http://vista.cira.colostate.edu/Improve/improve-program/

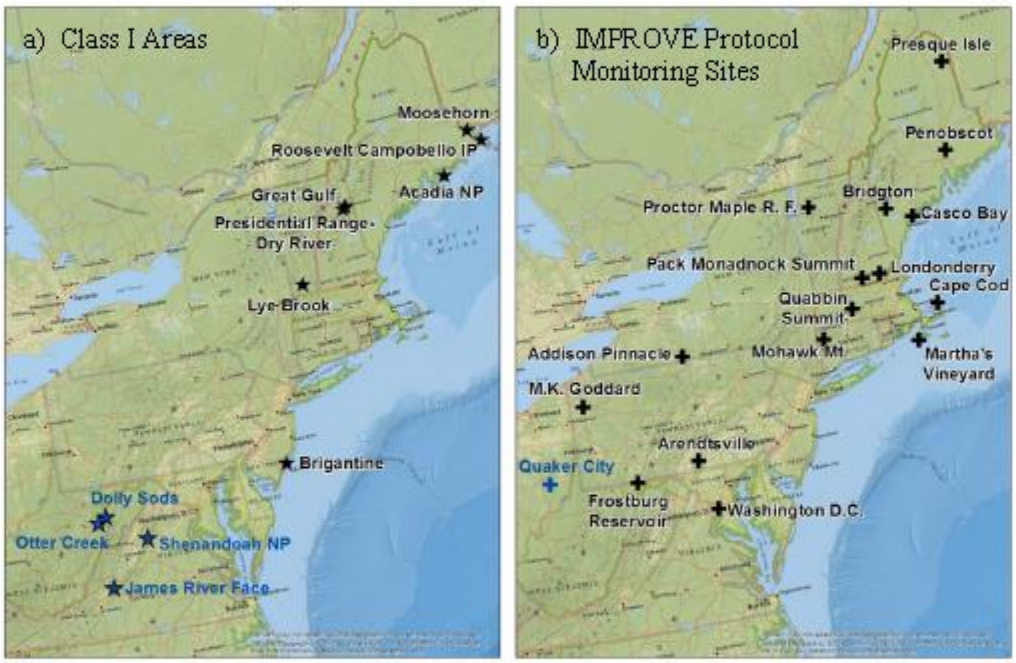


A monitoring strategy is required only for states with Class I areas and is therefore not applicable to Connecticut. However, the Department has an active role in maintaining the IMPROVE instrumentation located at the Cornwall protocol site. The Department evaluates Connecticut's monitoring network annually to determine if there is adequate coverage regarding the various pollutants.[5] The Department is committed to maintaining the Cornwall protocol site contingent on sufficient federal funding.

IMPROVE network data are collected, analyzed and stored in the Federal Land Manager Environmental Database (FED).[6] MANE-VU states used the FED to generate the visibility parameters described in this section using algorithms to calculate light extinction based on monitored concentrations of various particulates. The derivation of these visibility metrics is detailed in documentation by MANE-VU: "Mid-Atlantic/Northeast U.S. Visibility Data 2004-2017 (2nd RH SIP Metrics)". [7]

Figure 2-2. Regional Class I Areas and Monitoring Sites.

a) Class I areas within (black), and near (blue), the MANE-VU RPO; b) IMPROVE and Protocol monitoring sites within and near the RPO.
Source: [Mid-Atlantic/Northeast U.S. Visibility Data 2004-2017 (2nd RH SIP Metrics), MANE-VU, December 2018.]



[5] Further information regarding Connecticut's air monitoring network is in the Connecticut Annual Air Monitoring Plans.
[6] http://views.cira.colostate.edu/fed/QueryWizard/Default.aspx
[7] Downs, Tom, Project Manager, MEDEP, *Mid-Atlantic/Northeast U.S. Visibility Data 2004-2017 (2nd RH SIP Metrics*), MANE-VU, December, 2018. Available at: https://www.maine.gov/dep/ftp/MVTSC/RH_METRICS_TRENDS/MANEVU%20Trends%202004-17%20Report%202nd%20SIP%20Metrics%20-%20December%202018%20Update.pdf

2.1. Natural and Baseline Visibility Conditions

Natural visibility represents the visibility for each Class I area in the absence of emissions from anthropogenic sources. Natural haze levels are calculated for both 20% clearest days and 20% most impaired days. Natural levels represent the best expectation for the long-term visibility goal for 2064 as a benchmark year.

The regional haze rule specifies that baseline visibility conditions be determined for each Class I area for the clearest and most impaired days for the years covering 2000-2004, the first reporting period. Future progress is assessed from this baseline. The five-year average (2000-2004) baseline visibility, in deciviews (dv), was calculated for each Class I Area for the 20% clearest days and 20% most impaired days.

Following EPA's 2018 guidance, the 20% most impaired days represent the days most impaired by anthropogenic sources.[8] During the first implementation period, the 20% worst days were selected without regard to the source of impairment. EPA no longer uses this approach as it skewed results toward natural sources such as wildfires and dust storms.

Table 2-1 below shows natural and baseline visibility conditions for the Class I areas in and near the MANE-VU region.

Table 2-1 Baseline Visibility.

Baseline (2000-2004) Visibility for the 20% Best Days and 20% Most Impaired Days for Class I Areas in or near the MANE-VU Region.

Class I Area	State	Natural		Baseline 2000- 2004	
		Clearest Days (dv)	Most Impaired Days (dv)	Clearest Days (dv)	Most Impaired Days (dv)
Acadia National Park (ACAD1)	Maine	4.66	10.39	8.78	22.01
Moosehorn Wilderness Area and Roosevelt Campobello International Park (MOOS1)	Maine / (New Brunswick, Canada)	5.02	9.97	9.16	20.66
Great Gulf Wilderness Area and Presidential Range/Dry River Wilderness Area (GRGU)	New Hampshire	3.73	9.78	7.66	21.93
Lye Brook Wilderness Area (LYBR1)	Vermont	2.79	10.23	6.37	23.57
Brigantine Wilderness Area (BRIG1)	New Jersey	5.52	10.69	14.33	27.43
Dolly Sods Wilderness Area and Otter Creek Wilderness Area (DOSO1)	West Virginia	3.64	8.92	12.28	28.29
James River Face Area (JARI1)	Virginia	4.39	9.48	14.21	28.08
Shenandoah National Park (SHEN1)	Virginia	3.15	9.52	10.93	28.32

Source: *Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2017 (2nd RH SIP Metrics)*, dated December 18, 2018, https://www.maine.gov/dep/ftp/MVTSC/RH_METRICS_TRENDS/MANEVU%20Trends%202004-17%20Report%202nd%20SIP%20Metrics%20-%20December%202018%20Update.pdf

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8 EPA, *Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program*, Office of Air Quality Planning and Standards, December 2018. EPA-454/R-18-010.

2.2. Current Conditions and Progress

Current conditions are calculated based on the average of the most recent five years of data and were calculated by the MANE-VU states using data from 2013-2017. Progress since the baseline (2000-2004) is indicated by taking the difference between current conditions and conditions during the baseline years. The difference between current and natural conditions indicates the remaining visibility improvements necessary to meet a benchmark goal of natural visibility by 2064. Table 2-2 shows the current conditions, progress made since the baseline and the remaining difference necessary toward attaining natural conditions by 2064.

Table 2-2. Current Visibility.

Current (2013-2017) Visibility for the 20% Best Days and 20% Most Impaired Days for Class I Areas in or near the MANE-VU Region as compared to past (baseline) and future (expected natural) conditions

Class I Area	Current Conditions		Difference from Baseline		Difference from Natural	
	Clearest Days (dv)	Most Impaired Days (dv)	Clearest Days (dv)	Most Impaired Days (dv)	Clearest Days (dv)	Most Impaired Days (dv)
Acadia National Park (ACAD1)	6.52	14.89	2.26	7.12	1.86	4.50
Moosehorn Wilderness Area and Roosevelt Campobello International Park (MOOS1)	6.59	13.54	2.57	7.12	1.57	3.57
Great Gulf Wilderness Area and Presidential Range/Dry River Wilderness Area (GRGU)	5.20	13.31	2.46	8.62	1.47	3.53
Lye Brook Wilderness Area (LYBR1)	5.15	15.30	1.22	8.27	2.36	5.07
Brigantine Wilderness Area (BRIG1)	11.48	19.86	2.85	7.57	5.96	9.17
Dolly Sods Wilderness Area and Otter Creek Wilderness Area (DOSO1)	7.29	17.95	4.99	10.34	3.65	9.03
James River Face Area (JARI1)	9.69	18.15	4.52	9.93	5.30	8.67
Shenandoah National Park (SHEN1)	7.14	17.78	3.79	10.54	3.99	8.26

Source: *Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2017 (2nd RH SIP Metrics)*, dated December 18, 2018, https://www.maine.gov/dep/ftp/MVTSC/RH_METRICS_TRENDS/MANEVU%20Trends%202004-17%20Report%202nd%20SIP%20Metrics%20-%20December%202018%20Update.pdf

The uniform rate of progress (URP) is calculated by comparing the baseline visibility for the most impaired days to the natural visibility for the most impaired days and determining the uniform rate of reductions necessary to achieve natural visibility by the end of 2064. Table 2-3 indicates the target conditions necessary for each site to meet URP by 2017 and by 2028, together with current conditions for the 20% most impaired days. Notably, visibility at each site has already improved beyond the 2028 uniform rate of progress target toward achieving natural conditions by the end of 2064

Table 2-3. Uniform Rate of Progress Levels Compared to Current Conditions.

Class I Area	Uniform Rate of Progress (dv)		Current Conditions for
	2017	2028	Most Impaired Days (dv)
Acadia National Park (ACAD1)	19.50	17.36	14.89
Moosehorn Wilderness Area and Roosevelt Campobello International Park (MOOS1)	18.34	16.38	13.54
Great Gulf Wilderness Area and Presidential Range/Dry River Wilderness Area (GRGU)	19.29	17.07	13.31
Lye Brook Wilderness Area (LYBR1)	20.68	18.23	15.30
Brigantine Wilderness Area (BRIG1)	23.80	20.74	19.86
Dolly Sods Wilderness Area and Otter Creek Wilderness Area (DOSO1)	24.09	20.54	17.95
James River Face Area (JARI1)	24.05	20.64	18.15
Shenandoah National Park (SHEN1)	24.25	20.80	17.78

Source: *Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2017 (2nd RH SIP Metrics)*, dated December 18, 2018, https://www.maine.gov/dep/ftp/MVTSC/RH_METRICS_TRENDS/MANEVU%20Trends%202004-17%20Report%202nd%20SIP%20Metrics%20-%20December%202018%20Update.pdf

2.3. Visibility Trends

The MANE-VU region contains five IMPROVE monitors and 17 protocol sites. This section summarizes the trends for the five IMPROVE sites in the MANE-VU region and the three additional neighboring IMPROVE monitors. The full analysis of the visibility trends for these sites is included in "*Mid-Atlantic/Northeast U.S. Visibility Data, 2004-2017 (2nd RH SIP Metrics)"* dated December 2018.

Figure 2-3 and 2-4 show trends in measured visibility impairment due to specific pollutant species monitored for the 20% cleanest and 20% most impaired days respectively for each Class I area in the MANE-VU region. Note that the fraction of sulfate impairing visibility both on the cleanest and most impaired days is consistently the largest fraction (this excludes the Rayleigh fraction as this is the scattering due to gases naturally found in the atmosphere). Sulfate has dominated the visibility impairment at all eight monitors since the establishment of the regional haze network. However, the charts also indicate a growing impact of the nitrate fraction. Therefore, sulfate, nitrate and their precursors became the focus for the 2018 planning period.[9]

[9] Further details on the trends of the other pollutant species can be found in the "Mid-Atlantic/Northeast U.S. Visibility Data 2004-2017 Report and Plots".

Figure 2-3. Visibility Trends of Clearest Days.

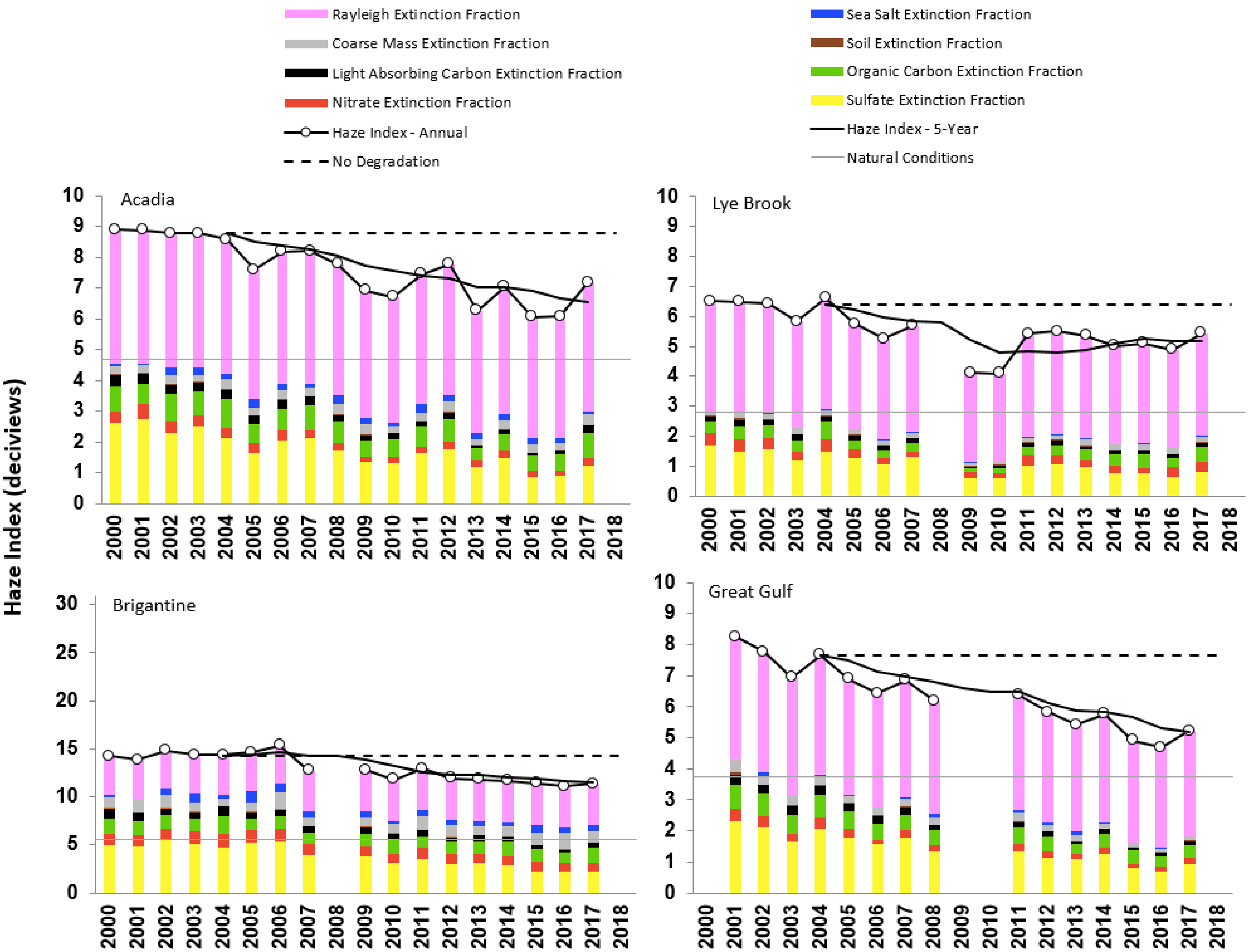


Figure 2-3 (continued). Visibility Trends of Clearest Days.

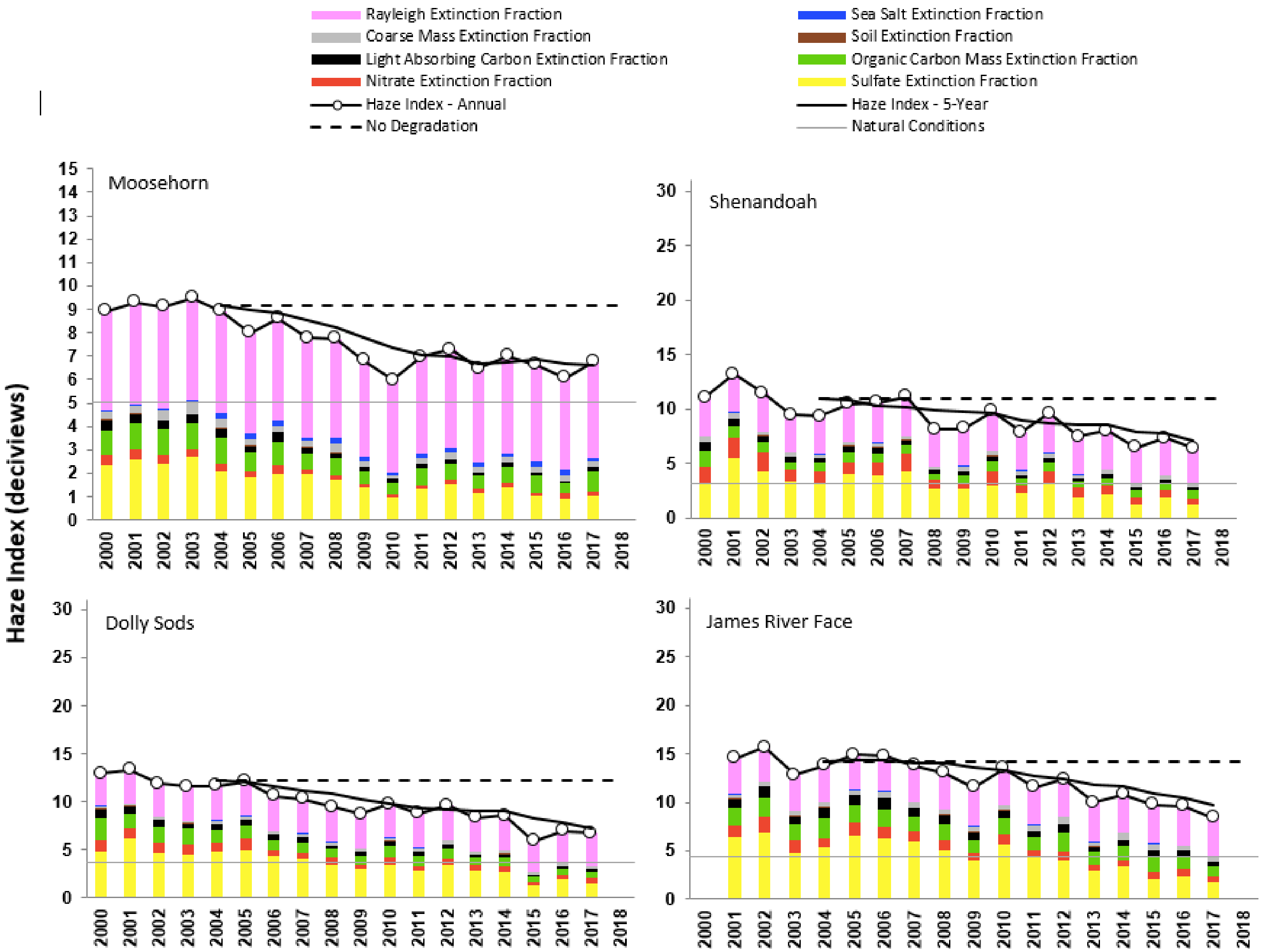


Figure 2-4. Visibility Trends of Most Impaired Days.

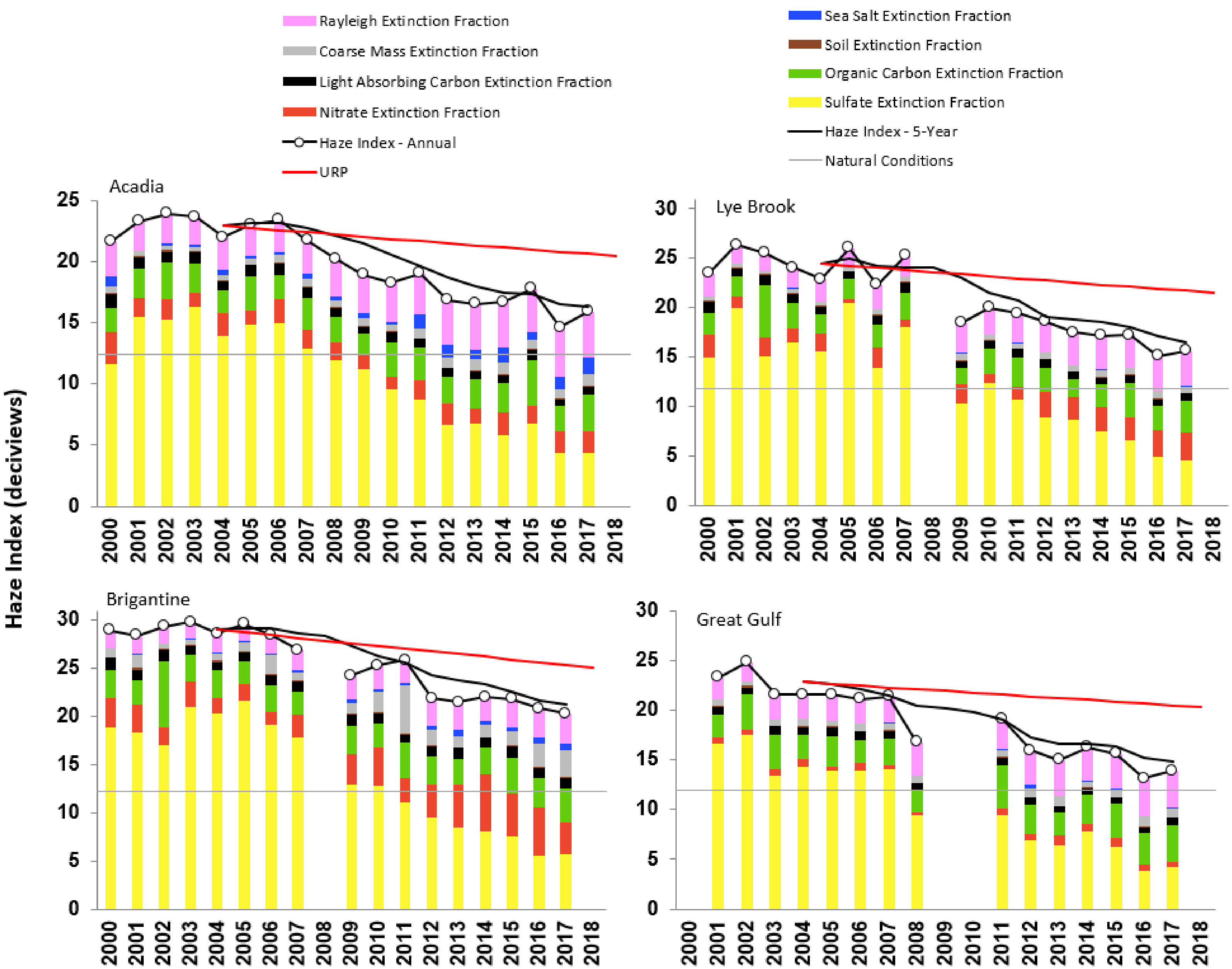
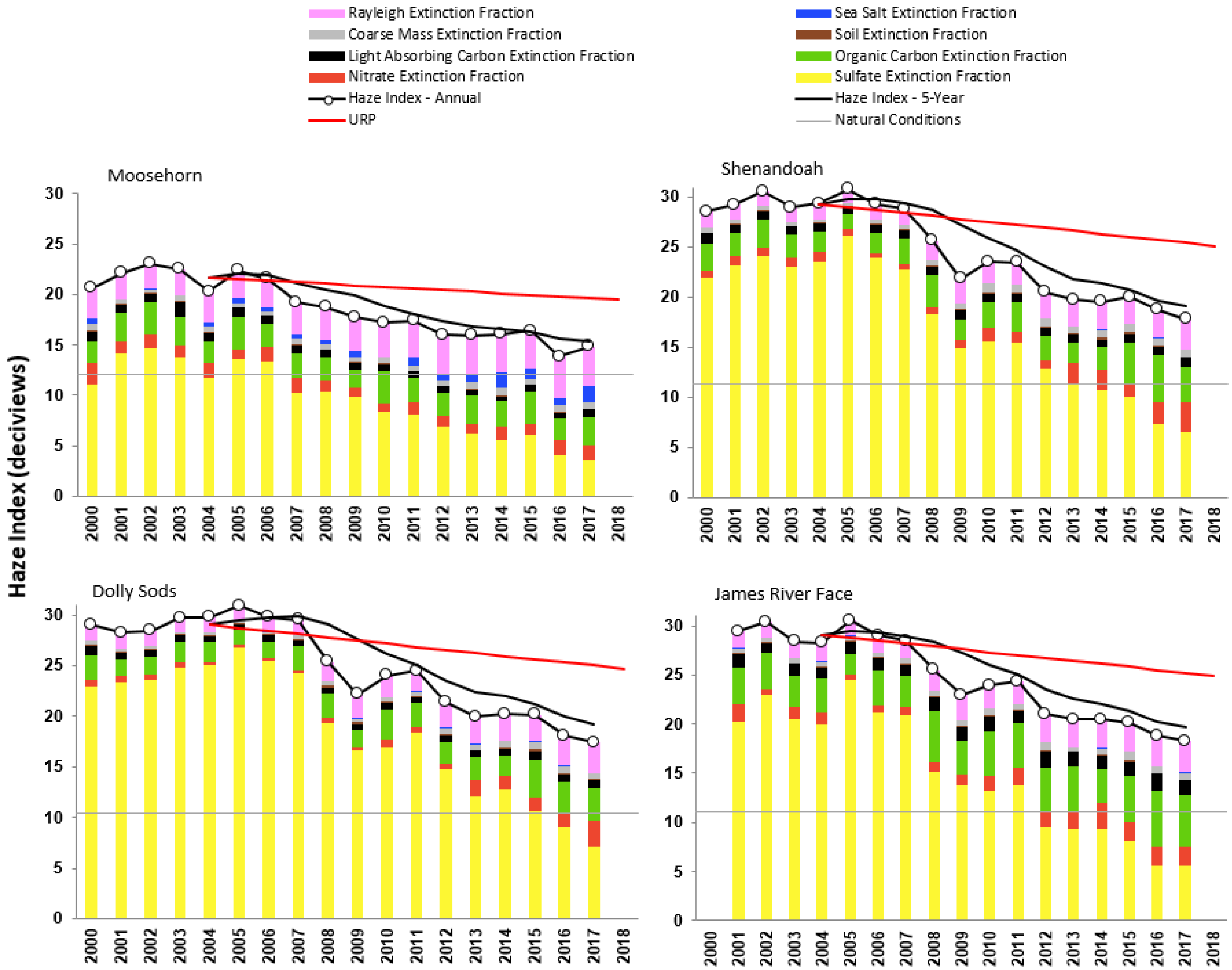


Figure 2-4 (continued). Visibility Trends of Most Impaired Days.



