Attainment Demonstration for Areas Classified Moderate Nonattainment for the 2015 Ozone Standards

Connecticut Department of Energy and Environmental Protection
Bureau of Air Management
State Implementation Plan Revision

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ACRONYMS and ABBREVIATIONS

ACT	Advanced Clean Trucks
afdust	Fugitive Particulate Dust Emissions (Modeled)
BACT	Best Available Control Technology
CAA	Clean Air Act
CAMx	Comprehensive Air Quality Model with Extensions
CCTM	CMAQ Chemical-Transport Model
CDD	Cooling Degree Day
CFR	Code of Federal Regulations
CHEAPR	Connecticut Hydrogen and Electric Automobile Purchase Rebate
CMAQ	Community Multi-Scale Air Quality Model
cmv_c1c2	Commercial Marine Vessel Emissions (Modeled)
cmv_c3	Commercial Marine Vessel Emissions – Large (Modeled)
CONUS	Continental/Contiguous United States
CSAPR	Cross-State Air Pollution Rule
CTDOT	Connecticut Department of Transportation
DEEP	Department of Energy and Environmental Protection (Connecticut)
DERA	Diesel Emissions Reduction Act
DMV	Department of Motor Vehicles (Connecticut)
DV	Design Value
EGU	Electric Generating Unit
EPA	Environmental Protection Agency (United States)
EV	Electric Vehicle
FMVCP	Federal Motor Vehicle Control Program
FR	Federal Register
GHG	Greenhouse Gas
GVWR	Gross Vehicle Weight Rating
ICI	Industrial, Commercial, and Institutional
I/M	Inspection and Maintenance
lbs	Pounds
LEV	Low Emission Vehicle
LIS	Long Island Sound
LISTOS	Long Island Sound Tropospheric Ozone Study
MANE-VU	Mid-Atlantic / Northeast Visibility Union
MARAMA	Mid-Atlantic Regional Air Management Association
MATS	Mercury and Air Toxics Standards
MCIP	Meteorology-Chemistry Interface Processor
MOVES	Motor Vehicle Emission Simulator
MVEB	Motor Vehicle Emission Budget
MY	Model Year
NAAQS	National Ambient Air Quality Standards
NEI	National Emission Inventory

NESCAUM	Northeast States for Coordinated Air Use Management
NHTSA	National Highway Traffic Safety Administration
NLEV	National Low Emission Vehicle Program
NNSR	Nonattainment New Source Review
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
nonpt	Area Sector Emissions (Modeled)
NOx	Oxides of Nitrogen
np_oilgas	Area Sector Oil and Gas Emissions (Modeled)
NSPS	New Source Performance Standard
OBD	On-Board Diagnostics
OMI	Ozone Monitoring Instruments
othafdust	Area Sector Fugitive Dust Emissions from Canada (Modeled)
othpt	Point Sector Emissions from Canada and Mexico (Modeled)
othptdust	Point Sector Fugitive Dust Emissions from Canada (Modeled)
OTC	Ozone Transport Commission
OTR	Ozone Transport Region
PBL	Planetary Boundary Layer
PFC	Portable Fuel Container
PM2.5	Fine Particulate Matter
ppb	parts per billion
ppm	parts per million
pt_oilgas	Point Sector Oil and Gas Emissions (Modeled)
ptegu	Point Sector Electric Generating Unit Emissions (Modeled)
ptnonipm	Point Sector Industrial Activity Emissions (Modeled)
RACM	Reasonably Available Control Measure
RACT	Reasonably Available Control Technology
RCSA	Regulations of Connecticut State Agencies
RFP	Reasonable Further Progress
ROP	Rate of Progress
RVP	Reid Vapor Pressure
RWC	Residential Wood Combustion
SCR	Selective Catalytic Reduction
SIP	State Implementation Plan
SMOKE	Sparse Matrix Operator Kernel Emissions/Inventory Data Analyzer
SNCR	Selective Non-Catalytic Reduction
SO_2	Sulfur Dioxide
TCM	Transportation Control Measure
TROPOMI	Tropospheric Monitoring Instrument
TSD	Technical Support Document
USC	United States Code
USDOT	United States Department of Transportation
VMT	Vehicle Miles Traveled