3. Emission Inventories and Emission Trends

As part of their regional haze SIPs, states are required by 40 CFR 51.308(g)(4) to track trends in emissions of pollutants contributing to visibility impairment. States are also required by 40 CFR 51.308(g)(5) to assess significant changes in anthropogenic emissions within and outside the state. Trends should identify the type of source or activity contributing to the emissions and indicate whether the emission changes impede progress toward improved visibility.

This section summarizes the emission inventories of Connecticut and the MANE-VU states from 2002 through the most recent National Emission Inventory (NEI) reporting year of 2017. Note that 2005 was a limited effort NEI and is therefore excluded from the summary.

NEI source categories include point sources, nonpoint sources, nonroad mobile sources and on-road mobile sources.[10] Point sources are larger stationary sources such as Electric Generating Units (EGUs), large industrial and commercial boilers. Nonpoint sources include the smaller stationary sources that are too numerous to practically obtain individual emissions information, so emissions are calculated through surrogates such as population and sales data. Examples of these sources include residential combustion sources, solvent use, gas stations, and surface coating operations. Onroad mobile sources include vehicles that typically operate on roads such as automobiles, trucks, buses and motorcycles. As of 2011, vehicle refueling at gas stations was moved from the nonpoint to onroad inventory. The 2002 onroad emissions were calculated with the EPA MOBILE6 model, subsequent years used the MOVES model. Nonroad mobile sources are sources that move frequently during operation. These sources include construction equipment, off-road recreational vehicles, locomotives, aircraft and boats. However, as of 2008, airports and railroad switchyards are being treated as point sources in the NEI.

As required under 40 CFR 51.308(g)(4), NOx and SO_2 emissions from sources reporting to the EPA's Air Market Program Database (AMPD) are indicated separately.[11]

These inventories show emission trends resulting from control programs and were used as a basis for the technical analyses and modeling demonstrations used for this SIP.

3.1. Nitrogen Oxides (NO_x)

Table 3-1 shows a summary of NOx emissions from all NEI data categories – point, nonpoint, non-road, and onroad for the period from 2002 to 2017 in Connecticut. This summary is also shown graphically in Figure 3-1.

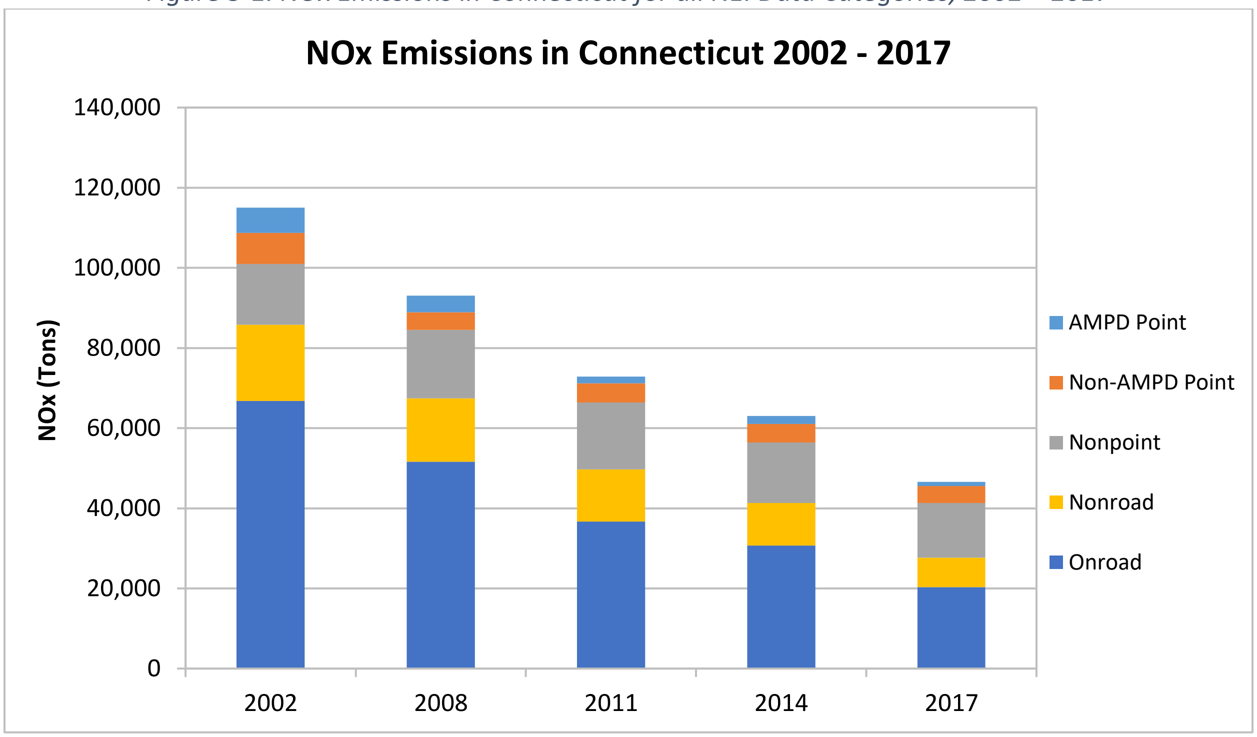
[10] https://www.epa.gov/air-emissions-inventories/emissions-inventory-system-eis-gateway

[11] Units that are required to report to the AMPD primarily include EGUs equal to or greater than 25 MW, but some states (including Connecticut) also include EGUs between 15-24 MW and larger industrial boilers equal to or greater than 250 MMBtu/hr in NOx control programs. https://ampd.epa.gov/ampd/

Table 3-1. NO_x Emissions in Connecticut for all NEI Data Categories, 2002 – 2017 (Tons)

NEI Category	2002	2008	2011	2014	2017	NOx Reduction (2002 – 2017)	Percent NOx Reduction (2002 – 2017)
AMPD Point	6,329	4,133	1,667	1,955	1,052	-5,277	-83%
Non-AMPD Point	7,702	4,447	4,737	4,614	4,174	-3,528	-46%
Nonpoint	15,189	17,045	16,719	15,119	13,709	-1,480	-10%
Nonroad	18,980	15,835	13,046	10,640	7,329	-11,651	-61%
Onroad	66,813	51,619	36,659	30,676	20,311	-46,502	-70%
Total	**115,012**	**93,080**	**72,828**	**63,003**	**46,575**	**-68,438**	**-60%**

Figure 3-1. NOx Emissions in Connecticut for all NEI Data Categories, 2002 – 2017



NO_x emissions have shown a steady decline in Connecticut over the period from 2002 to 2017, particularly in the point, nonroad and onroad mobile sectors. Reductions in AMPD point emissions are due primarily to the NO_x budget and successor programs for power plants. Additional reductions in the point sector emissions result from fuel switching to natural gas from oil, retiring of older units and improved controls on new units. In addition, point sources in Connecticut are declining more than shown in this evaluation because the point source sector in this evaluation includes airports, which are not declining in EPA's inventories.

Reductions in nonroad emissions are due to Federal rules to reduce emissions from new engines used in these sources. 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[12], Control of Emissions from Air Pollution from Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters Per Cylinder[13], and Control of Emissions from Nonroad Spark-Ignition Engines and Equipment[14].

Onroad mobile emission reductions are due to the National and State[15] Low Emission Vehicle Programs, and Federal requirements for onroad vehicles such as the Tier 2 motor vehicle emissions standards[16]. Federal requirements for onroad mobile sources and fuels were strengthened even further with the Tier 3 requirements[17]. More information on programs to control emissions from mobile sources can be found on EPA's Transportation, Air Pollution, and Climate Change website[18].

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 and increasingly zero-emission options.

Starting in 2008, marine vessels and railway 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 more recent years these nonroad sources show 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. Overall decreases in emissions from 2011 to 2017 are tempered by increases in natural gas consumption and EPA methodology changes for fuel combustion emissions from boilers and engines, and for wildfires and prescribed burning.

Tables 3-2 and 3-3 and Figures 3-2 and 3-3 show a steady decline in NO_x emissions from 2002 to 2017 for all the MANE-VU states and the Non-MANE-VU Ask states (i.e. states outside the MANE-VU region reasonably expected to contribute to visibility impairment at one or more Class I areas within the MANE-VU region) . Much of this decline in NO_x emissions is due to the Federal control programs for non-road and on-road 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).

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[12] https://www.gpo.gov/fdsys/pkg/FR-2004-06-29/pdf/04-11293.pdf

[13] https://www.gpo.gov/fdsys/pkg/FR-2008-06-30/pdf/R8-7999.pdf

[14] https://www.gpo.gov/fdsys/pkg/FR-2008-10-08/pdf/E8-21093.pdf

[15] CT LEV II Program RCSA 22a-174-36b and CT LEV III Program RCSA 22a-174-36c last amended 2018.

[16] Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements, Final Rule (https://www.gpo.gov/fdsys/pkg/FR-2000-02-10/pdf/00-19.pdf)

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

[18] https://www.epa.gov/air-pollution-transportation

Table 3-2. 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	50,267	36,566	38,093	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**	**1,987,602**	**1,669,705**	**1,474,096**	**1,084,279**	**-1,481,477**	**-58%**

Figure 3-2. Total NO_x Emissions in the MANE-VU States from all NEI Data Categories, 2002 – 2017

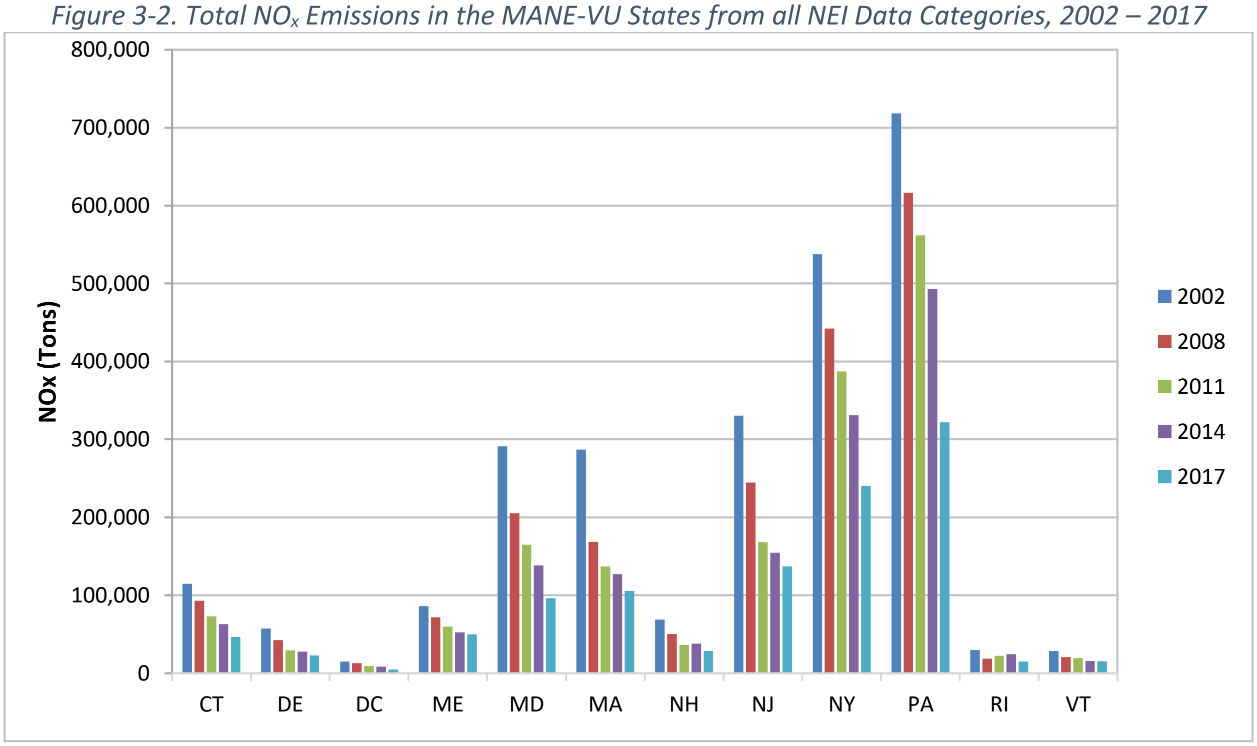


Table 3-3. Total NO_x Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017 (Tons)

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

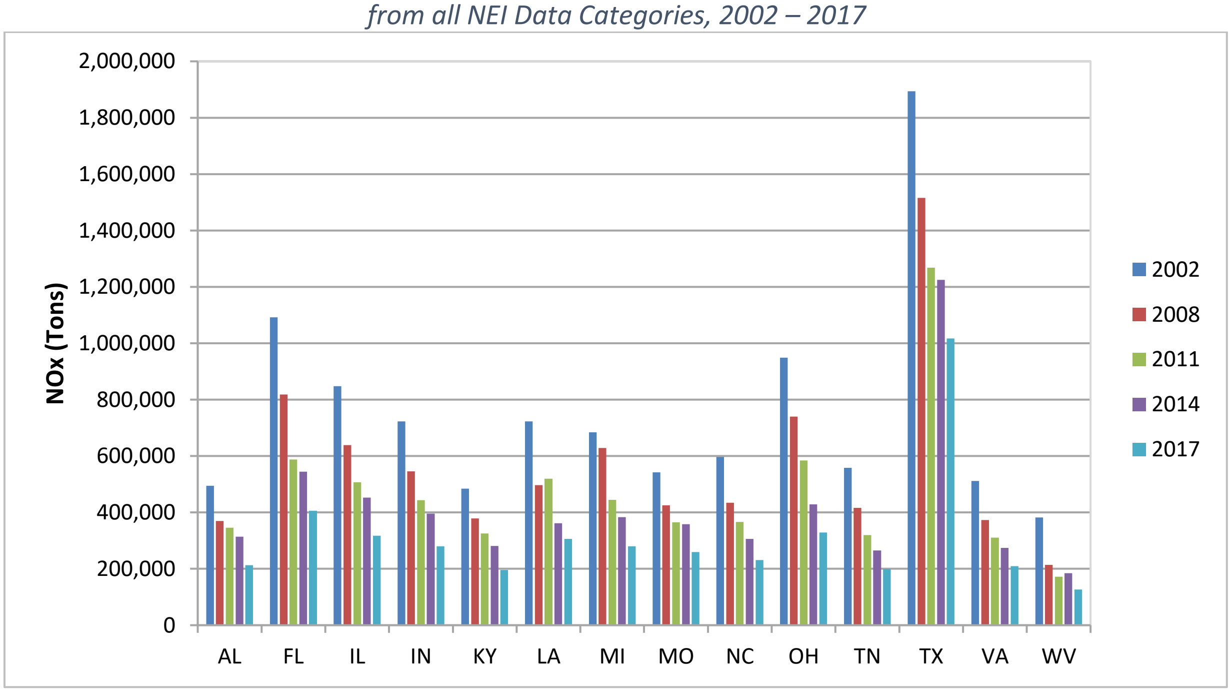


Table 3-4 shows AMPD NO_x data trends for the MANE-VU states from 2002 to 2019, and Table 3-5 shows AMPD NO_x data trends for the Non-MANE-VU Ask states from 2002 to 2019. The tables show significant decreases in NO_x emissions for the AMPD sources between 2002 and 2019 for all states in MANE-VU as well 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 3-4. NO_x Emissions from AMPD Sources in the MANE-VU States, 2002 – 2019 (Tons)

State	2002	2008	2011	2014	2016	2017	2018	2019	NOx Redux 2002-2019	% NOx Redux 2002-2019	NOx Redux 2011-2019	% NOx Redux 2011-2019
CT	6,329	4,133	1,667	1,955	1,058	1,052	1,492	801	-5,528	-87%	-866	-52%
DC	798	291	320	108	68	67	96	76	-722	-90%	-244	-76%
DE	11,363	11,545	3,748	1,791	1,308	889	948	496	-10,867	-96%	-3,252	-87%
MA	32,940	10,002	5,111	4,108	2,883	2,372	1,646	1,007	-31,933	-97%	-4,103	-80%
MD	76,519	40,327	22,536	15,053	9,405	6,127	8,431	4,019	-72,500	-95%	-18,517	-82%
ME	1,154	680	575	539	288	263	327	138	-1,016	-88%	-437	-76%
NH	6,873	4,650	3,951	2,753	1,336	1,070	1,695	1,018	-5,855	-85%	-2,932	-74%
NJ	36,163	15,147	7,040	7,096	4,382	3,443	3,408	2,949	-33,213	-92%	-4,091	-58%
NY	85,917	47,556	31,062	22,214	16,222	11,253	11,702	7,844	-78,073	-91%	-23,218	-75%
PA	218,268	187,771	149,620	125,612	79,450	37,148	34,928	33,132	-185,136	-85%	-116,488	-78%
RI	640	462	630	518	448	470	513	453	-187	-29%	-177	-28%
VT	230	296	117	161	167	139	142	133	-97	-42%	16	14%
Total	**477,195**	**322,858**	**226,377**	**181,908**	**117,014**	**64,292**	**65,326**	**52,066**	**-425,128**	**-89%**	**-174,311**	**-77%**

Table 3-5. NO_x 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	% NOx Redux 2002-2019	NOx Redux 2011-2019	% NOx Redux 2011-2019
AL	161,559	114,587	64,579	51,850	31,127	24,085	26,728	20,571	-140,988	-87%	-44,008	-68%
FL	258,378	161,297	58,854	62,984	51,442	49,084	36,875	31,251	-227,128	-88%	-27,604	-47%
IL	174,247	124,787	73,892	49,758	33,298	33,066	35,310	30,655	-143,592	-82%	-43,237	-59%
IN	281,146	198,948	120,941	109,708	82,615	63,421	67,776	54,464	-226,682	-81%	-66,477	-55%
KY	198,599	157,995	92,180	86,980	57,767	46,057	47,503	41,341	-157,258	-79%	-50,840	-55%
LA	80,365	49,875	48,024	37,264	38,836	29,249	29,575	29,848	-50,517	-63%	-18,175	-38%
MI	132,623	108,117	72,286	56,833	40,366	37,739	39,550	31,741	-100,882	-76%	-40,545	-56%
MO	139,799	88,742	63,419	74,252	56,692	49,692	50,393	44,165	-95,634	-68%	-19,255	-30%
NC	145,706	61,669	48,889	44,288	34,287	33,761	34,663	30,748	-114,958	-79%	-18,141	-37%
OH	370,497	237,585	103,591	89,346	55,756	57,039	51,172	41,349	-329,148	-89%	-62,242	-60%
TN	155,996	89,673	30,819	22,382	22,610	18,201	11,629	10,263	-145,734	-93%	-20,556	-67%
TX	253,861	159,668	148,073	122,540	107,158	109,901	106,258	95,562	-158,299	-62%	-52,510	-35%
VA	78,868	50,887	37,651	27,648	22,280	16,545	17,740	11,506	-67,362	-85%	-26,145	-69%
WV	225,371	101,046	58,223	72,970	52,584	44,079	40,925	37,012	-188,358	-84%	-21,211	-36%
Total	**2,657,015**	**1,704,876**	**1,021,422**	**908,805**	**686,817**	**611,919**	**596,096**	**510,476**	**-2,146,539**	**-81%**	**-510,946**	**-50%**

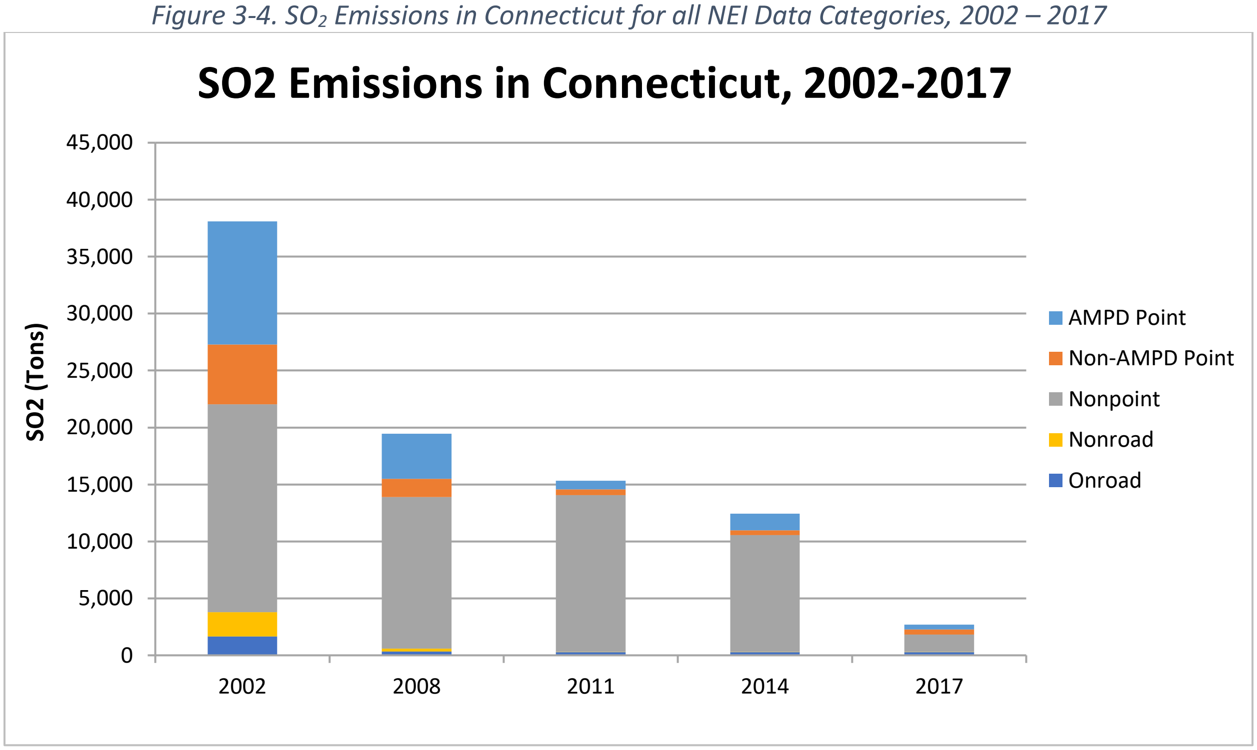
3.2. Sulfur Dioxide (SO_2)

Table 3-6 shows SO_2 emissions from all NEI data categories for the period 2002 to 2017 in Connecticut. This data is also shown graphically in Figure 3-4.

Table 3-6. SO_2 Emissions in Connecticut for all NEI Data Categories, 2002 – 2017 (Tons)

NEI Category	2002	2008	2011	2014	2017	SOx Reduction (2002 – 2017)	Percent SOx Reduction (2002 – 2017)
AMPD Point	10,814	3,955	752	1,478	421	-10,393	-96%
Non-AMPD Point	5,255	1,597	518	403	435	-4,820	-92%
Nonpoint	18,258	13,311	13,744	10,250	1,540	-16,718	-92%
Nonroad	2,109	246	38	29	18	-2,091	-99%
Onroad	1,667	334	282	286	279	-1,388	-83%
Total	**38,102**	**19,443**	**15,334**	**12,445**	**2,692**	**-35,410**	**-93%**

Figure 3-4. SO_2 Emissions in Connecticut for all NEI Data Categories, 2002 – 2017



SO_2 emissions have shown a steady significant decline in Connecticut over the period 2002 to 2017, particularly in the point, nonroad and onroad mobile sectors. Reductions in point emissions are primarily due to Federal and State low sulfur fuel regulations. Connecticut began strengthening its fuel sulfur limits for power plants and large stationary sources in 2000 and continued to broaden applicability and reduce allowable fuel sulfur content by statute and with rule revisions through 2017. The implementation of RCSA section 22a-174-19b in 2014 satisfied the MANE-VU goal of reduced fuel sulfur content as part of the long-term strategy for improved visibility.

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 3-1 and Figure 3-5 show total SO_2 emissions from all NEI data categories in the MANE-VU states for 2002 to 2017. A steady decrease in SO_2 emissions can be seen for each MANE-VU state over this 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 SO_2 emissions at 167 EGU stacks (both inside and outside of MANE-VU) requested by MANE-VU for the first regional haze planning period[19]. 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, SO_2 emissions reductions are expected to continue well beyond the 2002 to 2017 timeframe shown. Other potential SO_2 emission decreases are due to source shutdowns and fuel switching due to the availability of less expensive natural gas in recent years.

[19] 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)

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

Figure 3-5. Total SO_2 Emissions in the MANE-VU States for all NEI Data Categories, 2002 – 2017

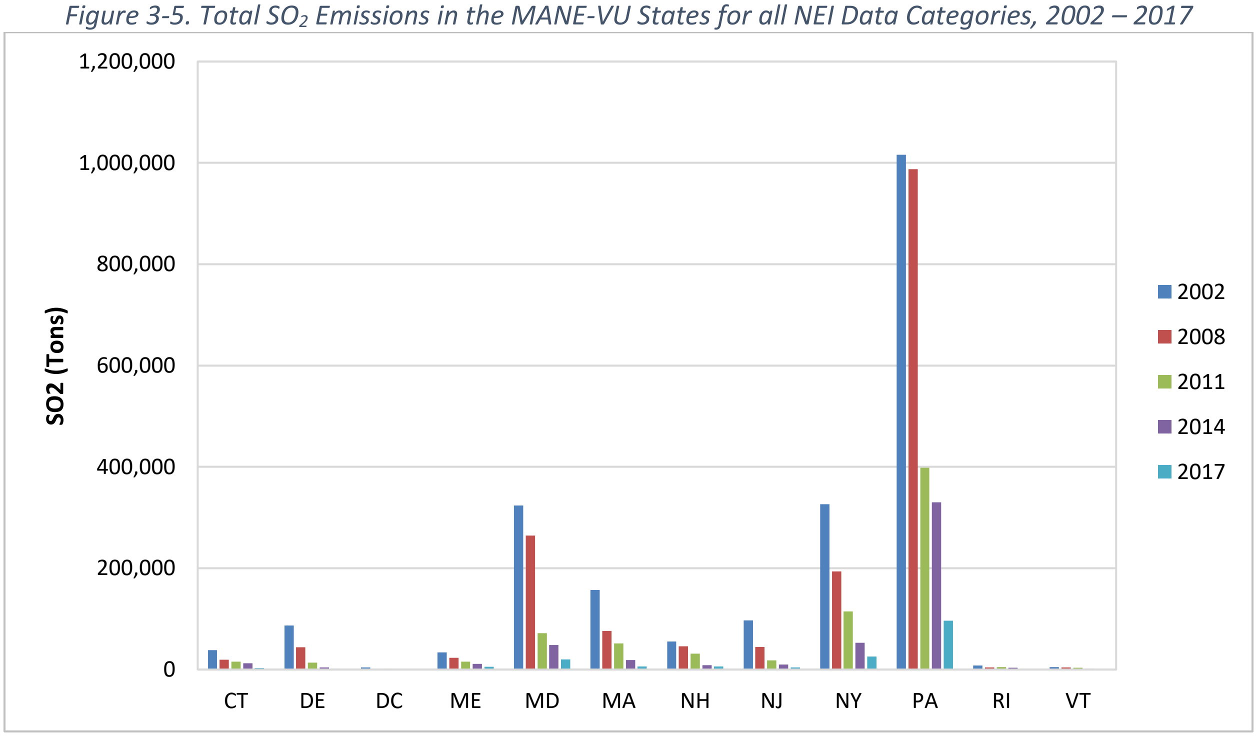


Table 3-8 and Figure 3-6 show total SO_2 emissions from all NEI data categories in the Non-MANE-VU Ask states for 2002 to 2017. Like MANE-VU states, decreases in SO_2 can be seen for all the Ask states over this period. In addition to the Federal rules, some of these decreases are attributable to the 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 3-8 Total SO2 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 3-6. Total SO_2 Emissions in the Non-MANE-VU Ask States for all NEI Data Categories, 2002 – 2017

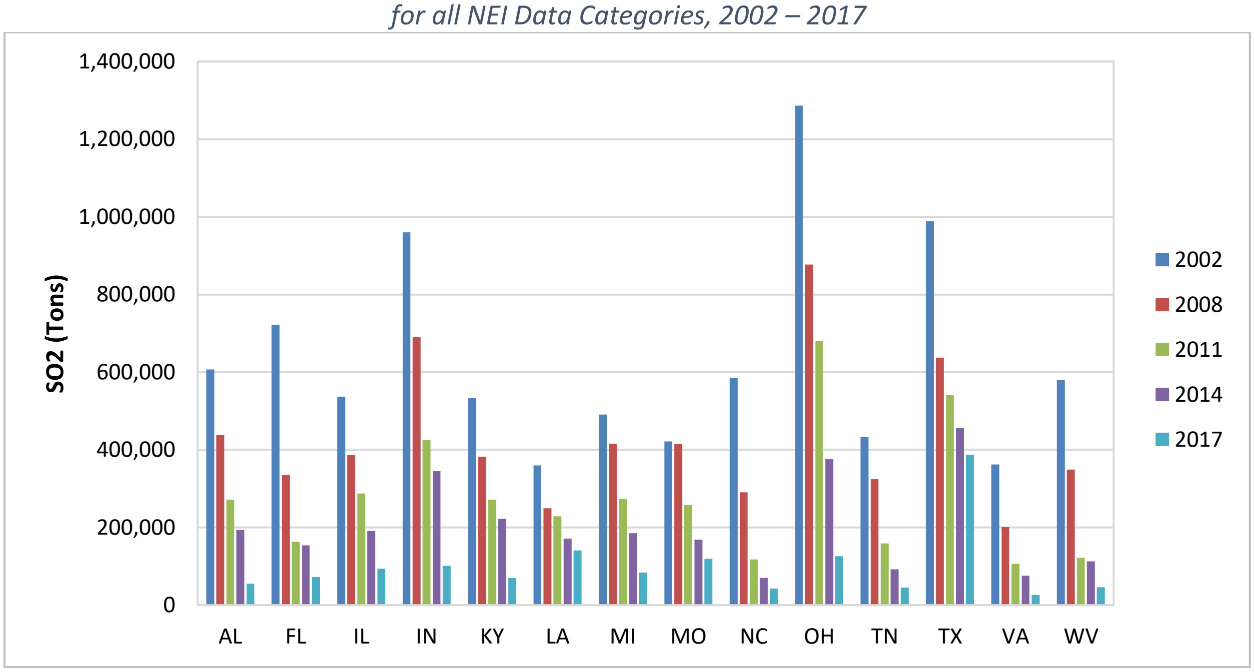


Table 3-9 shows AMPD SO_2 data trends for the MANE-VU states from 2002 to 2019, and Table 3-10 shows AMPD SO_2 data trends for the Non-MANE-VU Ask states from 2002 to 2019. The tables show significant decreases in SO2 emissions for the AMPD sources between 2002 and 2019 for all applicable states in MANE-VU as well as the Non-MANE-VU Ask states.

Reductions in SO_2 are most likely due to the acid rain program, power plant consent decrees, specific state rules, CAIR, CSAPR[20] (the CAIR successor program), 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 3-9. SO_2 Emissions from AMPD Sources in the MANE-VU States, 2002 – 2019 (Tons)

State	2002	2008	2011	2014	2016	2017	2018	2019	SO2 Redux 2002-2019	% SO2 Redux 2002-2019	SO2 Redux 2011-2019	% SO2 Redux 2011-2019
CT	10,814	3,955	752	1,478	362	421	690	132	-10,682	-99%	-621	-82%
DC	1,087	261	723	-	-	-	-	-	-1,087	-100%	-723	-100%
DE	32,236	31,808	9,306	829	513	545	644	279	-31,957	-99%	-9,027	-97%
MA	90,727	46,347	22,701	4,670	1,717	1,083	742	194	-90,533	-100%	-22,507	-99%
MD	255,360	227,198	32,275	23,553	16,754	8,121	11,325	5,572	-249,787	-98%	-26,703	-83%
ME	2,022	1,041	470	856	369	444	643	50	-1,973	-98%	-420	-89%
NH	43,947	36,895	24,445	2,636	573	473	1,197	417	-43,530	-99%	-24,028	-98%
NJ	48,269	21,204	5,414	2,655	1,725	1,722	1,433	1,250	-47,019	-97%	-4,165	-77%
NY	231,985	65,427	40,756	16,676	4,533	2,561	4,889	1,972	-230,013	-99%	-38,784	-95%
PA	889,766	831,915	330,539	270,332	98,006	69,790	69,018	52,394	-837,372	-94%	-278,146	-84%
RI	12	18	20	17	14	18	22	16	4	31%	-4	-20%
VT	6	2	1	2	1	1	1	1	-4	-79%	0	-21%
Total	**1,606,230**	**1,266,072**	**467,404**	**323,704**	**124,567**	**85,179**	**90,604**	**62,277**	**-1,543,954**	**-96%**	**-405,127**	**-87%**

Table 3-10. 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	SO2 Redux 2011-2019	% SO2 Redux 2011-2019
AL	448,248	357,547	179,256	119,898	25,034	10,478	12,023	6,420	-441,828	-99%	-172,837	-96%
FL	466,904	263,952	94,710	99,074	39,186	35,700	29,202	17,075	-449,829	-96%	-77,635	-82%
IL	353,699	257,431	205,630	122,463	66,993	54,511	57,357	50,137	-303,562	-86%	-155,493	-76%
IN	778,868	595,966	371,983	290,685	87,083	63,735	68,509	47,780	-731,088	-94%	-324,204	-87%
KY	482,653	344,874	246,399	202,042	76,424	57,119	55,161	49,949	-432,704	-90%	-196,450	-80%
LA	101,887	76,302	93,275	74,260	43,328	39,699	38,175	23,688	-78,199	-77%	-69,587	-75%
MI	342,999	326,501	222,702	152,942	84,019	65,369	65,504	50,554	-292,444	-85%	-172,147	-77%
MO	235,532	258,269	196,265	133,255	99,451	105,993	102,607	88,916	-146,616	-62%	-107,349	-55%
NC	462,993	227,030	77,985	42,862	30,136	22,265	21,522	21,978	-441,015	-95%	-56,007	-72%
OH	1,132,069	709,444	575,474	290,403	94,486	90,751	86,570	68,905	-1,063,164	-94%	-506,570	-88%
TN	336,995	208,069	120,353	58,434	31,270	24,312	11,735	11,224	-325,770	-97%	-109,129	-91%
TX	562,516	484,271	426,490	343,425	245,799	275,993	211,025	149,135	-413,381	-73%	-277,354	-65%
VA	230,846	125,985	68,071	33,088	10,316	5,791	8,875	2,343	-228,503	-99%	-65,728	-97%
WV	507,110	301,574	95,693	94,335	43,693	40,545	45,778	38,741	-468,369	-92%	-56,951	-60%
Total	**6,443,319**	**4,537,215**	**2,974,287**	**2,057,164**	**977,219**	**892,262**	**814,042**	**626,846**	**-5,816,474**	**-90%**	**-2,347,442**	**-79%**

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

3.3. Volatile Organic Compounds (VOCs)

Table 3-11 shows VOC emissions from all NEI data categories for the period 2002 to 2017 in Connecticut. This data is also shown graphically in Figure 3-7.

VOC emissions from Stage II refueling were reported in the nonpoint category in 2002 through 2008 but moved to the onroad category after 2008.

VOC emissions have declined in Connecticut over the period 2002 to 2017. VOC decreases were achieved in all sectors due to Federal new engine standards for onroad and nonroad vehicles and equipment, the National and State low emission vehicle programs, area source rules such as consumer products, portable fuel containers, paints, autobody refinishing, asphalt paving applications, and solvent cleaning operations, and VOC storage tank rules.

Table 3-11. VOC Emissions in Connecticut for all NEI Data Categories, 2002 – 2017 (Tons)

NEI Category	2002	2008	2011	2014	2017	VOC Reduction (2002 – 2017)	Percent VOC Reduction (2002 – 2017)
Point	5,607	1,247	1,042	1,106	1,189	-4,418	-79%
Nonpoint	103,501	34,045	40,272	47,470	33,289	-70,212	-68%
Nonroad	32,357	24,282	16,827	13,181	8,383	-23,974	-74%
Onroad	47,757	26,451	21,669	20,593	15,197	-32,560	-68%
Total	**189,223**	**86,024**	**79,809**	**82,350**	**58,059**	**-131,163**	**-69%**

Figure 3-7. VOC Emissions in Connecticut for all NEI Data Categories, 2002 – 2017

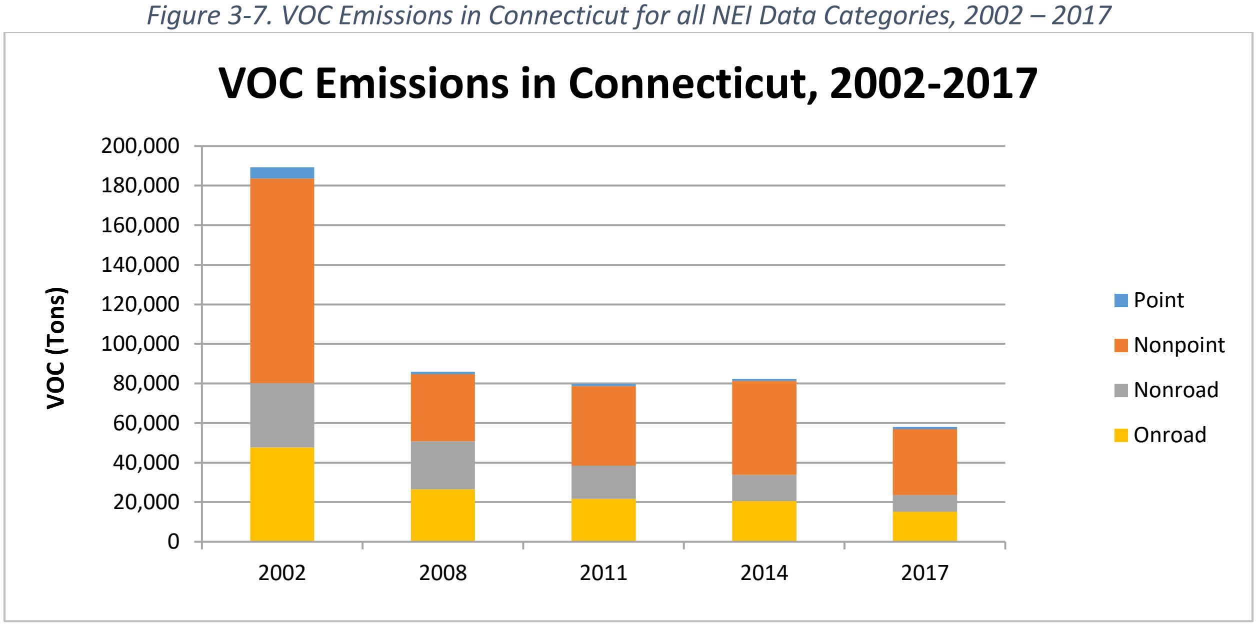


Table 3-12 and Figure 3-8 show total VOC emissions from all NEI data categories for the MANE-VU states during the period from 2002 to 2017. Except for in Pennsylvania, VOC emissions have declined in all MANE-VU states during this period. The overall increase in VOC emissions in Pennsylvania are due to increased activity in the oil and gas industry and drilling for natural gas and improvements in the methods for calculating emissions from this sector.

The majority of the VOC decreases are from Federal new engine standards for onroad and nonroad vehicles and equipment and state and federal low emission vehicle programs. Additional VOC reductions are attributable to Federal and state rules for portable fuel containers; architectural, industrial, and maintenance coatings; consumer products; and solvent degreasing. Many states' rules for these types of categories are based on the Ozone Transport Commission (OTC) Model Rules[21]. Evaporative VOC emissions from these types of sources are expected to continue to decline as more states adopt rules based on the OTC Model Rules. Other decreases are due to states' VOC RACT rules. Evaporative VOC emissions from onroad mobile sources have also decreased due to state motor vehicle Inspection & Maintenance (I & M) programs and the wide-spread use of on-board refueling vapor recovery (ORVR) technology on motor vehicles. VOC emissions from nonroad and onroad mobile sources are expected to continue to decrease as older, more polluting vehicles are replaced by newer, cleaner ones, including an increasing number of zero emission vehicles.

Table 3-12. Total VOC Emissions from all NEI Data Categories in the MANE-VU States, 2002 – 2017 (Tons)

State	2002	2008	2011	2014	2017	VOC Reduction (2002 – 2017)	Percent 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%**

[21] http://otcair.org/document.asp?Fview=modelrules

Figure 3-8. Total VOC Emissions from all NEI Data Categories in the MANE-VU States, 2002 – 2017

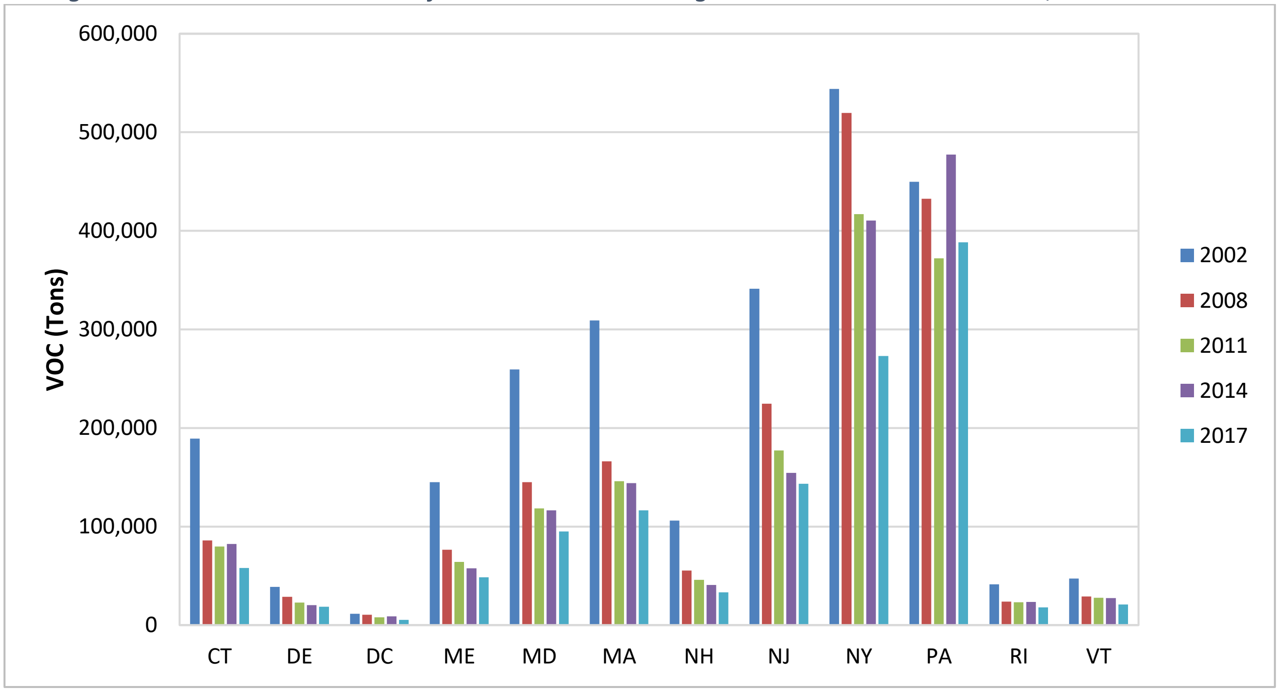
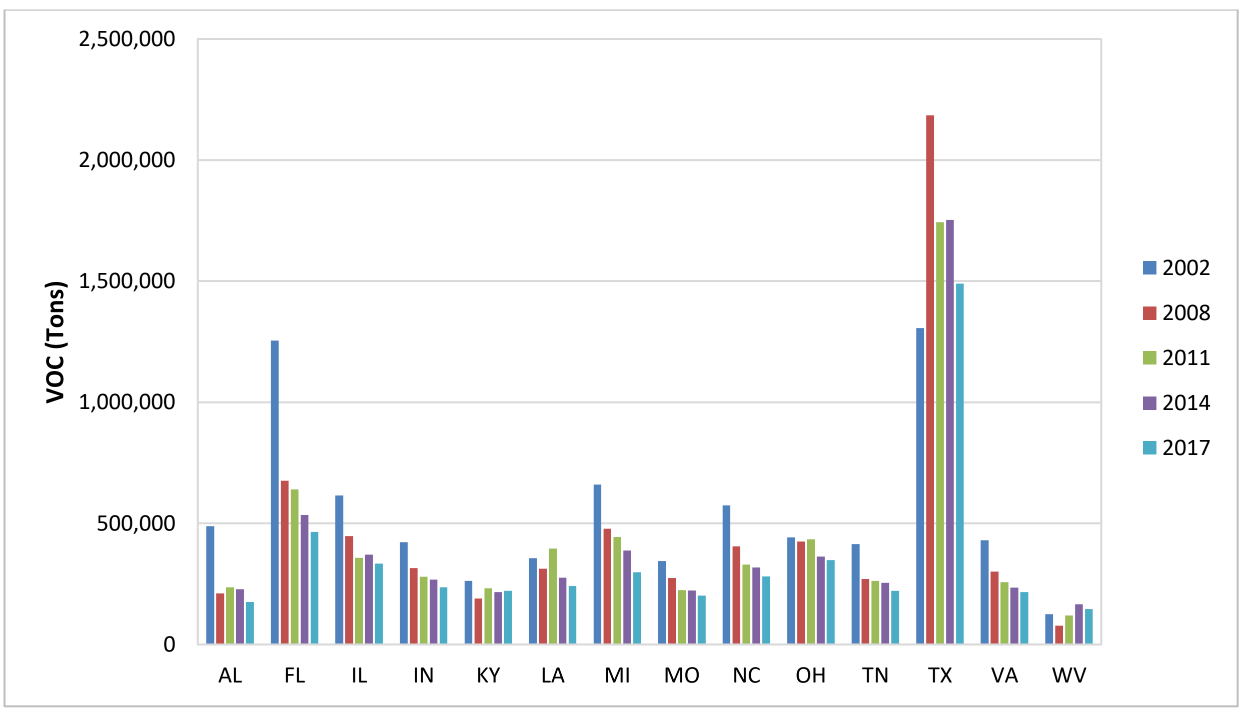


Table 3-13 and Figure 3-9 show total VOC emissions from all NEI data categories from the Non-MANE-VU Ask states. VOC emissions have declined from 2002 to 2017 in all of the Non-MANE-VU Ask states except in Texas and West Virginia. Increases in emissions from Texas and West Virginia are also most likely due to emissions generated from the oil and gas industry and drilling for natural gas and EPA's improved methods for estimating these emissions. Despite the increases from Texas and West Virginia, the overall total VOC emissions in the Non-MANE-VU Ask states have declined from 2002 to 2017.