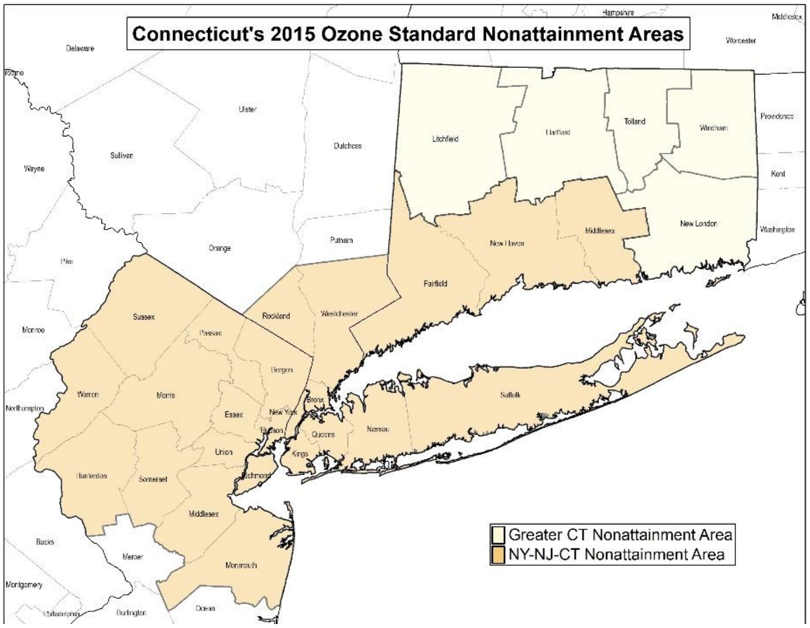
VOC	Volatile Organic Compound
VW	Volkswagen
WOE	Weight of Evidence
WRF	Weather Research and Forecasting Model
ZEV	Zero Emission Vehicle

1 Introduction and Background

1.1 Purpose of Document

This document presents the Connecticut Department of Energy and Environmental Protection's (DEEP) air quality state implementation plan (SIP) revision addressing the requirements of the Clean Air Act (CAA) regarding Connecticut's plan to attain the 2015, 70 ppb 8-hour National Ambient Air Quality Standards (NAAQS) for ozone. This plan describes the national, regional, and local control measures to be implemented to reduce emissions and assesses the likelihood of reaching attainment in Connecticut's two nonattainment areas by the August 3, 2024 attainment date. Figure 1-1 shows a map of the Greater Connecticut and the Southwest Connecticut portion of the New York – New Jersey – Connecticut (NY-NJ-CT) nonattainment areas. This demonstration relies on air quality modeling and other analyses to support its conclusions.

Figure 1-1. *Map of Connecticut's Nonattainment Areas.*



This document is not intended to focus on the older, less stringent, 2008 NAAQS for which Greater Connecticut is in attainment and Southwest Connecticut remains in nonattainment. However, information and control strategies relevant to the 2008 NAAQS may be included in this document in as much as they contribute to, or inform the status of, attainment with the 2015 NAAQS. Additional information regarding Connecticut's ozone attainment planning can be found at: https://portal.ct.gov/DEEP/Air/Planning/Ozone/Ozone-Planning-Efforts.

The results of these analyses indicate that attainment of the 2008 ozone NAAQS is maintained in Greater Connecticut and attainment of the 2015 NAAQS is likely to occur near the attainment date. Attainment for the 2008 and 2015 ozone NAAQS in Southwest Connecticut can only be assured by securing additional emission reductions through control of sources that are outside the scope of Connecticut's authority to control, as well as through the implementation of more stringent emission standards on new light, medium, and heavy-duty vehicles in Connecticut and throughout the Ozone Transport Region (OTR).