Table 3-13.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 Reduction (2002 – 2014)	Percent VOC Reduction (2002 – 2014)
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	615,437	447,920	358,168	371,226	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	281,455	-292,851	-51%
OH	441,791	425,224	433,846	363,164	347,773	-94,018	-21%
TN	413,803	270,776	262,588	255,189	221,151	-192,652	-47%
TX	1,306,082	2,185,097	1,743,762	1,752,968	1,490,387	184,305	14%
VA	430,319	301,131	256,981	234,222	216,691	-213,628	-50%
WV	124,621	77,182	119,437	165,676	146,312	21,691	17%
Total	**7,695,093**	**6,569,556**	**5,954,169**	**5,594,148**	**4,874,098**	**-2,820,995**	**-37%**

Figure 3-9. Total VOC Emissions from all NEI Data Categories in the Non-MANE-VU Ask States, 2002 – 2017



3.4. Particulate Matter Less Than 10 Microns (PM10)

Table 3-14 shows a summary of PM10 emissions from all NEI data categories – point, nonpoint, non-road, and onroad for the period from 2002 to 2017 in Connecticut. This summary is also shown graphically in Figure 3-10.

In Connecticut, PM10 emissions decreased in the point, nonpoint, and nonroad categories for the period from 2002 to 2017. The variations in the onroad category are due to changes in emission inventory calculation methodologies, which resulted in higher particulate matter estimates in the other years than in 2002. The large variation in emissions in the nonpoint category is due to changes in calculation methodologies for residential wood burning and fugitive dust categories, which have varied significantly. EPA and Connecticut have partnered to increase the accuracy of the emissions categories since the 2002 inventory, and the process is ongoing.

When looking at the following tables and charts, it should be noted that non-combustion PM10 emissions (e.g. paved & unpaved road dust, agricultural dust, etc.) are unadjusted, that is, they represent the raw mass emissions before adjustment with transport fractions. Emission estimates using EPA's calculation methodologies for fugitive dust are generally significantly higher than observed monitored data. Therefore, EPA developed transport fractions to reduce the fugitive dust emissions to account for particulate emissions that settle out or are "trapped" by obstructions such as vegetation and buildings. EPA requests that the emissions be submitted to the NEI without any adjustments. EPA will then perform the adjustments prior to modeling the inventory.

Table 3-14. PM10 Emissions in Connecticut for all NEI Data Categories, 2002 – 2017 (Tons)

NEI Category	2002	2008	2011	2014	2017	PM10 Reduction (2002 – 2017)	Percent PM10 Reduction (2002 – 2017)
Point	1,703	670	503	538	473	-1,164	-72%
Nonpoint	48,164	34,466	34,861	24,948	26,141	-23,216	-46%
Nonroad	1,790	1,423	1,287	1,134	791	-657	-56%
Onroad	1,610	2,490	2,447	2,222	1,654	612	3%
Total	**53,267**	**39,048**	**39,097**	**28,842**	**29,058**	**-24,425**	**-45%**

Figure 3-10. PM10 Emissions in Connecticut for all NEI Data Categories, 2002 – 2017

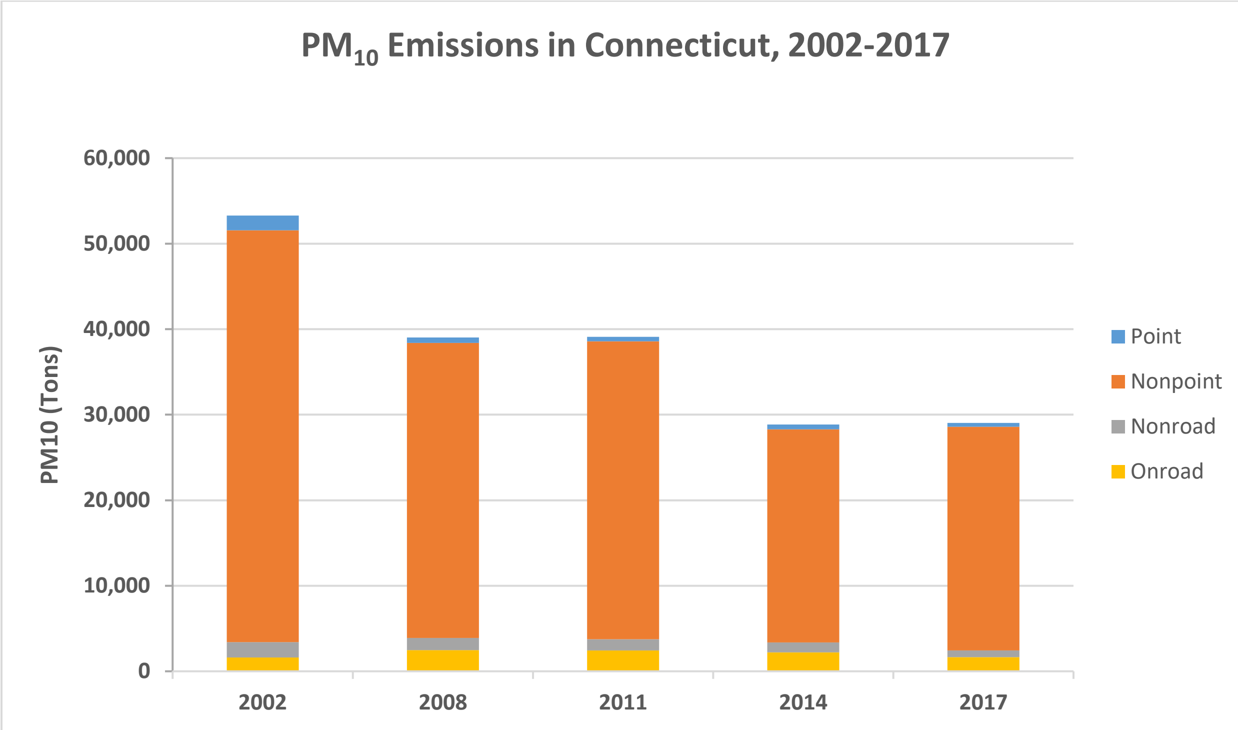


Table 3-15 and Figure 3-11 show total PM10 emissions from all NEI data categories in the MANE-VU states. Similarly, Table 3-16 and Figure 3-12 show total PM10 emissions from all data categories in the Non-MANE-VU Ask states. PM10 emissions in the MANE-VU and Non-MANE-VU Ask states show no pattern over 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 most likely due to changes in estimation methodologies for categories such as yard waste burning, paved and unpaved fugitive road dust, and residential wood combustion.

Table 3-15.Total PM10 Emissions in the MANE-VU States from all NEI Data Categories, 2002 – 2017 (Tons)

State	2002	2008	2011	2014	2017	PM10 Reduction (2002 – 2017)	Percent PM10 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 3-11. Total PM10 Emissions in the MANE-VU States from all NEI Data Categories, 2002 – 2017

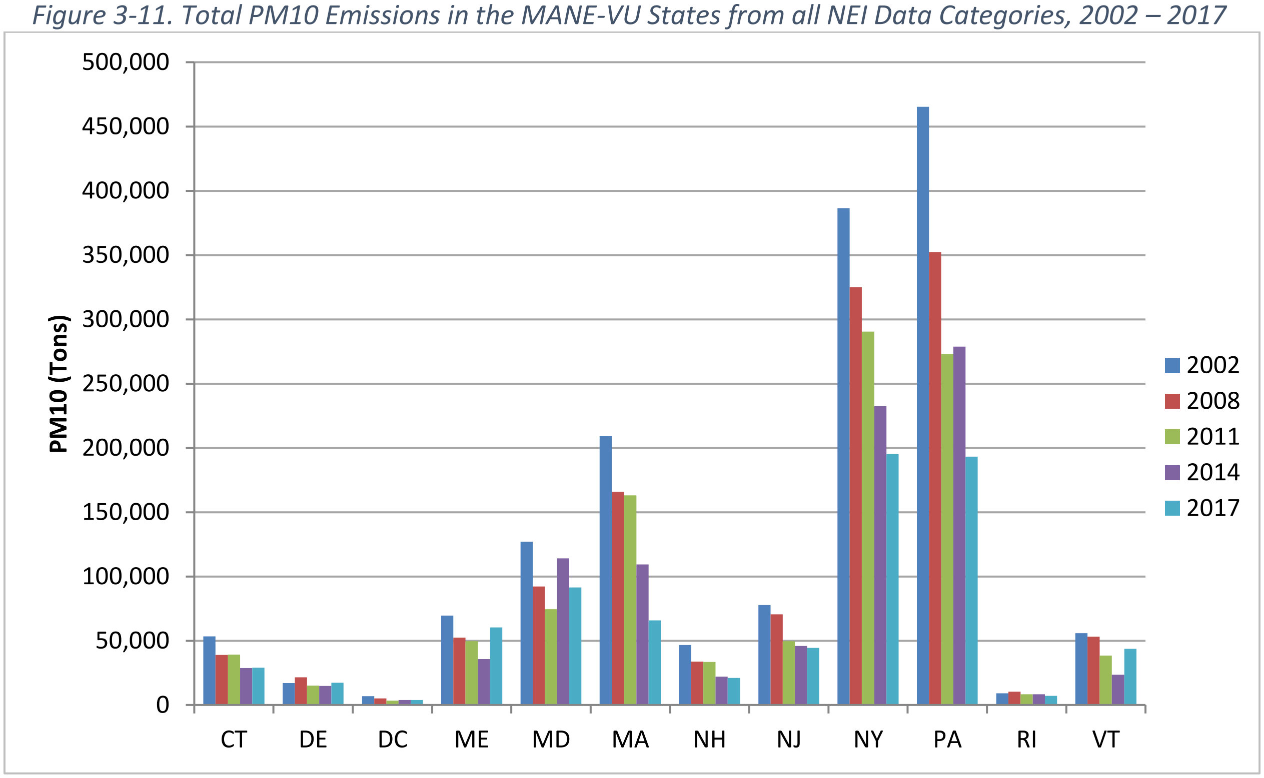
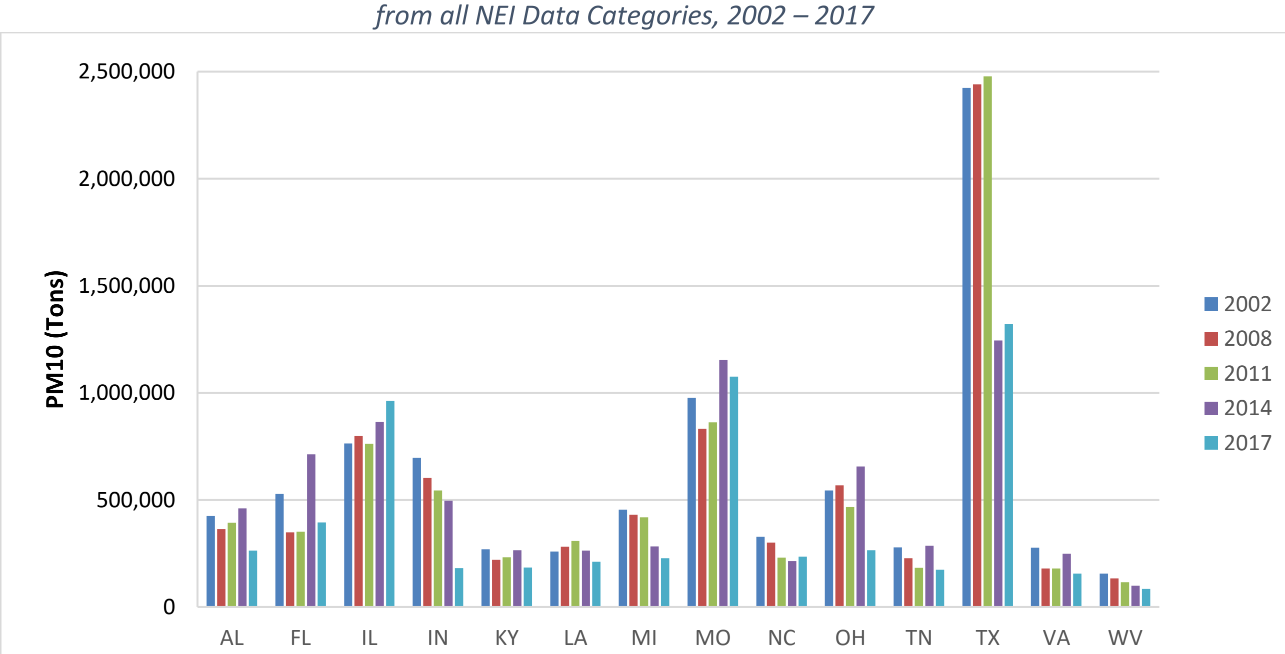


Table 3-16. Total PM10 Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017 (Tons)

State	2002	2008	2011	2014	2017	PM10 Reduction (2002 – 2014)	Percent PM10 Reduction (2002 – 2014)
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 3-12. Total PM10 Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017



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

Table 3-17 shows a summary of PM2.5 emissions from all NEI data categories for the period from 2002 to 2017 in Connecticut. This summary is also shown graphically in Figure 3-13.

EPA began requiring PM2.5 emission reporting in 2002. PM2.5 emissions were not reported as part of Connecticut's emission statement program in 2002, therefore they were estimated. Also, as discussed previously, starting in 2008, air and rail yard emissions were included in point source inventories instead of in nonroad inventories. PM2.5 emissions decreased in the nonroad because of Federal new engine standards for nonroad vehicles and equipment. The increase in emissions in the onroad category from 2002 to 2008 is due to changes in calculation methodologies and a model change that resulted in higher fine particulate matter estimates in the years after 2002. The variation in emissions in the nonpoint category is due to changes in calculation methodologies for residential wood burning and fugitive dust categories, which have varied significantly. EPA and Connecticut have been working on making these categories more accurate since the 2002 inventory and it is still an ongoing process.

As discussed in the PM10 section, when looking at the following tables and charts, it should be noted that non-combustion PM2.5 emissions (e.g. paved & unpaved road dust, agricultural dust, etc.) are unadjusted, that is, they represent the raw mass emissions before adjustment with transport fractions. Emission estimates using EPA's calculation methodologies for fugitive dust are generally significantly higher than observed monitored data. Therefore, EPA developed transport fractions to reduce the fugitive dust emissions to account for particulate emissions that settle out or are "trapped" by obstructions such as vegetation and buildings. EPA requests that the emissions be submitted to the NEI without any adjustments, then they perform the adjustments prior to modeling the inventory.

Table 3-17. PM2.5 Emissions in Connecticut for all NEI Data Categories, 2002 – 2017 (Tons)

NEI Category	2002	2008	2011	2014	2017	PM2.5 Reduction (2002 – 2014)	Percent PM2.5 Reduction (2002 – 2014)
Point	1,263	533	442	507	447	-817	-65%
Nonpoint	13,154	12,484	13,739	10,489	9,875	-3,279	-25%
Nonroad	1,699	1,349	1,221	1,074	748	-951	-56%
Onroad	1,067	1,824	1,143	1,019	653	-414	-39%
Total	**17,183**	**16,190**	**16,545**	**13,088**	**11,723**	**-5,460**	**-32%**

Figure 3-13. PM2.5 Emissions in Connecticut for all NEI data Categories, 2002 – 2017

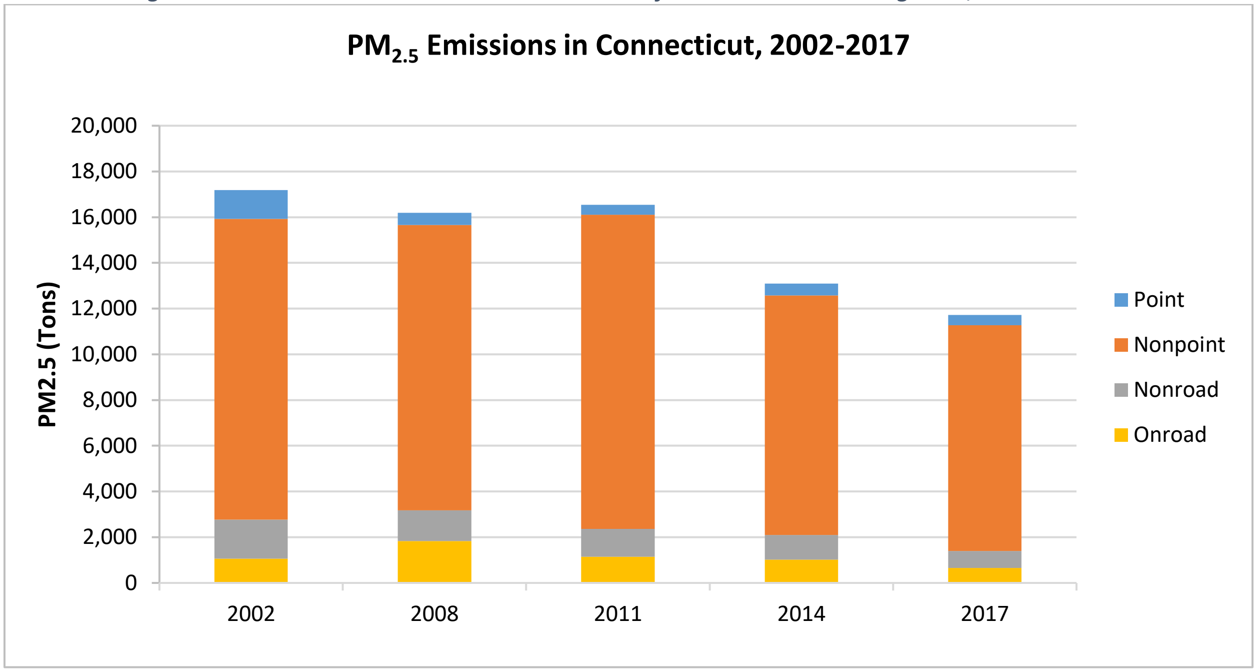


Table 3-18 and Figure 3-14 show total PM2.5 emissions from all NEI data categories in the MANE-VU states. Similarly, Table 3-19 and Figure 3-15 show total PM2.5 emissions from all data categories in the Non-MANE-VU Ask states. PM2.5 emissions in the MANE-VU and Non-MANE-VU Ask states vary from year to year and state to state. In some states, emissions have declined or remained constant; in others, there are increases. As with Connecticut, these variations are most likely due to changes in reporting and calculation methodologies.

Table 3-18. Total PM2.5 Emissions in the MANE-VU States from all NEI Data Categories, 2002 – 2017 (Tons)

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

Figure 3-14. Total PM2.5 Emissions in the MANE-VU States from all NEI Data Categories, 2002 – 2017

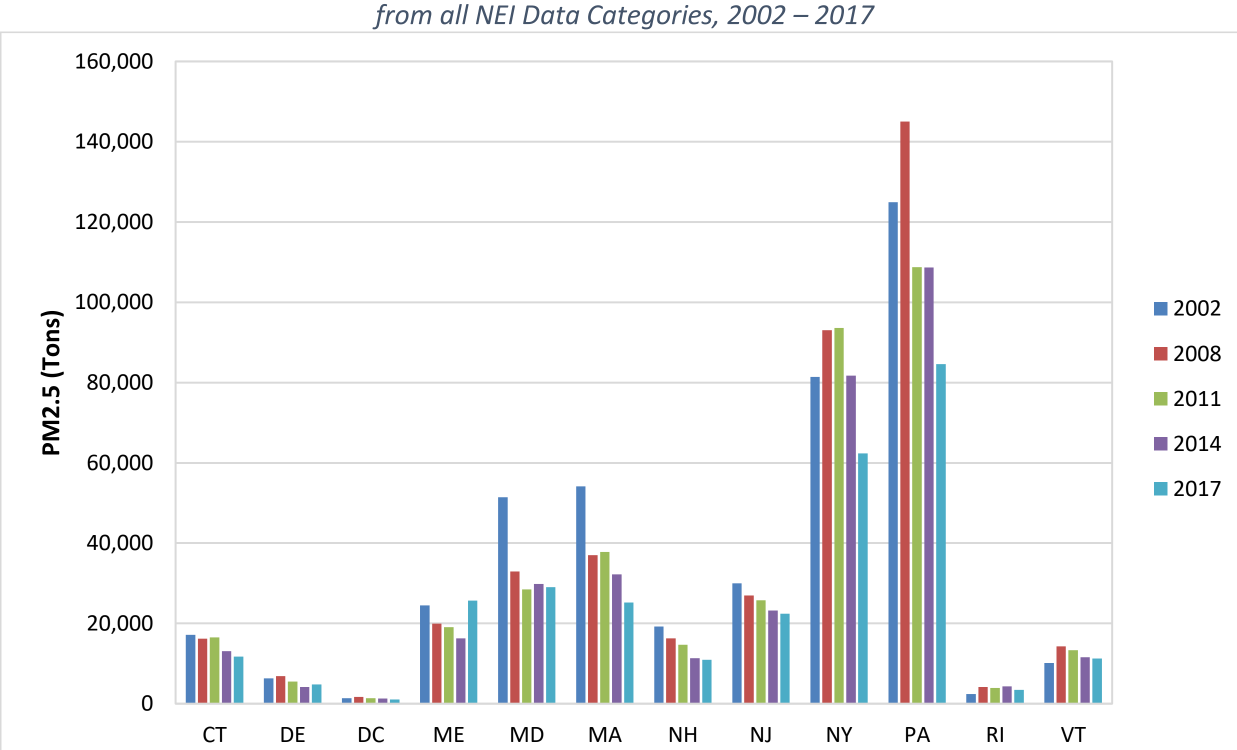
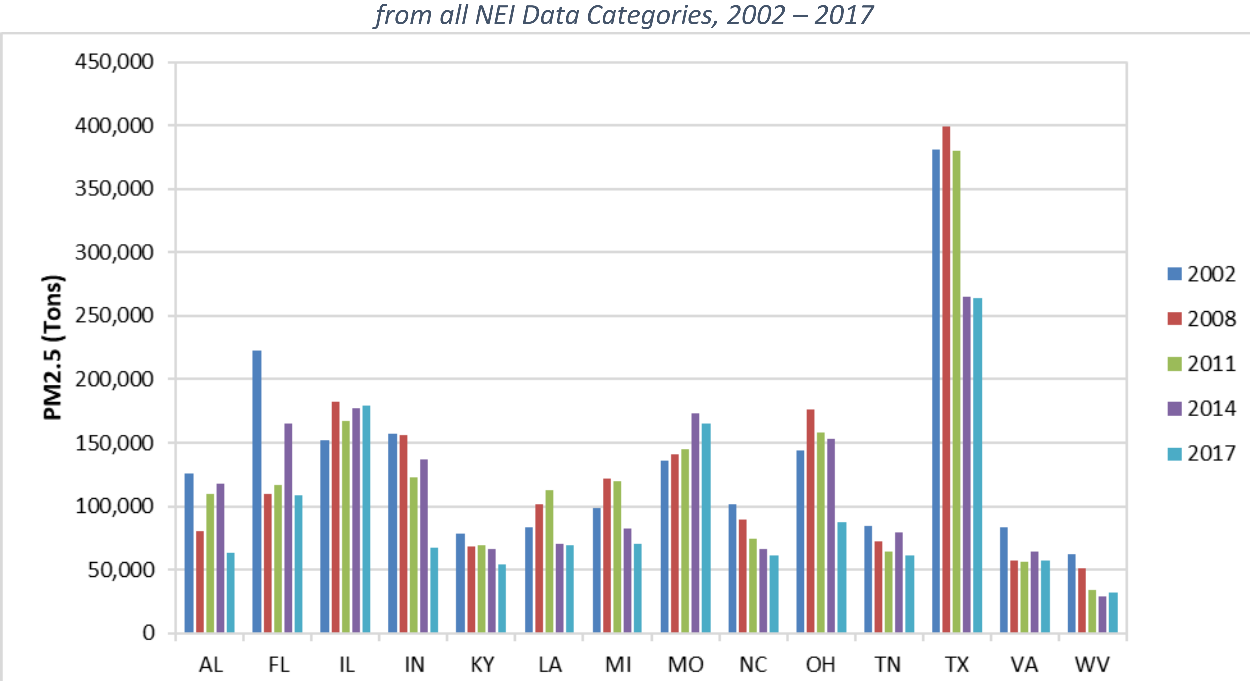


Table 3-19. Total PM2.5 Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017 (Tons)

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

Figure 3-15. Total PM2.5 Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017



3.6. Ammonia (NH_3)

Table 3-20 shows NH_3 emissions from all NEI data categories for the period 2002 to 2017 in Connecticut. This data is also shown graphically in Figure 3-16.

NH_3 emissions were not reported to Connecticut's emission statement program in 2002, therefore, they were estimated by EPA.

Though ammonia decreases were achieved in the onroad and nonroad sectors due to Federal new engine standards for vehicles and equipment, increases and decreases for all categories are due to reporting, grouping and methodology changes. As discussed previously, 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.

In summary, overall, ammonia emissions have decreased from 2002 to 2017.

Table 3-20. NH_3 Emissions in Connecticut for all NEI Data Categories, 2002 – 2017 (Tons)

NEI Category	2002	2008	2011	2014	2017	NH3 Reduction (2002 – 2017)	Percent NH3 Reduction (2002 – 2017)
Point	272	283	463	495	475	203	75%
Nonpoint	4,648	3,470	3,592	2,671	3,913	-735	-16%
Nonroad	17	18	18	19	15	-2	-11%
Onroad	3,257	1,218	1,127	1,009	893	-2,364	-73%
Total	**8,194**	**4,989**	**5,200**	**4,194**	**5,296**	**-2,898**	**-35%**

Figure 3-16. NH_3 Emissions in Connecticut for all NEI Data Categories, 2002 – 2017

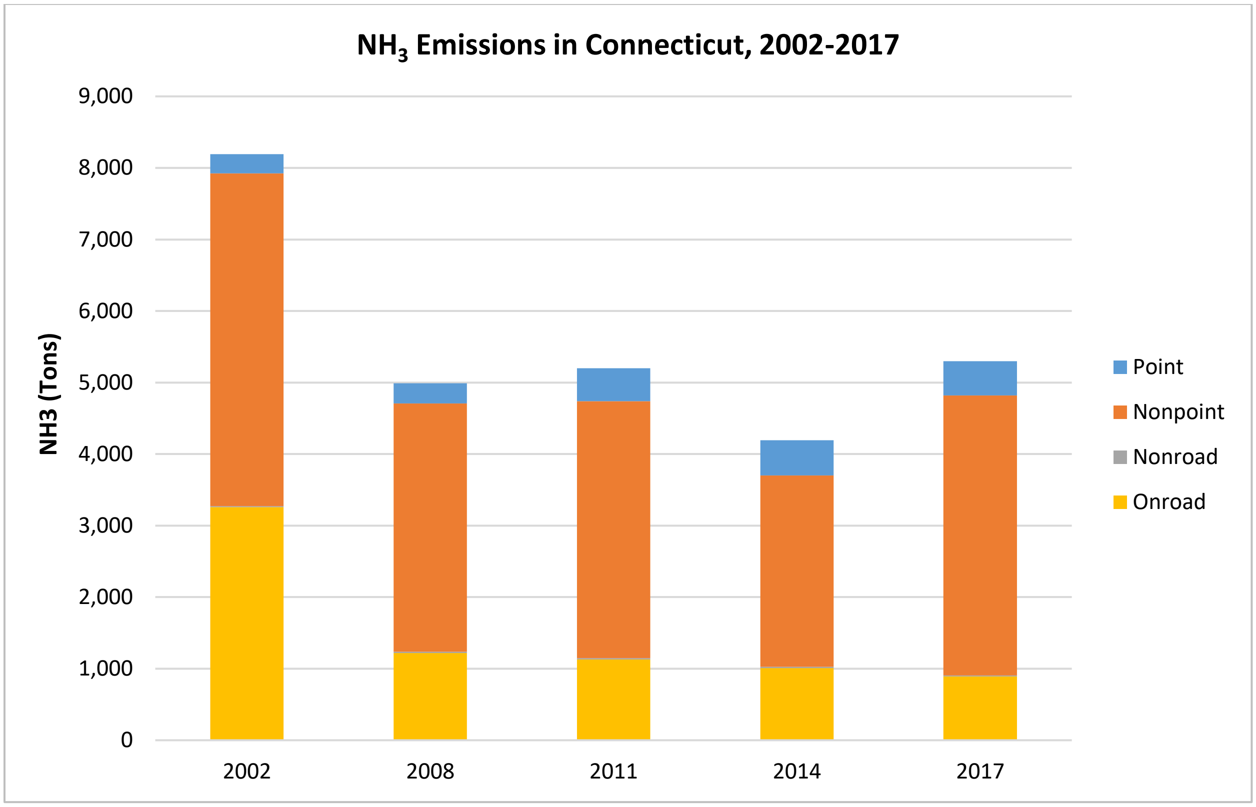
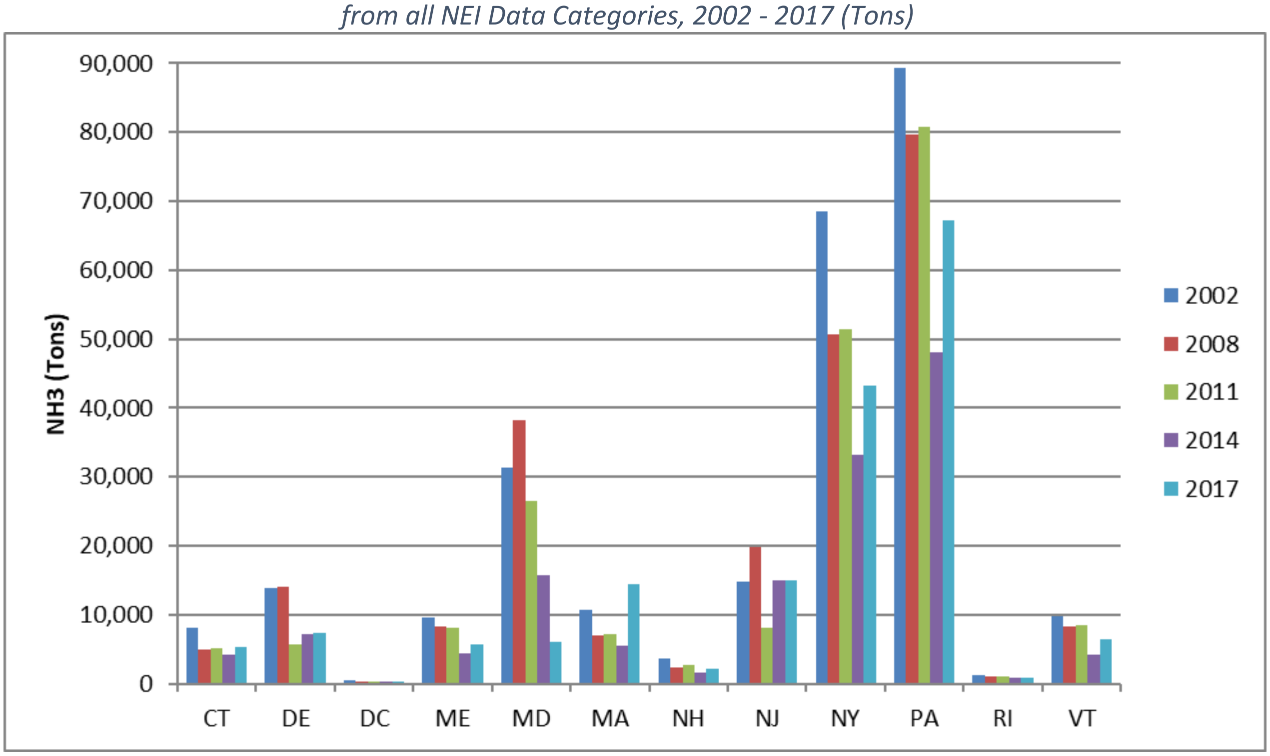


Table 3-21 and Figure 3-17 show total ammonia emissions for all NEI data categories combined for the MANE-VU states. Some year-to-year variability is evident. However, for the majority of MANE-VU states, ammonia emissions for 2017 are lower than they were for earlier years.

Table 3-21. Total NH3 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	8,194	4,989	5,200	4,194	5,296	-2,898	-35%
DE	13,920	13,975	5,771	7,252	7,353	-6,567	-47%
DC	421	354	330	317	263	-158	-37%
ME	9,557	8,207	8,024	4,356	5,765	-3,792	-40%
MD	31,278	38,288	26,429	15,746	6,108	-25,170	-80%
MA	10,794	6,929	7,177	5,411	14,492	3,698	34%
NH	3,567	2,311	2,684	1,645	2,122	-1,445	-41%
NJ	14,807	19,804	8,049	14,895	14,976	169	1%
NY	68,536	50,737	51,487	33,110	43,180	-25,356	-37%
PA	89,263	79,588	80,871	48,000	67,183	-22,080	-25%
RI	1,202	1,092	1,075	862	873	-329	-27%
VT	9,810	8,379	8,567	4,148	6,490	-3,320	-34%
Total	**261,350**	**234,652**	**205,665**	**139,936**	**174,101**	**-87,248**	**-33%**

Figure 3-17. Total NH_3 Emissions in the MANE-VU States from all NEI Data Categories, 2002 - 2017 (Tons)

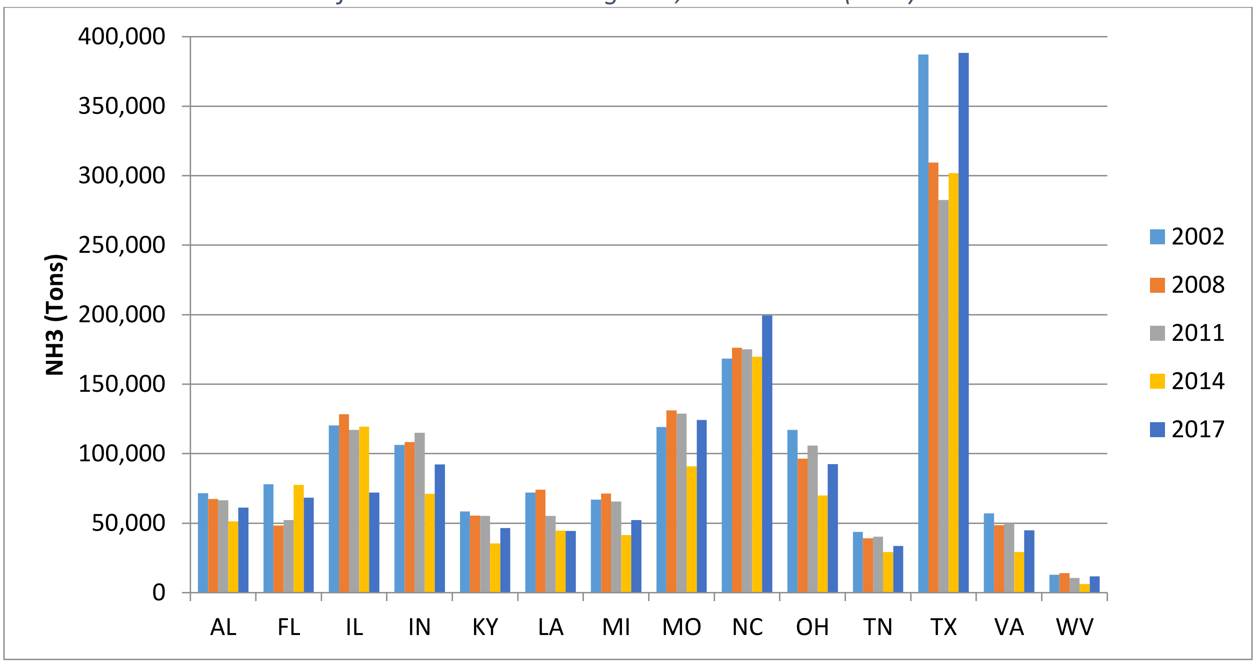


Total ammonia emissions for all NEI data categories for the Non-MANE-VU Ask states are shown in Table 3-22 and Figure 3-18. Again, some year- to-year variability in ammonia emissions can be seen. In most of the Non-MANE-VU Ask states, 2017 emissions are lower than they were for previous years. For every Non-MANE-VU Ask state, 2017 emissions are lower than they were for at least one of the earlier years.

Table 3-22.Total NH3 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	-10,474	-15%
FL	77,959	48,211	52,218	77,637	68,283	-9,676	-12%
IL	120,222	128,348	117,209	119,481	71,951	-48,271	-40%
IN	106,354	108,301	115,038	71,036	92,297	-14,057	-13%
KY	58,406	55,558	55,265	35,476	46,390	-12,016	-21%
LA	72,094	74,188	55,272	44,703	44,395	-27,699	-38%
MI	66,954	71,406	65,507	41,500	52,261	-14,693	-22%
MO	119,101	131,113	128,753	90,853	124,221	5,119	4%
NC	168,398	176,143	175,127	169,777	199,395	30,997	18%
OH	117,152	96,512	105,793	69,854	92,404	-24,749	-21%
TN	43,831	39,213	40,364	29,237	33,574	-10,257	-23%
TX	387,228	309,529	282,413	301,772	388,408	1,180	0%
VA	57,150	48,462	49,935	29,151	44,768	-12,382	-22%
WV	12,832	14,100	10,668	6,162	11,815	-1,017	-8%
Total	**1,479,309**	**1,368,541**	**1,320,058**	**1,137,969**	**1,331,316**	**-147,993**	**-10%**

Figure 3-18. Total NH_3 Emissions in the Non-MANE-VU Ask States from all NEI Data Categories, 2002 – 2017 (Tons)



3.7. Emissions Trends Summary

Analysis of regional and local emissions trends for each of the haze causing pollutants for the years 2002, 2008, 2011, 2014, and 2017 show significant decreases in emissions across all pollutants. Since the base year of the first regional haze planning period (2002), PM10 emissions over the region have decreased by 49% and PM10 emissions in Connecticut have decreased by nearly 45% (approximately 24,000 tons). This pattern is consistent across all pollutants with decreases of 58% in the region and 60% in Connecticut for NOx emissions; 31% in the region and 32% in Connecticut for PM2.5 emissions; and 92% in the region and 93% in Connecticut for SO2 emissions.

While emissions have decreased between 2002 and 2017, the dominant source sectors have not changed in relative significance between 2011 and 2017. The mobile source sector dominated the 2017 NOx inventory. Home heating oil was the second largest source category for NOx emissions (nonpoint) and MWCs accounting for the majority of the Non-EGU point sector emissions. The nonpoint sector also dominates the 2017 SO2 inventory primarily due to home heating oil.

Connecticut is committed to periodically updating its emission inventories and reporting on trends and projections in future SIP submittals required under the regional haze rule.

4. Contribution Analysis

The MANE-VU states conducted screening assessments to identify emissions from states that might reasonably contribute to visibility impairment in Class I areas. This section summarizes the screening analyses used and the results obtained. Further details of the assessments can be found in MANE-VU's document entitled "Selection of States for MANE-VU Regional Haze Consultation (2018)."[22]

A common screening tool to determine the potential impact of a particular state, source or group of sources on a particular receptor is the emissions (Q) to distance (d) ratio, Q/d. The MANE-VU states enhanced this screening method by including a parameter, C, to account for predominant wind direction. The Q/d assessment used both 2011 and 2018 emissions as described in "MANE-VU Updated Q/d*C Contribution Assessment" [April 2016].[23]

A second assessment was conducted using the CALPUFF dispersion model to simulate sulfate and nitrate formation and transport in the MANE-VU and nearby region. The CALPUFF modeling focused on 500 electric generating units (EGUs) and 121 large industrial and institutional sources located throughout the eastern United States. Included among the 621 sources were three EGUs from Connecticut: Middletown Unit 4, Bridgeport Harbor Station Unit 3 and New Haven Harbor Unit 1. No other sources from Connecticut warranted inclusion in the assessment. This assessment is fully documented in "2016 MANE-VU Source Contribution Modeling Report - CALPUFF Modeling of Large Electrical Generating Units and Industrial Sources" [April 2017].[24]

Both techniques (Q/d and CALPUFF) provided estimates for potential visibility impact. Rather than relying on one technique to identify contributing states, both techniques were included by means of an average of each relative contribution calculation for nitrates and sulfates. Since nitrates and sulfates have similar visibility impairment for similar ambient air concentrations, they were weighted equally in the impact calculations and Q/D and CALPUFF results were also equally weighted when both were available.

The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model was used to provide a qualitative assessment of results. The HYSPLIT trajectory analysis considered trajectories for the 20% most impaired visibility days in each MANE-VU Class I area using years that coincided with data used in the CALPUFF modeling. The trajectory analysis generally confirmed contribution results from the CALPUFF modeling. An average of less than two percent of trajectories travel over Connecticut toward Class I areas on impaired days, according to the study. Details of the analysis are contained in a separate report, *"Regional Haze Metrics Trends and HYSPLIT Trajectory Analyses"* [May 2017].[25]

The table below provides average relative percent mass-weighted sulfate and nitrate contributions from each analyzed state to the five MANE-VU Class I areas. The scores for the 36 states total 100 (or 100%).

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[22] https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU%20Contributing%20State%20Analysis%20Final.pdf

[23] https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU%20TSC%20-%20Updated%20QC%20over%20d%20Contribution%20Assessment%20-%20Final.pdf

[24] https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU%20CALPUFF%20Modeling%20Report%20Draft%2004-4-2017.pdf
with appendices:
https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU%20CALPUFF%20Modeling%20Appendices%20Draft%2004-4-2017.pdf

[25] https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU_Speciation_and_Trajectory_Analyses_-_Final.pdf

States listed towards the top of the table (in orange shading) are each estimated to contribute three percent or greater of the 36 state total contributions. States in the pink shade contribute 2 to 3 percent and states listed in green contribute less than 2 percent in this ranking. In addition, the table provides the maximum percentage that a state contributes to any Class I area in the MANE-VU region.

Table 4-1. State Contribution Screening Results.

Percent Mass-Weighted Sulfate and Nitrate Contribution for top 36 Eastern States to all MANE-VU Class I areas consolidated (maximum to any Class I area) and to individual MANE-VU Class I area. Taken from: https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU%20Contributing%20State%20Analysis%20Final.pdf

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

States estimated to contribute two percent or more to any of the five Class I areas were considered "contributing states." Connecticut's contributions consistently fall below two percent with contributions ranging between 0.7% and 1.4% across the MANE-VU region. Therefore, Connecticut is not reasonably anticipated to contribute to visibility impairment in any Class I area. However, as a MANE-VU state, Connecticut agreed to participate in the inter-RPO consultations and address the resultant "Ask" in its implementation plan.

5. Regional Planning and Consultation

Per 40 CFR 51.308 (f)(2)(ii) states with a Class I area are required to consult with the states that are reasonably anticipated to contribute to visibility impairment. Additionally, 40 CFR 51.308(i) requires that states coordinate with FLMs regarding the visibility impairment and elements in the State's long-term strategy for each Class I area. The MANE-VU consultations serve in part to address both of these requirements. This section summarizes the consultations.[26]

MANE-VU invited the following agencies to consult with the environmental agencies represented within MANE-VU: EPA; United States Department of Interior; Alabama Department of Environmental Management (DEM); Florida Department of Environmental Protection (DEP); Illinois DEP; Indiana DEM; Kentucky DEP; Louisiana Department of Environmental Quality (DEQ); Michigan DEP; Missouri Department of Natural Resources (DNR); North Carolina DEP; Ohio DEP; Tennessee Department of the Environment and Conservation (DEC); Texas Commission on Environmental Quality (CEQ); Virginia DEQ; and West Virginia DEP. Official consultations began in February of 2017 and continued through March 2018. During consultations, MANE-VU members presented the various analyses summarized earlier in this document. MANE-VU accepted comments from the participants throughout the process that resulted in the final requests for emission control strategies.

States are also required to provide the FLMs with a recommended comment period of 120 days (or minimum of 60 days) when each state drafts its final SIP. This draft will be revised as necessary following that consultation and prior to final submittal to the EPA.

5.1.The Ask

The consultations and the technical analyses summarized above resulted in a set of recommended strategies to ensure progress toward the natural visibility goal. MANE-VU adopted these strategies in their final form on August 25, 2017. MANE-VU designated these strategies the "Ask". While contribution assessments conducted by MANE-VU show that Connecticut is not likely to contribute to visibility impairment at any Class I area, Connecticut participated in the inter RPO consultation and has chosen to address the MANE-VU "Ask" in its implementation plan. To date Connecticut has not been invited to consult with any state outside of MANE-VU. If Connecticut is requested to participate in consultation with any other state or RPO, Connecticut commits to participate in such consultation and address the results in an amendment to this implementation plan. Connecticut addresses the elements of MANE-VU's "Ask" below.

5.2.Connecticut's Assessment of the Ask

Six elements of the MANE-VU Ask are identified in italics below and followed by Connecticut's assessment of what is reasonable to further the goal of visibility improvement.

Element 1: Operation of Control Equipment

[26] Summarized from : July 27, 2018 MANE-VU Regional Haze Consultation Report https://otcair.org/MANEVU/Upload/Consultation/MANE-VU_RH_ConsultationReport_Appendices_ThankYouLetters_08302018.pdf

"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."

The table below lists all units in Connecticut that are electric generating units with a nameplate capacity of 25 MW or more that have control devices to treat emissions of nitrogen oxides. There are no electric generating units of 25 MW or more in Connecticut that have control devices to treat emissions of sulfur oxides. Front end design and operating characteristics, such as burner design or use of low sulfur fuels, are not relevant to this element of the Ask and are not listed here, though these methods are commonly used on Connecticut sources to limit sulfur oxides and nitrogen oxides prior to the stack entry.

All of the units listed in the table below are turbines with Selective Catalytic Reduction (SCR) to control nitrogen oxides with the exception of Middletown Unit 3 which is a boiler controlled by Selective Non-Catalytic Reduction (SNCR) to reduce emissions of nitrogen oxides.

Description of the requirements to maintain and operate the control equipment to minimize emissions are included in the table and are made enforceable through record keeping and reporting requirements contained in RCSA section 22a-174-7 and the indicated new source review permits. As each of these units are at Title V sources, the requirements and enforceability are reviewed at least once every five years and are federally enforceable as well. Therefore, Connecticut already meets the request of this element of the Ask.