1.2 Ozone Production and Effect on Health and the Environment

Tropospheric, or ground-level ozone is produced through a combination of atmospheric chemical reactions involving volatile organic compounds (VOCs) and nitrogen oxides (NOx) in the presence of sunlight. These ozone precursors are emitted from many human activities as well as from natural processes. Anthropogenic emissions of VOCs include evaporation and combustion of gasoline and VOC evaporation from consumer products and industrial and commercial solvents. VOCs emitted by vegetation and other biogenic sources in Connecticut are estimated to exceed anthropogenic VOC emission levels. Nitrogen oxides are generally formed as a product of high temperature combustion such as in internal combustion engines and utility and industrial boilers. A small quantity of NOx is produced by lightning and emitted by microbial processes in soil. Variability in weather patterns contributes to considerable yearly differences in the magnitude and frequency of high ozone concentrations. Ozone and the pollutants that form ozone are often transported into Connecticut from pollution sources found as far as hundreds of miles upwind.

Ozone, a strong oxidant, damages living tissue and materials. Crop yield has been shown to be reduced and ornamental plants damaged with exposure to ozone. Plastic, rubber, and paint become more brittle, paints and dyes fade, and materials generally deteriorate and corrode more readily in the presence of ozone.

Ground-level ozone at concentrations currently experienced in Connecticut can cause several types of short-term health effects. Ozone can irritate the respiratory system, causing wheezing and coughing, can irritate the eyes and nose, and can cause headaches. Ozone can affect lung function, reducing the amount of air that can be inhaled and limiting the maximum rate of respiration, even in otherwise healthy individuals. Exposure to high levels of ozone can also increase the frequency and severity of asthmatic attacks, resulting in more emergency room visits, medication treatments, and lost school and workdays. In addition, ozone can enhance people’s sensitivity to asthma-triggering allergens such as pollen and dust mites. Other possible short-term effects resulting from exposure to high levels of ozone include aggravation of symptoms in those with chronic lung diseases, such as emphysema, bronchitis, and chronic obstructive pulmonary disease and increased susceptibility to respiratory infections due to impacts of ozone on the immune system. Studies have also raised the concern that repeated short-term exposure to high levels of ozone could lead to permanent damage to lung function, especially in the developing lungs of children.

1.3 Ozone NAAQS and SIP History

The 1970 CAA amendments established health and welfare protective limits, or NAAQS, for several air pollutants, including “photochemical oxidants”, of which ozone was a key component. The photochemical oxidants standard was set at 0.08 parts per million (ppm) as a 1-hour average. The 1977 CAA amendments modified the photochemical oxidants standard to focus only on ozone, leading to the establishment in 1979 of a less stringent 1-hour average ozone NAAQS of 0.12 ppm. The U.S. Environmental Protection Agency (EPA) classified areas as “nonattainment” if monitors in the area measured ozone levels exceeding the NAAQS on more than three days over a 3-year period. Nonattainment areas were required to adopt programs to provide for attainment of the ozone standard no later than 1987. Despite implementation of a variety of emission reduction strategies and significant improvement in measured ozone levels, many areas, including Connecticut, did not attain the standard by the 1987 deadline. Recognizing the difficulties of attaining the standard and the regional nature of the ozone problem particularly in the northeast, Congress established through the 1990 amendments to the CAA, the OTR and the Ozone Transport Commission (OTC) to help facilitate regional compliance strategies. These amendments also established different classification levels of 1-hour ozone nonattainment, based on the severity of the ozone problem in each area. Areas measuring more severe ozone levels were provided more time to attain but were also required to adopt more stringent control programs. Pursuant to the 1990 amendments, EPA designated all of Connecticut as nonattainment for the 1-hour NAAQS. The Greater Connecticut area was classified as serious nonattainment with a required attainment date of 1999. Southwest Connecticut was classified as a part of a multi-state severe nonattainment area with portions of New York and New Jersey, with an attainment deadline of 2007. At that time, the Southwest Connecticut portion of the multi-state nonattainment area consisted of most of Fairfield County and a small portion of Litchfield County. The remainder of the state was included in the Greater Connecticut area.

DEEP submitted initial state implementation plans (SIPs) for both the Southwest Connecticut and Greater Connecticut ozone nonattainment areas on September 16, 1998. The attainment demonstration for Greater Connecticut included a technical analysis showing that overwhelming transport of ozone and ozone precursor emissions from upwind areas precluded compliance by the required 1999 attainment date. Connecticut also requested that the compliance deadline be moved out to 2007. EPA issued final approvals for the 2007 attainment plans and the attainment date extension for Greater Connecticut on January 3, 2001.[1]

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[1] 66 FR 634

Table 1-1. *History of Ozone NAAQS with respect to Connecticut Nonattainment Areas. Outstanding attainment dates are highlighted in red.*

Final Rule /Decision	Level	Form	Status of the Southwest Connecticut Area	Status of the Greater Connecticut Area
1971 36 FR 8186 April 30, 1971	0.08 ppm Total photochemical oxidants	1 Hour Average Not to be exceeded more than once per year.	Designation: Nonattainment. Standard Revoked in 1979.	Designation: Nonattainment. Standard Revoked in 1979.
1979 44 FR 8202 February 8, 1979	0.12 ppm Ozone	1 Hour Average Attainment is defined when the expected number of days per calendar year, with maximum hourly average concentration greater than 0.12 ppm, is equal to or less than 1.	Designation: Nonattainment. Standard replaced with 1997 NAAQS.	Designation: Nonattainment. Standard Replaced with 1997 Standard.
1990 CAA Amendments	Retained the 1979 standard. The 1990 CAA Amendments introduced the concept of classifications and varying requirements depending on the severity of the classification. Also recognized the need for multistate efforts and established the ozone transport region.		Designation: Severe Nonattainment. Clean Data Determination for the 1979 NAAQS on June 18, 2012. [77 FR 36163]	Designation: Serious Nonattainment. Clean Data Determination for the 1979 NAAQS on March 16, 2012. [77 FR 15607]
1993 58 FR 13008 March 9, 1993	EPA decided that revisions to the standards were not warranted at the time.			
1997 62 FR 38856 July 18, 1997	0.08 ppm Ozone	8 Hour Average Annual fourth highest daily maximum 8-hour concentration averaged over 3 years.	Designation: Moderate Nonattainment Proposed Approval of the SWCT Attainment Demonstration on May 9, 2013. [78 FR 27161] Standard revoked April 6, 2015. [80 FR 12264] Measured compliance 2009-2011. Subsequent violations resulted in EPA-issued SIP Call on May 4, 2016. [81 FR 26697] *Approval of attainment demonstration (2017) and measured attainment since 2014. [83 FR 39890]*	Designation: Moderate Nonattainment. Determination of attainment, effective September 30, 2010. [75 FR 53219] Approval of Attainment Demonstration on January 27, 2014. [78 FR 78272] Standard revoked April 6, 2015. [80 FR 12264]
2008		8 Hour Average		