Table 5-1. Connecticut EGUs with Nameplate Capacity of 25 MW or more and Installed Controls

Facility Name	Unit ID	Unit Size	Primary Fuel Type (Secondary)	Control Requirement
Bridgeport Energy	BE1 & BE2	260 MW	Pipeline Natural Gas	Selective Catalytic Reduction. NSR permits 015-0190 and -0191 require that SCR operating parameters be maintained within manufacturer recommended ranges to achieve compliance with permit emission limits.
Bridgeport Harbor Station	BHB5	345 MW	Pipeline Natural Gas	Selective Catalytic Reduction. NSR Permit 015-0299 requires the permittee to operate and maintain the air pollution control equipment in a manner for minimizing emissions at all times.
CPV Towantic	1 & 2	402 MW	Pipeline Natural Gas (Diesel Oil)	Selective Catalytic Reduction. NSR Permits 144-0023 and -0024 require the permittee to operate the equipment in a manner to comply with the emissions limits in the permit.
Devon	15 - 18	50 MW	Diesel Oil (Pipeline Natural Gas)	Selective Catalytic Reduction. NSR permits 105-0098 through -0101 require the permittee to properly operate the control equipment at all times that the equipment is in operation and emitting air pollutants.
Kleen Energy Systems Project	U1 & U2	310 MW	Pipeline Natural Gas (Diesel Oil)	Selective Catalytic Reduction. NSR Permits 104-0131 and -0133 include requirements to operate a control equipment to minimize emissions at all times.
Lake Road Generating Company	LRG1, LRG2 & LRG3	264 MW	Pipeline Natural Gas (Diesel Oil)	Selective Catalytic Reduction. NSR Permits 089-0067 -0068 and -0069 require the control equipment to be operated while firing the turbine.
Middletown	12 to 15	50 MW	Diesel Oil (Pipeline Natural Gas)	Selective Catalytic Reduction. NSR Permits 104-0144 through -0147 require the permittee to properly operate the control equipment at all times that this equipment is in operation and emitting air pollutants.
Middletown	3	236 MW	Pipeline Natural Gas (Residual Oil)	Selective Non Catalytic Reduction. RCSA section 22a-174-22e contains 24 hour, ozone season, and non-ozone season NOx emissions limitations for boilers serving EGUs.
Milford Power Company LLC	CT01 & CT02	272 MW	Pipeline Natural Gas (Diesel Oil)	Selective Catalytic Reduction. NSR Permits 105-0068 and -0069 require the permittee to properly operate the control equipment at all times that the equipment is in operation and emitting air pollutants.
New Haven Harbor	NHHS2, 3 & 4	50 MW	Diesel Oil (Pipeline Natural Gas)	Selective Catalytic Reduction. NSR Permit 117-0373 through -0375 require that the permittee properly operate the control equipment at all times that the equipment is in operation and emitting air pollutants.
Pratt & Whitney, East Hartford	1	32 MW	Pipeline Natural Gas (Diesel Oil)	Selective Catalytic Reduction. NSR permit 053-0049 requires that the permittee properly operate the control equipment at all times that the equipment is in operation and emitting air pollutants.
Wallingford Energy, LLC	CT01 - CT07	50 MW	Pipeline Natural Gas	Selective Catalytic Reduction. NSR Permits 189-0194 through -0198 and -0246 and -0247 require that the permittee properly operate the control equipment at all times that this equipment is in operation and emitting air pollutants.
Waterbury Generation	10	96 MW	Pipeline Natural Gas (Diesel Oil)	Selective Catalytic Reduction. NSR Permit 192-0030 requires the permittee continuously monitor and record SCR ammonia injection rate, operating temperature and pressure drop to maintain parameters within ranges recommended by the manufacturer to achieve compliance with permit emission limits.

Element 2: Consider Installation of Control Equipment on Specific Significant Units.

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

Connecticut's maximum impact to any Class I area was modeled to be just over 1 Mm^{-1}. Therefore no sources from Connecticut have the potential to degrade visibility by as much as 3 Mm^{-1} at a Class I area and no sources from Connecticut are included in the "attached listing."[27] Therefore, Connecticut satisfies element 2.

Element 3: Adopt Ultra-Low Sulfur Fuel Oil Standards

"Each MANE-VU State that has not yet fully adopted an ultra-low sulfur fuel oil standard as requested by MANEVU 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."

Connecticut's ultra-low sulfur fuel program is in place with the most recent sulfur content limitations effective as of July 1, 2018. Connecticut's ultra-low sulfur fuel program consists of Connecticut General Statutes (CGS) section 16a-21a and Regulations of Connecticut State Agencies (RCSA) sections 22a-174-19a and 22a-174-19b. CGS 16a-21a and RCSA 22a-174-19a limit the sulfur content of home heating oil to 15ppm and the sulfur content of off-road diesel to 3000 ppm (0.3%S). RCSA 22a-174-19b further limits sulfur content of fuel oil sold in Connecticut for use in stationary sources to 15 ppm for distillate and 3000 ppm (0.3%S) for aviation and residual fuels. EPA approved the latest revisions of these rules into Connecticut's SIP on May 25, 2016.[28] The original MANE-VU submission provided the full four-factor analysis.[29] Therefore, Connecticut's low sulfur fuel program already meets element 3 of the Ask.

Element 4: Lock in Emission Reductions from Fuel Switching

"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."

EGUs and large sources are subject to Title V permitting requirements under RCSA section 22a-174-33 and these sources are reviewed every five years and specify allowable operating scenarios, which includes 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 under RCSA section 22a-174-3a and -33.

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[27] The listing can be found at: https://otcair.org/MANEVU/Upload/Publication/Formal%20Actions/MANE-VU%20Intra-Regional%20Ask%20Final%208-25-2017.pdf

[28] 81 FR 33134

[29] Assessment of Reasonable Progress Goals for Regional Haze In MANE-VU Class I areas and the Addendum for Residual Oil

Therefore, Connecticut's New Source Review and Title V permitting regulations already satisfy element 4.

Element 5: Reduce Emissions on High Electricity Demand Days

"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;"

The Department has two recent regulations to address NOx emissions from electric generating units and other stationary sources. RCSA section 22a-174-22e prescribes averaging times and emission limits for units at major sources of NOx. RCSA section 22a-174-22f limits daily NOx emissions from generators at non-major facilities during the summer season and any unit that exceeds the allowable daily thresholds is subject to the limits in RCSA section 22a-174-22e. The requirements of RCSA section 22a-174-22e are phased-in over two implementation periods. The first phase was effective June 1, 2018 and the second phase will be effective June 1, 2023. The daily emissions limits in parts per million by dry volume (ppmvd) that pertain to combustion turbines are in the table below.

Table 5-2. Daily Limits for Combustion Turbines under 22e

Unit Type	Phase 1		Phase 2	
	Gas-fired	Distillate-fired	Gas-fired	Distillate-fired
Simple Cycle Turbine	55 ppmvd	75 ppmvd	40 ppmvd	50 ppmvd
Combined Cycle Turbine	42 ppmvd	65 ppmvd	25 ppmvd	42 ppmvd

As demonstrated above, Connecticut has already adopted rules to control nitrogen oxide emissions from peaking turbines and they are at least as stringent as requested in element 5 of the Ask. Therefore, Connecticut has fully addressed element 5 of the Ask.

Element 6: Consider Energy Efficiency Measures

"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."

Connecticut continues to support programs to increase energy efficiency, CHP and other clean energy technologies. Energize Connecticut[SM] is an initiative dedicated to saving energy and building a clean energy future for everyone in the state. It is an initiative of the Connecticut Energy Efficiency Fund, the Connecticut Green Bank, the State, and local utilities. The initiative has funding support from a charge on customer energy bills. The Energy Efficiency Board reports that energy savings efforts through 2018 have resulted in avoidance of the equivalent of one 130 MW power plant.[30]

Additional relevant policy efforts include the following:

- In 2013, Connecticut adopted RCSA 22a-174-3d to facilitate construction and operation of CHP plants through a permit-by-rule process.

- On June 7, 2019, the Department of Energy and Environmental Protection released its Notice of Scope of Proceeding and Request for Written Comment for the procurement of up to 2,000 megawatts (MWs) of offshore wind capacity.

- On September 3, 2019, Connecticut's Governor issued Executive Order No. 3, which commits the Department, in consultation with the Connecticut Public Utilities Regulatory Authority to analyze and recommend strategies for achieving a carbon emissions free goal for the electricity-generating sector by 2040.

- As a member of the Regional Greenhouse Gas Initiative (RGGI) since 2008, Connecticut has invested approximately 200 million dollars into energy efficiency and programs for renewable resources. These investments will continue as Connecticut maintains its membership in the RGGI cooperative.

While each of these programs may provide varying degrees of air quality benefit, none of the measures is conducive to satisfying the permanent and enforceable criteria necessary for inclusion in a state implementation plan.

5.3. MANE-VU's Ask of EPA and FLMs

The following *italicized* section is an excerpt from the August 25, 2017 "Statement of the Mid-Atlantic/Northeast Visibility Union (MANE-VU) States Concerning a Course of Action by the Environmental Protection Agency and Federal Land Managers toward Assuring Reasonable Progress for the Second Regional Haze Implementation Period (2018-2028)."

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[30] Energy Efficiency Board 2018 Programs and Operations Report, March 1, 2019: https://www.energizect.com/sites/default/files/FINAL-2018-Annual-Legislative-Report-2019-03.pdf

The transport range of visibility impairing pollutants has been demonstrated to be extensive and well beyond the MANE-VU region. For example, a wildfire near Fort McMurray, Alberta in western Canada last year brought visibility impairing fine particulate matter and ozone over 2,000 miles into the region at concentrations that contributed to exceedances of these health standards in some locations. Clearly, states located beyond those that MANE-VU chose to consult for regional haze can play an active role in impairing visibility at the MANE-VU Class I areas. Further, even though onroad vehicles produce a significant portion of the visibility impairing pollutants that affect our Class I areas, they are beyond our states' ability to regulate. Therefore, the MANE-VU Class I area states need additional help from the Environmental Protection Agency and Federal Land Managers in pursuing important reasonable emission control measures.30 These include, but are not limited to:

1. Federal Land Managers to consult with MANE-VU Class I area states when scheduling prescribed burns and ensure that these burns do not impact nearby IMPROVE visibility measurements and do not impact potential 20 percent most and least visibility impaired days;

2. EPA to develop measures that will further reduce emissions from heavy-duty onroad vehicles; and

3. EPA to ensure that Class I Area state "Asks" are addressed in "contributing" state SIPs prior to approval. In the case of this "Ask", contributing states are defined as those that the MANE-VU Class I area states requested for consultation.

Connecticut considers these measures reasonable in furthering visibility improvement in the region's Class I areas. Additionally, NOx emissions from heavy-duty on-road vehicles contribute significantly to ozone exceedances in Connecticut and any reductions from this source category will result in the co-benefit of improving regional air quality with respect to the NAAQS for ozone.

5.4. National Park Service (NPS) Request for Source Assessment

At the close of the MANE-VU consultation process, the NPS provided MANE-VU with a list of sources that the NPS suggests each state consider for its long-term strategy.[31] The NPS selected those facilities having the highest emissions to distance ratio (Q/d). Q/d values were calculated based on the total 2014 NEI emissions of NOx, PM_{10} and SOx and distance to a nearby Class I area. Q/d values for facilities in the selected states ranged from a high of 143 to a low of 0.7 tons/year/kilometer. The NPS used Acadia as the nearby Class I area for Connecticut.

Table 5-3 lists the facilities NPS identified within Connecticut along with an updated Q/d calculated from the 2017 draft NEI. Factors affecting future emission reductions are also listed. The table indicates that Q/d values decrease from 2014 to 2017 for each of the identified facilities.

Five of the facilities in Connecticut are municipal waste combustors (MWCs) required to optimize NOx emission controls under a recent revision to RCSA section 22a-174-38. Full implementation of NOx reductions from this revision did not occur until August 2017. The table notes the expected emissions reduction from each MWC upon full implementation of the rule.

[31] See Appendix C of the July 27, 2018 MANE-VU Regional Haze Consultation Report: April 12, 2018 National Parks Service Letter

The remaining facilities are required to comply with RCSA section 22a-174-22e, which the Department will have fully implemented as of June 2023. Connecticut's last coal unit, Bridgeport Harbor Station Unit 3 is among the identified sources and the largest emitter of the units identified. PSEG Power Connecticut, LLC has committed to shut this unit down in 2021.

Table 5-3. Connecticut Facilities Identified by National Park Service.

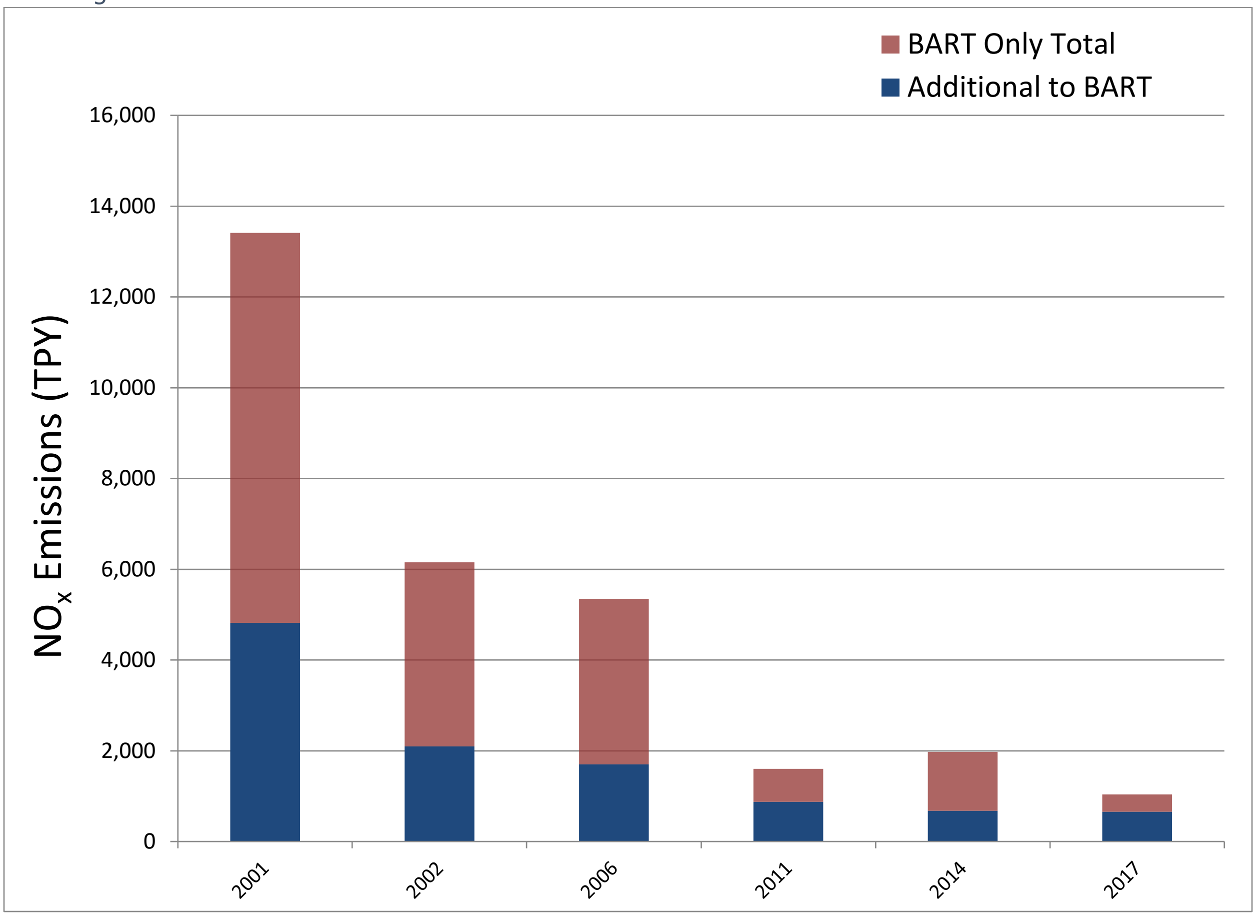
Facilities Identified by NPS for Consideration in States Long-Term Strategies. Facilities for Connecticut were selected based on distance, d in kilometers, from Acadia National Park and emissions, Q in tons/year from the 2014 National Emissions Inventory (NEI) to establish a priority ranking by the NPS. Updated (2017) Q/d and relevant regulatory constraints on emissions are also indicated in the table. Q represents the sum of emissions of NOx, SOx and PM10 emissions for the year.

Facility	Q_{2014}	d	Q_{2014}/d	Q_{2017}	Q_{2017}/d	Regulatory Status
PSEG PWR CT LLC/BPT HARBOR STA	1,530	487	3.1	408	0.8	Unit 3 is scheduled to retire July 1, 2021. Sources will have to comply with Phase 2 NOx emission limits of RCSA section 22a-174-22e by June 1, 2023.
WHEELABRATOR BRIDGEPORT LP	1,409	489	2.9	1280	2.6	RCSA section 22a-174-38 amendment with more stringent NOx and ammonia limits effective August 1, 2017. NOx reduction of 444 tons/year (3 Units).
C R R A / MID-CONNECTICUT	821	412	2.0	701	1.7	Turbines at the facility will have to comply with Phase 2 NOx emission limits of RCSA section 22a-174-22e by June 1, 2023. MWC to comply with NOx and Ammonia limits of 22a-174-38 effective August 1, 2018.
MIDDLETOWN POWER LLC	547	421	1.3	286	0.7	Sources will have to comply with Phase 2 NOx emission limits of RCSA section 22a-174-22e by June 1, 2023.
PSEG FOSSIL LLC/ POWER CT LLC	486	461	1.1	60	0.1	Sources will have to comply with Phase 2 NOx emission limits of RCSA section 22a-174-22e by June 1, 2023.
COVANTA SOUTHEASTERN CT CO	417	397	1.1	393	1.0	RCSA section 22a-174-38 amendment with more stringent NOx and ammonia limits effective August 1, 2017. NOx reduction of 85 tons/year (2 Units).
WHEELABRATOR LISBON INC (WM)	327	386	0.8	288	0.7	RCSA section 22a-174-38 amendment with more stringent NOx and ammonia limits effective August 1, 2017. NOx reduction of 45 tons/year (2 Units).
ALGONQUIN GAS TRANSMISSION (Cromwell)	317	421	0.8	154	0.4	In 2019, Algonquin removed six registered Cooper Bessemer engines and replaced them with two Solar turbines. Permits (043-0035 and -0036) to construct the turbines were issued in 2018 and will result in further lowering of emissions.
COVANTA BRISTOL, INC	300	436	0.7	280	0.6	RCSA section 22a-174-38 amendment with more stringent NOx and ammonia limits effective August 1, 2017. NOx reduction of 84 tons/year (2 Units).

5.5. Update on Best Available Retrofit Technology (BART and Alternative BART)

Connecticut's first regional haze SIP identified an alternative BART program to address the Connecticut emissions that may reasonably impact visibility in nearby Class I areas. The identified program consisted of RCSA section 22a-174-19a to address sulfur dioxide emissions and RCSA sections 22a-174-22, 22a-174-22a, 22a-174-22b and 22a-174-22c to address nitrogen oxide emissions. Although there is no federal requirement to address BART or alternative BART in this planning period, the Department notes several changes to the NOx emissions control requirements of Connecticut's alternative BART program, which now consists of RCSA sections 22a-174-22e and 22a-174-22f. Under the initial and revised regulatory schemes, NOx emissions from the sources subject to alternative BART, the "affected units," have continued to decline.

Figure 5-1. Actual NOX Emissions From the additional Alternative -BART Units and BART Units



As a result of EPA's changes to the federal cap and trade programs addressing NOx emissions, Connecticut's RCSA sections 22a-174-22a and 22a-174-22b have been repealed. RCSA section 22a-174-22c, implementing the Clean Air Interstate Rule (CAIR), is an effective regulation but EPA no longer administers the underlying federal trading program given CAIR's replacement with the Cross State Air Pollution Rule (CSAPR) and the CSAPR Update, which are not applicable to Connecticut. As part of Connecticut's reasonably available control technology (RACT) review for the 2008 ozone NAAQS, the Department replaced RCSA section 22a-174-22 with RCSA sections 22a-174-22e and 22a-174-22f.

NOx emissions from the affected units have declined since the first planning period, due in part to retirements. Two of the seven BART units retired in 2013 and 2014 (Norwalk Harbor 2 and Fusion Paperboard PFI boiler). A third BART unit, PSEG Bridgeport Harbor Station Unit 3, is scheduled to retire in 2021. The four remaining operating BART units – Middletown 3, Middletown 4, Montville 6 and New Haven Harbor 1 – are subject to RCSA section 22a-174-22e. With the implementation of the Phase 2 emission limits of RCSA section 22a-174-22e in 2023, NOx emissions from these four units will have to be reduced.

The sulfur dioxide emissions control requirements of the alternative BART program are unchanged.

6. Modeling Inventories

In accordance with 40 CFR 51.308(f)(2)(iii), Connecticut 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 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[32], and the *Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2011 Based Modeling Platform Support Document – October 2018 Update*[33] which includes projections to 2028.

The following is a summary of the Gamma inventory.

6.1. Base Year, 2011

Figure 6-1 displays Connecticut's base emissions and the relative proportion to the other states in the MANE-VU region. Biogenic sources are responsible for nearly half of Connecticut's VOC emissions. The on-road sector is responsible for the greater portion of Connecticut's NOx emissions. The non-point sector (e.g. residential wood burning, residential heaters, consumer products, etc.) is the dominant contributing sector for both particulate and sulfur dioxide emissions. The "other" category includes agricultural activities, which are a primary source of ammonia (NH_3) emissions. Connecticut's emissions account for five percent or less of the regional emissions of any pollutant in the base year.

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[32] 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

[33] https://otcair.org/upload/Documents/Reports/OTC%20MANE-VU%202011%20Based%20Modeling%20Platform%20Support%20Document%20October%202018%20-%20Final.pdf

Figure 6-2 shows MANE-VU emissions as compared to the other regional planning organizations throughout the US.   Biogenic emissions, a large portion of the national VOC emissions are not shown in the barchart of this figure. The proportion of source sector contribution to individual pollutant totals are generally similar in the MANE-VU region with the notable exception of SO2 where regional emissions are dominated by the EGU sector.