73 FR 16483 March 27, 2008	0.075 ppm Ozone	Annual fourth highest daily maximum 8-hour concentration averaged over 3 years.	Designation: Marginal Nonattainment. Reclassified to Moderate Nonattainment effective June 3, 2016. [81 FR 26697] Reclassified to Serious Nonattainment effective September 23, 2019. [84 FR 44238] Reclassified to Severe Nonattainment effective November 7, 2022. [87 FR 60926] **Severe Attainment Date: July 20, 2027.**	Designation: Marginal Nonattainment. Reclassified to Moderate Nonattainment effective June 3, 2016. [81 FR 26697] Reclassified to Serious Nonattainment effective September 23, 2019. [84 FR 44238] Clean Data Determination effective August 12, 2020. [85 FR 41924] Determination of Attainment effective November 7, 2022. [87 FR 60926]
2010 & 2011 75 FR 2938 Jan 19, 2010 Proposal	Proposed reconsideration of 2008 standards and ultimate withdrawal of reconsideration by Presidential Statement on September 2, 2011.			
2015 80 FR 65292 October 26, 2015	0.070 ppm Ozone	8 Hour Average Annual fourth highest daily maximum 8-hour concentration averaged over 3 years.	Designation: Moderate Nonattainment. **Moderate Attainment Date: August 3, 2024.**	Designation: Marginal Nonattainment. Reclassified to Moderate Nonattainment effective November 7, 2022. [87 FR 60897] **Moderate Attainment Date: August 3, 2024.**
2020 85 FR 87256 December 31, 2020	Primary and Secondary Standard retained, without revision.			

The CAA requires EPA to review and revise, as appropriate, established criteria pollutant standards every five years. Prompted by increasing evidence of health effects at lower concentrations over longer exposure periods, EPA promulgated a more stringent ozone health standard in 1997 based on an 8-hour averaging period. The revised NAAQS was established as an 8-hour average of 0.08 ppm. Compliance is determined in an area using the monitor measuring the highest 3-year average of each year's 4th highest daily maximum 8-hour ozone concentration (known as the design value). Due to legal and other delays, the nonattainment designations did not become effective until June 15, 2004.[2]

For the 1997 standard, Connecticut was designated nonattainment by EPA based on measured 8-hour ozone values from the 2001-2003 period. Connecticut's nonattainment area boundaries shifted during this designation process. Fairfield, New Haven, and Middlesex Counties were

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[2] 69 FR 23858

included in the Southwest Connecticut nonattainment area as part of a moderate 8-hour ozone NAAQS nonattainment area, along with the New York and New Jersey counties that make up most of the New York Metropolitan Area (NYMA). The remaining five counties in Connecticut were grouped as a separate moderate nonattainment area, which continued to be referred to as the Greater Connecticut ozone NAAQS nonattainment area. With these revisions to the ozone standard, Connecticut submitted revised implementation plans in 2008.

On March 27, 2008, EPA again revised the ozone standards. Consistent with past revisions, EPA set the primary health standard and secondary welfare standard for ozone at the same level. EPA concluded, based on their review of the scientific evidence at the time, that it was appropriate to revise the primary and secondary standards for ozone from the existing levels of 0.08 ppm to 0.075 ppm. Connecticut was initially designated marginal nonattainment for both the Greater Connecticut region and the Southwest Connecticut portion of the NY-NJ-CT nonattainment area. Due to delays, designations for the 2008 NAAQS were not made effective until July 20, 2012.

In 2015, EPA once again revised the ozone standard downward -- from 0.075 ppm to 0.070 ppm. Initially, Greater Connecticut was designated marginal nonattainment and Southwest Connecticut designated moderate.[3] These designations for the 2015 NAAQS ran concurrent with the designations for the 2008 NAAQS. Attainment dates for the 2015 NAAQS were set to August 3, 2021 for Greater Connecticut and August 3, 2024 for Southwest Connecticut.

Meanwhile, Connecticut's nonattainment areas did not attain the 2008 NAAQS by the July 20, 2015 attainment date. Therefore, on April 11, 2016, EPA finalized a rule reclassifying Connecticut's nonattainment areas for the 2008 NAAQS from marginal to moderate based on data from 2012 through 2014. This reclassification, published in the Federal Register on May 4, 2016,[4] established a new attainment deadline of July 20, 2018, which required measured attainment with the 2008 NAAQS by the end of the 2017 ozone season.