Figure 6-1. Connecticut's Base Inventory and Relative Proportion to Regional Emissions

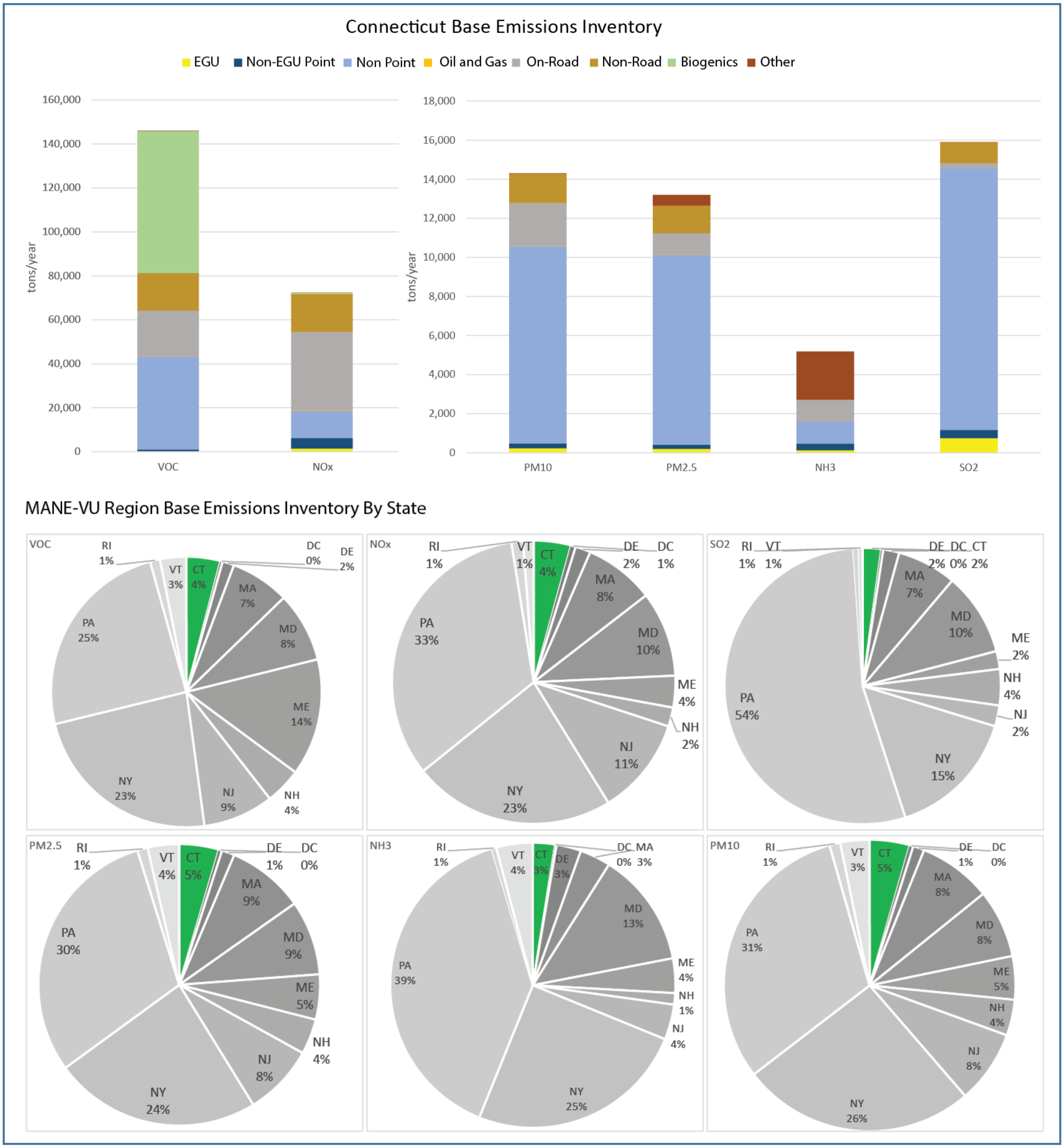
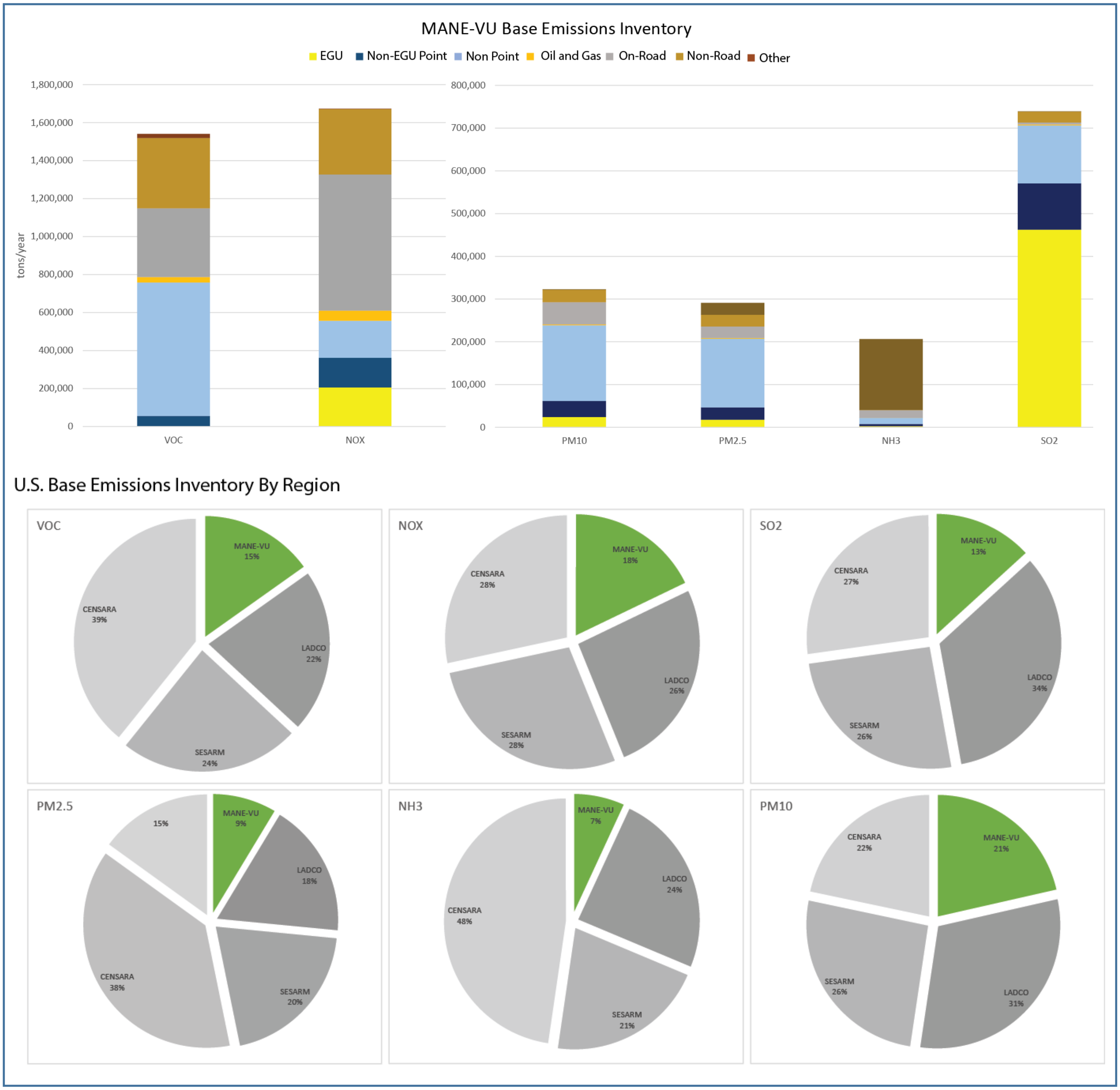


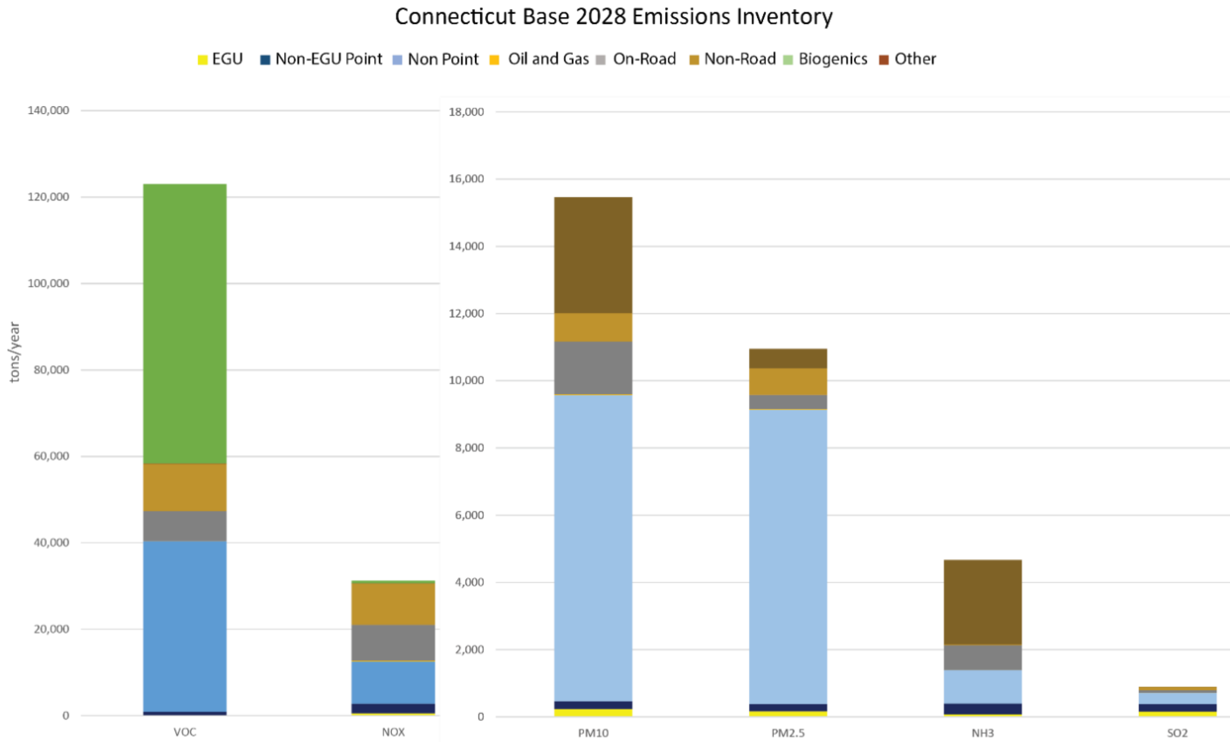
Figure 6-2. MANE-VU's Base Inventory and Relative Proportion to the Other Regional Emissions



6.2. Inventory Projected to End of Planning Cycle, 2028

Emissions were projected out to 2028 – the end of the second planning cycle. Figure 6-3 illustrates Connecticut's projected emissions by sector for 2028. These emissions generally decrease when compared with the 2011 emissions shown in Figure 6-1. NOx emissions decrease by nearly 50% while SO2 emissions decrease to less than seven percent of their 2011 levels.

Figure 6-3. Base 2028 Emissions Inventory of Connecticut Sources



These projected emissions incorporate the impact of strategies that are on-the-books, anticipated growth in the respective sector and anticipated unit closures and the MANE-VU "Ask". For example, the large reductions in sulfur emissions in Connecticut are due to implementation of phase II sulfur fuel restrictions contained in RCSA 22a-174-19b which became effective in 2018. Additionally, Connecticut projections include the closures listed below. Note that due to inventory development timing issues, projections do not account for the more recently announced Bridgeport Harbor Station Unit 3 closure scheduled for July 2021.

Table 6-1. Retirements Accounted for in 2028 Regional Haze Modeling

Facility- Unit	Shutdown Year
AES Thames- Unit A	2011
AES Thames- Unit B	2011
Norwalk Harbor Station- Unit 1	2013
Norwalk Harbor Station- Unit 2	2013
Norwalk Harbor Station- Unit 10	2013
Bridgeport Harbor Station- Unit 2	2013

6.3. Modeling Inventory Summaries

Tables 6-2 through 6-6 summarize the MANE-VU 2002 and the MANE-VU 2011 Gamma emissions inventories and 2028 Gamma emissions projections for MANE-VU. Emissions for Connecticut are also shown. The inventory sectors shown in the tables below for the modeling inventories summaries vary in definition from the sectors shown in the EPA NEI inventory summaries above and from each other as described below. Also note that the NEI and 2002 inventories include unadjusted fugitive dust, while the Gamma inventories included adjusted fugitive dust.

The 2002 modeling emissions inventory categories shown below include the following:

- Point (includes ERTAC Electric Generating Units and Non-EGU Point Sources, and does not include airports and rail yards as in the NEI summaries)
- Area Sources (includes Stage I and Stage II refueling, residential wood burning, agricultural ammonia and fires, prescribed and wild fires and unadjusted fugitive dust, and does not include marine and rail as in the NEI summaries)
- Nonroad (includes marine and rail)
- Onroad (does not include gasoline Stage II refueling as in the NEI summaries)
- Biogenic Sources

The 2011 and 2028 Gamma emissions inventory categories shown below include the following:

- Point ERTAC Electric Generating Units
- Non-EGU Point Sources (includes airports and rail yards)
- Area Sources (includes Stage I refueling and residential wood burning, does not include marine and rail as in the NEI summaries)
- Nonroad (includes marine and rail)
- Onroad (includes gasoline Stage II refueling)
- Oil and Gas
- Other (includes agricultural ammonia and fires, prescribed and wild fires and adjusted fugitive dust)
- Biogenic Sources

Table 6-2. MANE-VU 2002 Emissions Inventory Summary – MANE-VU States.

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
Point	97,300	673,660	55,447	89,150	6,194	1,907,634
Area*	1,528,141	262,477	332,729	1,455,311	249,795	316,357
Nonroad**	572,751	431,631	36,084	40,114	287	57,257
Onroad	789,560	1,308,233	22,107	31,561	52,984	40,091
Anthropogenic	**2,987,752**	**2,676,001**	**446,367**	**1,616,136**	**309,260**	**2,321,339**
Biogenics	2,575,232	28,396	-	-	-	-
TOTAL	**5,562,984**	**2,704,397**	**446,367**	**1,616,136**	**309,260**	**2,321,339**

Notes:

*Area includes Stage II refueling and unadjusted fugitive dust

**Nonroad includes airports, rail and commercial marine vessels

Table 6-3. MANE-VU 2011 Gamma Emissions Inventory Summary – MANE-VU States.

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
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	**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

Table 6-4. MANE-VU 2028 Gamma Emissions Projections Summary – MANE-VU States.

	VOC	NOx	$PM_{2.5}$	PM_{10}	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	**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

***Nonroad includes commercial marine vessels and underway railroad

****Onroad includes Stage II refueling

Table 6-5. MANE-VU 2002 Emissions Inventory Summary – Connecticut.

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
Point	4,907	12,923	1,283	1,617	--	15,988
Area*	87,302	12,689	14,247	48,281	5,318	12,418
Nonroad**	33,880	25,460	1,793	1,952	--	2,087
Onroad	31,755	68,816	1,042	1580	3,294	1,667
Anthropogenic	**157,845**	**119,888**	**18,366**	**53,430**	**8,628**	**32,161**
Biogenics	64,017	560				
TOTAL	**221,862**	**120,448**	**18,366**	**54,430**	**8,628**	**32,161**

Notes:

*Area includes Stage II refueling and unadjusted fugitive dust

**Nonroad includes airports, rail and commercial marine vessels

Table 6-6. MANE-VU 2011 Gamma Emissions Inventory Summary – Connecticut[34]

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
EGU Point	115	1389	204	237	129	751
Non-EGU Point*	879	4732	218	245	334	417
Area**	42,088	12,487	9705	10080	1127	13395
Nonroad***	17075	17174	1411	1491	20	1059
Onroad****	21065	35590	1092	2201	1116	272
Oil/Gas	43	292	20	20	0	2
Other	139	17	553	3,223	2467	7
Anthropogenic	**81,404**	**71,681**	**13,203**	**17,497**	**5,193**	**15,903**
Biogenics	64643	606	-	-	-	-
TOTAL	**146048**	**72286**	**13203**	**17497**	**5192**	**15903**

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

Table 6-7. MANE-VU 2028 Emissions Projection Summary – Connecticut

	VOC	NO_x	$PM_{2.5}$	PM_{10}	NH_3	SO_2
EGU Point	49	608	168	233	77	158
Non-EGU Point*	845	2171	211	234	320	224
Area**	39520	9746	8765	9109	1004	331
Nonroad***	10922	9594	790	844	25	92
Onroad****	6875	8269	416	1567	732	80
Oil/Gas	46	242	22	22	0	2
Other	131	14	580	3454	2512	6
Anthropogenic	**58,388**	**30,644**	**10,952**	**15,463**	**4,670**	**893**
Biogenics	64643	606				
TOTAL	**123030**	**31249**	**10951**	**15464**	**4670**	**894**

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

[34] Connecticut 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

6.4. 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* [35] 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 6-8 and Table 6-9. The data shows that residential wood combustion represents approximately 33% of the annual average PM2.5 emissions in the MANE-VU region. In Connecticut, residential wood combustion is estimated to be 49% of the 2011 inventory.

As discussed previously, there are large variations in emissions in the residential wood burning category due to changes in calculation methodologies. EPA and Connecticut have been working on making this category more accurate since the 2002 inventory, and it is an ongoing process.

Table 6-8. MANE-VU 2011 Gamma Residential Wood Combustion Emissions (Tons)

State	CO	NH_3	NOx	PM10-PRI	PM2.5-PRI	SO_2	VOC
CT	45,804	345	712	6,474	6,470	116	8,914
DE	6,685	57	108	963	962	18	1,201
DC	2,853	23	43	404	404	6	549
ME	41,650	315	485	6,316	6,316	188	7,048
MD	20,857	192	335	3,119	3,115	56	3,446
MA	70,644	577	1,080	10,306	10,300	209	12,711
NH	42,381	327	503	6,493	6,493	170	7,311
NJ	44,060	355	710	6,302	6,295	105	8,310
NY	150,460	1,065	1,899	22,946	22,939	554	27,943
PA	164,540	1,218	2,323	23,644	23,634	474	31,534
RI	10,178	79	178	1,452	1,451	28	1,941
VT	47,285	370	568	7,142	7,140	247	7,564
Res Wood	**647,397**	**4,921**	**8,945**	**95,561**	**95,519**	**2,169**	**118,471**
Total 2011	**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%**

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

Table 6-9. 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%

7. Air Quality Modeling Results

Using the inventories described above, the MANE-VU states conducted modeling to demonstrate reasonable progress toward meeting the long-term visibility goals and to establish reasonable progress goals (RPGs) for 2028. Model performance and results are provided in the previously mentioned document: "Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2011 Based Modeling Platform Support Document –October 2018 Update".

Figure 7-1 shows the improvements made from 2011 as predicted by the CMAQ model through projected 2028 future base and controlled emissions. The charts that follow in Figure 7-2 show the modeled results for each of the Class I areas in the MANE-VU region along with rolling average haze metrics and uniform rate of progress to the 2064 goal. The RPGs are represented by the 2028 control case modeling results.

Figure 7-1. Modeled Base vs Future Year Results.

Projected change in visibility (deciviews) from 2011 to 2028 (base and control) at each class I area in or near the MANE-VU Region. Taken from OTC/MANE-VU 2011 Based Modeling Platform Support Document-Oct. 2018 Update (fig 12-5).

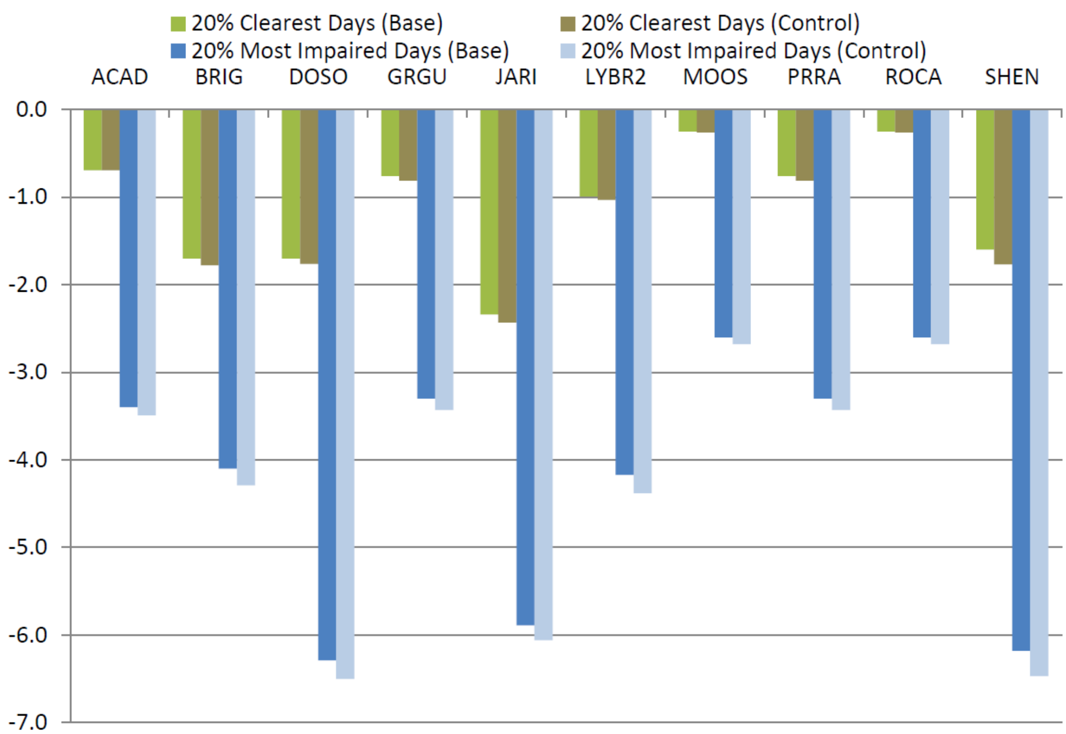
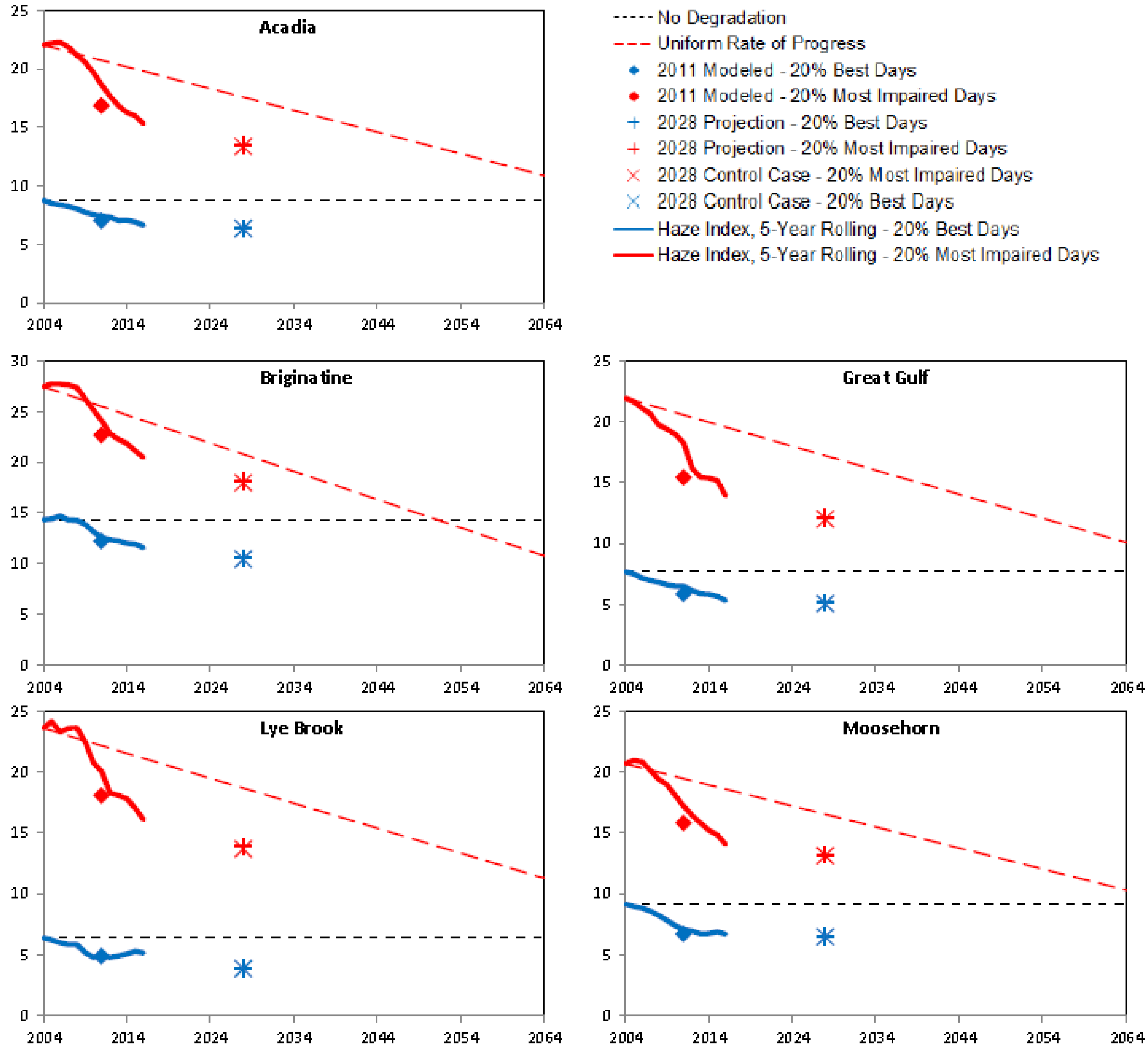


Figure 7-2. Monitored vs. Modeled Visibility.

Modeled 2011 base case, 2028 base case, and 2028 control case compared to no degradation on best days, URP on most impaired days, and 5-year rolling haze indices at each Class I area in the MANE-VU Region. Taken from OTC/MANE-VU 2011 Based Modeling Platform Support Document-Oct. 2018 Update (Fig 12-6).



8. Additional Elements of Connecticut's Long-Term Strategy

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.

8.1. Emissions Reductions Due to Ongoing Air Pollution Control Programs

During the 2018 to 2028 planning period, Connecticut's existing air pollution control programs will continue to reduce statewide emissions. In 2018, significant reductions occurred as a result of revisions to RCSA section 22a-174-38 to obtain NOx emission reductions from municipal waste combustors; implementation of RCSA sections 22a-174-22e and -22f to obtain NOx emissions from major and minor sources of NOx; and implementation of the last phase of RCSA section 22a-174-19b to reduce sulfur oxide emissions from fuel burning sources. Additional NOx emission reductions will occur in 2023 with the implementation of the next phase of RCSA sections 22a-174-22e and -22f.

Additionally, many of Connecticut's existing programs will continue to result in emissions reductions. The adoption of the California Low Emission Vehicle Program (LEV III program), EVConnecticut and the Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) program will continue to support electrification of light duty vehicles in Connecticut. Reducing motor vehicle emissions budgets, required for ozone planning purposes, also aid in assuring continued improvement from the mobile source sector, a sector that also contributes to regional haze.

8.2. Measures to Mitigate Construction Activities

Per 40 CFR 51.308(f)(2)(iv)(B) each State must consider measures to mitigate the impacts of construction activities for the long-term strategy. The Department provides a summary of Connecticut's programs below.

Connecticut's RCSA section 22a-174-18, the control of particulate matter and visible emissions, includes dust control measures and measures to address visible emissions from diesel powered mobile sources and is applicable to road building and construction activities (including limitations on idling).

A major initiative in Connecticut is improving transportation infrastructure. The initiative includes efforts to reduce congestion, increase public transit ridership and repair/maintain/improve existing transportation infrastructure. The federal National Environmental Policy Act and the Connecticut Environmental Policy Act (CGS sections 22a-1 through 22a-1h) require appropriate studies to identify and assess potential effects due to any federally or state funded project during the construction phase. These studies must include the assessment of the potential or actual consequences on air quality.

Connecticut, designated nonattainment for ozone, is required to comply with transportation conformity rules and has established emissions budgets for on-road and non-road construction projects.

Connecticut Department of Transportation (DOT) most recently prepared the *"Air Quality Conformity Determination for the 2018 - 2021 Statewide Transportation Improvement Program"* (STIP). [36] These programs assure mitigation of emissions during and after highway construction projects.

Connecticut's implementation of federal Diesel Emissions Reduction Act (DERA) grants continues to be an effective method to reduce air pollution from on-road, construction and other diesel equipment. Connecticut first implemented the DERA program in 2008 and since then there has been over 2,445 tons of NOx reductions. The 2019 DERA grants alone will provide 18.6 tons of NOx reductions, 0.8 tons of PM reductions, 1.1 tons of hydrocarbon reductions and 2051 tons of carbon dioxide reductions.

In January of 2018 Connecticut was named a beneficiary of the Volkswagen settlement. Throughout 2018 the Department has awarded 11 projects that will procure over 144 tons of NOx reductions, over 6 tons of PM reductions, over 10 tons of HC reductions and 7,600 tons of carbon dioxide reductions over the lifetime of the projects. In 2019, an additional 67.6 tons of NOx; 3.4 tons of PM; 4.1 tons of HC; and 5,085 tons of carbon dioxide reductions were procured. Emission sources covered under this program include construction related equipment such as pickup and dump trucks.

[36] https://portal.ct.gov/-/media/DOT/documents/dplansprojectsstudies/plans/AirQualityConformity/Conformity-Determination-Report-February-2019-Revised-April-2019.pdf?la=en

8.3. Source Retirement and Replacement Schedules

Per 40 CFR 51.308(f)(2)(iv)(C) each state must consider the expected schedule of source retirements and the respective replacements. The table below lists the units that have been retired in Connecticut.

Table 8-1. Retirements Anticipated between 2011 and 2028.

Facility - Unit	Retirement Year (Offline Date)	Latest Allowable NOx and SO2 Emissions
AES Thames- Unit 1	2012	NOx- 606 TPY SO2- 1,293 TPY
AES Thames- Unit 2	2012	NOx- 606 TPY SO2- 1,293 TPY
Bridgeport Harbor- Unit 2	2013	NOx- 192 TPY SO2- 2,580 TPY
Bridgeport Harbor- Unit 3*	2021	NOx- 4,425 TPY SO2- 5,926 TPY
Fusion Paperboard	2014	NOx- 206 TPY SO2- 662 TPY
Norwalk Harbor Station – Unit 1	2013	NOx- 1,493 TPY SO2- 2,567 TPY
Norwalk Harbor Station – Unit 2	2013	NOx- 1,493 TPY SO2- 2,567 TPY
Norwalk Harbor Station – Unit 10	2013	NOx- 192 TPY SO2- 506 TPY
Total Allowable Tons Retired		**NOx- 9,213 TPY** **SO2- 17,394 TPY**

*Not considered retired in the ERTAC file used for air quality modeling described in Section 6.

Table 8-2. Replacement Units Anticipated Between 2011 and 2028

Facility - Unit	Start-Up Year	Allowable NOx and SO2 Emissions
Towantic- Unit 1	2018	NOx- 48 TPY SO2- 10 TPY
Towantic- Unit 2	2018	NOx- 48 TPY SO2- 10 TPY
Bridgeport Harbor- Unit 5*	2020	NOx- 126 TPY SO2- 23 TPY
Total Anticipated Additional Allowable		**NOx- 222 TPY** **SO2- 43 TPY**

*Not included in the ERTAC file used for air quality modeling in section 6.

Tables 8-1 and 8-2 indicate that a net reduction of approximately 8,990 TPY of allowable NOx and 17,350 TPY of allowable SO2 will occur between the 2011 base year and the 2028 projected year. It is also notable that the most recent confirmed retirement and replacement will occur at the PSEG

Bridgeport Harbor Facility. Bridgeport Harbor Unit 3 is Connecticut's last remaining coal plant and the Connecticut unit with the largest contribution to visibility impairment to the MANE-VU Class I areas at just over a 1 dv impact.[37] The unit anticipated to replace Unit 3 has permitted allowable emissions only about 5% of that of the coal unit.

8.4. Smoke Management Practices

40 CFR 51.308(f)(2)(iv)(D) requires states to consider smoke management techniques for prescribed fire used for agriculture and wildland vegetation management. Per CGS Section 22a-174(f), the Commissioner of Connecticut DEEP allows open burning (including prescribed burns for agriculture and wildland vegetation management) through permits issued by municipal officials, except in the following cases:

1. When national or state ambient air quality standards may be exceeded;
2. Where a hazardous health condition might be created;
3. When the forest fire danger in the area is identified by the commissioner as extreme and where woodland or grass land is within one hundred feet of the proposed burn;
4. Where there is an advisory from the commissioner of any air pollution episode; and
5. Where prohibited by an ordinance of the municipality.

The first and fourth exceptions limit open burning on poor air quality days, thereby in part reducing the impacts of prescribed burns' impact on visibility. EPA approved this program into Connecticut's SIP on September 1, 2016 [81 FR 60274].

[37] See CALPUFF modeling references in Section 4.

9. Summary and Conclusions

Connecticut has documented its long-term strategy to assure reasonable progress toward visibility goals in nearby Class I areas and assessed its progress in reducing emissions of visibility impairing pollutants. Though Connecticut visibility impairing pollutant emissions were not sufficient to exceed the two percent visibility impairment level triggering the need for consultation by the Class I states, Connecticut consulted with, and incorporated, the elements of the Ask that Class I states requested be included in affecting states' regional haze plans.

The Department has concluded that the following permanent and enforceable programs are appropriate for making meaningful progress towards reducing Connecticut's impact on visibility impairment:

1. RCSA 22a-174-19a, Control of sulfur dioxide emissions from power plants and other large stationary sources of air pollution;

2. RCSA 22a-174-19b Fuel sulfur content limitations for stationary sources;

3. RCSA 22a-174-22e, Control of nitrogen oxides emissions from fuel-burning equipment at major stationary sources of nitrogen oxides;

4. RCSA 22a-174-22f, High daily NOx emitting units at non-major sources of NOx; and

5. RCSA 22a-174-38, Municipal Waste Combustors.

Connecticut's existing implementation plan requires no further revision at this time in order to achieve established goals for visibility improvement at nearby Class I areas. Therefore, the Department does not plan to revise the existing plan at this time.

Appendix A – Summary of Comments from U.S. Environmental Protection Agency and Federal Land Managers (FLMs) with Responses from the Department

The Department sent an early draft of Connecticut's proposed Regional Haze State Implementation Plan for the Second Planning Period to EPA and the FLMs as part of the consultation process. The draft document was sent out for comment on January 15, 2020 to representatives of EPA, the National Park Service (NPS), the US Department of Agriculture (USDA) Forest Service, and the US Fish and Wildlife Service.

The Department received comments from EPA, USDA Forest Service, and the National Park Service. The US FWS did not formally comment.

The comments, our responses and any changes to the proposed implementation plan are indicated below.

A.1. EPA Comments

1. Executive Summary (p. 2)

"Figure 0-2. Remaining Visibility Improvement Necessary to Achieve Natural Conditions in 2064" should indicate if the improvement depicted is for the 20% most impaired visibility days or the 20% cleanest days.

Response: The improvement depicted is for the 20% most impaired days and has been noted in the chart title.

The statement "Connecticut does not have any Class I areas, however, it contributes to the success of meeting RPGs by taking reasonable steps to reduce emissions of visibility impairing pollutants from sources within the State" is in direct conflict with the State's conclusion that Connecticut does not contribute to any Class I area.

Response: The phrase "does not contribute" appears only here and in EPA's comments. DEEP sees no conflict.

2. Contribution Analysis (p. 45-47)

Connecticut indicates that three sources in Connecticut were among the 621 sources in the CALPUFF contribution modeling: Middletown Unit 4, Bridgeport Harbor Station Unit 3, and New Haven Harbor Unit 1. It would strengthen the SIP to include in the narrative the criteria for selection and modeling results for these sources.

Response: The selection criteria and modeling results are found in:

https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU%20CALPUFF%20Modeling%20Report%20Draft%2004-4-2017.pdf

Section 3.1 of the document addresses source selection and model results are discussed in section 4.

The SIP says Connecticut does not contribute to any Class I area, citing a max percent impairment contribution of 1.4%, which is below a “threshold” of 2%. Connecticut should include more justification for the 2% threshold and consider evaluating the largest contributing sources for four-factor analysis.

Response: The document at this link addresses the 2% threshold:

https://otcair.org/MANEVU/Upload/Publication/Reports/MANE-VU%20Contributing%20State%20Analysis%20Final.pdf

The Department inadvertently provided an earlier draft of the document in its reference at footnote 22. The citation in the footnote has been corrected.

The 2% threshold was chosen after back-trajectory and modeling results showed that states contributing at least 2% of the sulfates and nitrates account for the majority of total light extinction at Class I areas. This threshold was used to determine which states were reasonably anticipated to contribute to visibility impairment in any Class I area. As Connecticut did not exceed this threshold, it cannot credibly link any source, or group of sources to visibility impairment in a Class I area and therefore has no reason to consider four-factor analyses.

Additionally, no state has advised the Department that it considers its Class I area to be affected by emissions from Connecticut. If another state does demonstrate to DEEP that Connecticut, or sources within its borders, are linked to visibility impairment in their Class I area, then the Department will re-consider the need for conducting four-factor analyses and can do so during periodic review of this SIP.

Furthermore, Connecticut has satisfied the MANE-VU “Asks” to reduce sulfur emissions and its largest sources of nitrogen oxides are well controlled and periodically reviewed for further control as part of ongoing ozone attainment planning requirements.

3. Rationale for threshold in Element 2 of MANE-VU ask (p. 56)

Regarding the 3.0 inverse megameter threshold, the SIP would be strengthened if it were more explicit about how the four factors were considered in developing this threshold. For example, Connecticut could include an explanation of what sources were not captured by the threshold and why is it reasonable, based on the four statutory factors, to not look at them, along with a discussion of the percentage of visibility-impairing emissions captured by the threshold.

Response: None of the sources in Connecticut were captured by the threshold. Only sources with impacts above the threshold were to conduct a four-factor analysis.

4. Four-factor analysis

Statute and regulations require that reasonable progress be determined by considering the four factors (i.e., by applying the four factors to sources). The four factors apply to sources (individual sources, groups of sources, and/or source sectors). Therefore, it is difficult to see how Connecticut could reasonably consider the four factors without selecting any sources. As stated in the guidance, we [EPA] think it would be very difficult to support an approvable SIP with no sources brought forward for four-factor analysis and a state would need to explain how doing so is consistent with the rule and statutory requirements, i.e. the four factors.

Response: The Department concurs that the four factors cannot be considered when no sources are linked to visibility impairment.

Connecticut's SIP describes current controls and does not include selection of any sources for a four-factor analysis. We recommend that Connecticut select sources for and conduct four-factor analyses.

a. Evaluation of SO2 controls – The draft SIP states, "There are no electric generating units of 25 MW or more in Connecticut that have control devices to treat emissions of sulfur oxides." These sources likely need to undergo four-factor analysis to provide a reasonable basis that no SO2 controls are needed.

Response: No sources in Connecticut are reasonably linked to visibility impairment at a Class I area, therefore these sources do not need to undergo a four-factor analysis.

b. Bridgeport Harbor Unit 3 - The SIP cites a "commitment to" retire Bridgeport Harbor Unit 3 by 2021 and does not include a four-factor analysis for this unit. Connecticut also does not provide documentation that the retirement is federally enforceable. If Connecticut is relying on this retirement as a RH measure, it must be federally enforceable and in the SIP.

Response: Connecticut is not relying on the retirement of Bridgeport Harbor Unit 3 as a Regional Haze measure. Nevertheless, Connecticut is assured that Bridgeport Harbor Unit 3 will shut down in 2021 based on public statements made by the owner/operator.[38] Additionally, ISO New England in a letter dated August 7, 2017 to PSEG Power Connecticut regarding their delist bid for Bridgeport Harbor Unit 3 states: "Pursuant to the ISO Tariff Section III.13.2.5.2.5.3, this resource and its associated market assets will be retired and the interconnection rights for the resource will terminate effective June 1, 2021."

5. Long-term strategy (LTS)

Connecticut did not conduct a four-factor analyses and therefore does not identify any additional measures for a long-term strategy. This may not be supportable without a four-factor analysis to provide a reasonable basis that "no measures" are appropriate for the LTS.

Response: Connecticut did not conclude that there were no measures appropriate for its LTS. It concluded that measures adopted prior to this SIP revision are appropriate for its LTS.

6. Emissions Inventory

Connecticut must include a review of emissions data from a 2017 (or newer) emissions inventory per 40 CFR 51.308(f)(2)(iii) because the SIP will be submitted to EPA more than one year after the 2017 NEI submission deadline. The technical analysis must include a review to determine whether more current emissions data suggest any changes to the emissions sources and associated emissions reductions that should be evaluated as part of the reasonable progress planning process. The state should explain what

[38] https://bridgeportharborstation.com/one-year-later/ Update: Bridgeport Harbor Unit 3 retired 6/1/21

information was considered and whether the newer data had any impact on the analyses for the SIP and provide a reasonable basis for its choice of information.

Response: The Department revised section 3 of the SIP to include the 2017 NEI. Emissions continue to decrease and therefore reinforce our conclusions.

7. Emissions changes

The SIP would be strengthened if it discussed why emissions of NOx, SO2, PM10 and PM2.5 increased from 2011-2014. Also, the SIP would be strengthened if it discussed the PM10 "other" emissions projected to 2028.

- NOx point emissions increased from 2011 to 2014. (p. 17)
- SO2 point emissions increased from 2011 to 2014. (p. 22)
- PM10, PM2.5 point emissions increased from 2011 to 2014. (p. 32, 36)
- Sharp increase in PM10 "other" category emissions projected in 2028 compared to 2011. (p. 66**)**

Response: Year to year variations in emissions are to be expected. Emissions are influenced by economic and meteorological factors. This is particularly true for the point source emissions, which are comprised largely of electricity generation units. Economic slowdowns will tend to result in decreased emissions while temperature variations may result in increased fossil fuel emissions to produce electricity for heating or cooling. The winter of 2013-14, particularly early 2014, was notable for unusually cold weather in the northeast caused by the "polar vortex".

The "other" category in table 6-6 has been corrected and no longer shows a sharp increase when comparing base year to projected PM10 emissions. The Department inadvertently omitted the base year area source fugitive dust emissions from the spreadsheet used to format table 6-6 in the prior draft.

A.2. USDA Forest Service Comments

The draft Regional Haze State Implementation Plan Revision indicates that Bridgeport Harbor Unit 3 will shut down in 2021. Please provide additional information that supports this assertion.

Response: Please see our response to EPA comment 4b.

The EPA's eGRID2018 database* indicates that the sulfur dioxide emission rate for Bridgeport Harbor Unit 4 is 1.147 lb/MMBtu. Based on a conversation with Connecticut Bureau of Air Management officials, it is our understanding that the State believes that this emission rate is inaccurate. Please provide additional information or evidence that supports this belief. If, in fact, the 1.147 lb/MMBtu rate is accurate, please consider performing a four-factor analysis for this unit.

Response: The eGRID2018 emission rate is inaccurate. Bridgeport Harbor Unit 4 is subject to RCSA 22a-174-19a and a federally enforceable Title V permit, permit 015-217-TV, limiting SO2 emissions from the unit to 0.33 lb/MMBtu.

The EPA's eGRID2018 database indicates that Middletown Unit 4 has a relatively high sulfur dioxide emission rate of 0.283 lb/MMBtu, but that the unit only ran for 33 hours in 2016. We are not aware of any limit on the unit's annual operations and assume the unit could run at maximum capacity in the future. That being the case, please consider performing a four-factor analysis for this unit.

Response: Middletown Unit 4 is subject to Title V and NSR permits which are federally enforceable. NSR permit 104-0003 (issued June 9, 2020) requires the permittee to report actual annual emissions of PM2.5, PM10, SO2, NOx, VOC, CO, lead, and ammonia for the prior calendar year compared to the 2-year baseline average emissions, immediately preceding the installation of the urea injection and/or combustion modification equipment which results from a recent requirement to comply with RACT. DEEP requires this reporting so it can evaluate if any increase in emissions over the baseline will trigger further permitting and control technology reviews resulting from increased use of the equipment.

A.3. NPS Air Resources Division Comments

As we have commented to MANE-VU and individual states, we believe the 3 inverse Mm screening threshold for sources subject to Four Factor Analysis is too high. This threshold—equivalent to an approximately 1 deciview change—does not adequately consider cumulative visibility impacts or those that may occur at Class I areas below that threshold.

Response: The visibility impairment on the most impaired days at the Class I areas in the MANE-VU region range from between 13 and 20 deciviews. In that range, 3 inverse megameters more nearly approximates ½ of a deciview.

The 3 Mm^{-1} threshold was used only in the second element of the Ask. There were six elements to the Ask. Element three of the Ask, for example, applies to all fuel oil burning sources regardless of size or the impact any individual source may have on visibility in a Class I area.

EPA OAQPS has stated on several occasions that it expects some 4-factor analyses to be completed by each state, otherwise a SIP may be deemed incomplete.

Response: As discussed above in responses to EPA, Connecticut is not linked to visibility impairment in any Class I area. Therefore, there is no technical or regulatory reason to require a four-factor analysis.

We appreciate Connecticut addressing the list of sources identified as candidates for 4-factor analysis in our October 2018 letter in the draft SIP (Table 5.3). The draft SIP provides updated emission inventory data and relevant regulatory limits for these sources.

After evaluating updated information we still recommend that Connectiuct consider conducting 4-factor analysis for four municipal waste combustors (MWC). These facilities are Wheelabrator Bridgeport LP, CRRA/Mid-Connecticut, Covanta Southeastern CT, and Wheelabrator Lisbon LP. Similar MWC facilities in Maryland and Virginia are already achieving significantly lower NOx emissions (25% lower) or will be by the end of 2021. It may be possible for Connecticut sources to achieve a similarly lower rate using improved combustion technology. The viability of this potential improvement can most appropriately be explored through a formal 4-factor analysis.

As shared earlier, the attached analysis details our review of the Connecticut MWCs that we recommend for a 4-factor analysis. In addition, we have included information on Maryland and Virginia efforts in regulating and permitting MWCs. During our call you responded that Connecticut does not intend to revisit 4-factor analyses because the state already has a very low NOx emissions limit designed to help meet the ozone standard. However, you agreed to review materials provided and discuss internally.

Response: The Department appreciates the information submitted by the National Park Service. The information is relevant to, and included in, current efforts with the Ozone Transport Commission (OTC) states to evaluate municipal waste combustor emissions for reasonably available control technology (RACT). Connecticut is currently nonattainment for both the 2008 and 2015 ozone standards and is required to impose RACT and to obtain emission reductions of ozone precursors of not less than 3% per year in order to attain the standards. The OTC has formed a workgroup – in which the Department actively participates -- to evaluate and compare emissions from municipal waste combustors and expects to make a recommendation near the end of this year. The Department has already committed in its RACT SIP to act on the information compiled by this workgroup and adhere to the resultant OTC recommendations. The Department, however, does not intend to implement additional emission control requirements on any MWC unit that intends to shut down in the near future in response to evolving state waste management policies.

Connecticut commends fellow OTC member States of Maryland and Virginia for demonstrating that these emissions limits are achievable. Nevertheless, while the Department believes it has clear regulatory authority to obtain reasonable further emission reductions from MWC facilities to meet requirements for attaining the ozone standards, as indicated above however, the Department cannot justify conducting four-factor analyses of these sources at this time.

NPS ATTACHMENT

Updated Analysis Supporting ARD Recommendations to Connecticut for 4-Factor Analysis of Municipal Waste Combustors

In our October 2018 letter to the Connecticut Department of Energy and Environmental protection, the NPS Air Resources Division (ARD) requested that the state consider five facilities for four-factor analysis, including four large municipal waste combustors. These facilities were:

1. Wheelabrator Bridgeport LP,
2. CRRA/Mid-Connecticut,
3. Covanta Southeastern CT, and
4. Wheelabrator Lisbon LP.

The list of facilities requested for analysis was updated to include the most recent available emissions data and new q/d values were calculated. Only NOx and SO2 emissions were included in the value of Q. This resulted in slightly lower values for q/d.

Facility_Name	NOx Controls	year	Q (NOx+SO2, tons/yr)	D (km)	Q/d	Emissions source
WHEELABRATOR BRIDGEPORT LP	SNCR	2017	1215.1	489.2	2.48	NEI
C R R A / MID-CONNECTICUT	SNCR	2017	682.4	411.6	1.66	NEI
COVANTA SOUTHEASTERN CT CO	SNCR	2017	391.8	396.6	0.99	NEI
WHEELABRATOR LISBON INC (WM)	SNCR	2017	277.8	386.3	0.72	NEI
Bridgeport Energy	Low NOx burner/SCR	2019	169.4	493.0	0.34	CAMD
PSEG FOSSIL LLC/ POWER CT LLC	SCR (on turbines)	2017	58.8	461.2	0.13	NEI
PSEG FOSSIL LLC/ POWER CT LLC	SCR (on turbines)	2019	6.3	461.2	0.01	CAMD

The Connecticut draft State Implementation Plan (SIP) states that as modeling did not indicate any sources that would contribute 3 Mm^{-1} of visibility impairment to any Class I area, there is no need for a four-factor analysis in keeping with the MANE-VU Ask. In addition, the SIP notes that the four municipal waste combustors must meet the more stringent NOx emissions limitations specified by the Regulations of State Connecticut Agencies Section 22a-174-38. These more stringent limits, which took effect 12 months after the date of implementation of the rule, are:

Table 38-2A	**ppmdv (7% Ox)**
Mass burn refractory combustor	177
Mass burn water wall combustor built before 1986	150
Mass burn water wall combustor built 1986 or later	150
Processed-municipal solid waste combustor	146
Reciprocating grate waste fire fired incinerator/boiler	79

These NOx emissions limits are lower than those specified by the most current (2006) revision of the New Source Performance Standards for municipal waste combustors. In addition, the four listed Connecticut facilities are already equipped with selective non-catalytic reduction equipment to reduce NOx emissions.

However, an examination of similar facilities suggests it may be possible to achieve lower short-term NOx emissions rates even for existing facilities. At least one facility in Maryland, the Montgomery County Resource Recovery Facility, is achieving a 30-day rolling average NOx emissions rate of 105 ppmv. This limit was promulgated in a state rule, which can be found here: http://www.dsd.state.md.us/comar/comarhtml/26/26.11.08.10.htm.

In addition, two existing facilities in Virginia are undergoing modifications that will result in lower RACT NOx limits after work is completed in late 2021. Those facilities are Covanta Arlington/Alexandria and Covanta Fairfax. Under the new RACT permits, the operational short-term NOx limits will be:

a. Daily Average Nitrogen Oxides: 110 ppmvd @7% O2
b. Annual Average Nitrogen Oxides: 90 ppmvd @ 7% O2

The limits from the RACT permits (available upon request) for these Virginia facilities have been incorporated into Virginia's State Implementation Plan. The change to the SIP that incorporated these limits can be found in the Federal Register:

https://www.federalregister.gov/documents/2019/12/09/2019-26403/approval-and-promulgation-of-air-quality-implementation-plans-virginia-source-specific-reasonably

These three facilities are employing a new low NOx combustion system to achieve substantial improvements in NOx emissions rates. All are existing facilities, with combustors that were constructed between 1988 and 1995. It may be possible to improve the short-term NOx emissions rates of other existing municipal waste combustor units as well. We recommend that CT explore this potential for reasonable emission reductions through the use of four-factor analyses.