DEEP submitted revised implementation plans for Greater Connecticut and Southwest Connecticut in January 2017 and August 2017, respectively.[5,6] These plans indicated that Greater Connecticut attained the 2008 NAAQS and Southwest Connecticut was fully compliant with the revoked 1997 NAAQS.[7,8] Southwest Connecticut did not attain the 2008 NAAQS as required and was therefore reclassified from moderate to serious nonattainment on September 23, 2019.[9] This reclassification established a new attainment date for Southwest Connecticut of July 20, 2021 for the 2008 NAAQS.

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[3] Initial Designations for the 2015 Ozone NAAQS 83 FR 25776 published June 4, 2018; effective August 3, 2018.

[4] 81 FR 26697

[5] https://portal.ct.gov/-/media/DEEP/air/ozone/ozoneplanningefforts/EnclosureAGreaterCTADpdf.pdf

[6] https://portal.ct.gov/-/media/DEEP/air/ozone/ozoneplanningefforts/SouthwestConnecticutAttainmentSIPFINALpdf.pdf

[7] 85 FR 41924, July 13, 2020, Clean Data Determination acknowledging that Greater Connecticut had been measuring attainment with the 2008 NAAQS since 2016.

[8] 83 FR 39890, August 13, 2018 approval of attainment demonstration and showing that Southwest Connecticut had been measuring attainment with the 1997 NAAQS since 2014.

[9] 84 FR 44238

In response to the reclassification of the area to serious nonattainment for the 2008 NAAQS, DEEP submitted a SIP revision for Southwest Connecticut on June 23, 2022.[10] However, Southwest Connecticut again failed to timely attain the NAAQS and was reclassified from serious to severe nonattainment effective November 7, 2022 with a new attainment date of July 20, 2027.[11]

On November 7, 2022, Greater Connecticut was reclassified to moderate nonattainment for the 2015 NAAQS.[12] As southwest Connecticut was already classified moderate nonattainment, the entire state is required to attain the 2015 NAAQS on August 3, 2024. Attainment with this more stringent standard would necessarily result in attainment with the less stringent 2008 NAAQS. Nevertheless, this SIP revision addresses only the requirements for the 2015 NAAQS.

1.4 Attainment Plan Requirements

Section 172 of the CAA outlines the general nonattainment plan provisions and CAA section 182 requires additional plan requirements for ozone nonattainment areas based on classification status. Additionally, if the area is in the OTR, as Connecticut is, there are additional requirements under CAA section 184. Furthermore, implementation plans from earlier nonattainment designations may be required to remain in place to attain or maintain compliance with the previous standards.

For the 2015 ozone NAAQS, Southwest Connecticut was initially classified as moderate nonattainment while Greater Connecticut was recently reclassified from marginal to moderate nonattainment. The moderate nonattainment area deadline for attainment is in August 2024, with SIP revisions due in January 2023. CAA section 182(i) addresses reclassified areas and allows adjustments to the submittal schedule for attainment plan requirements but does not allow for an extension to the required attainment date beyond the date for the new classification. CAA sections 182(a) and 182(b) outline the ozone SIP requirements specific to marginal and moderate areas. The implementation rule for the 2015 ozone NAAQS, adopted August 3, 2018,[13] is codified in 40 CFR 51 Subpart CC.

The following requirements for the nonattainment areas were addressed in recent DEEP actions as described briefly below.

- Emissions offsets from new major sources and modifications are required at a ratio of 1.15 to 1 for moderate areas. However, because Connecticut's nonattainment areas had, under prior designations, been classified as serious and severe nonattainment, offsets continue to be required at more stringent ratios of 1.2 to 1 and 1.3 to 1. Connecticut's rules for obtaining offsets from new and modified sources, as well as

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[10] https://portal.ct.gov/-/media/DEEP/air/ozone/ozone_sip_revision/2008OzoneSIPSeriousNonattainmentAreaspdf.pdf
[11] 87 FR 60926
[12] 87 FR 60897
[13] Implementation Rule for the 2015 NAAQS: 83 FR 62998

other new source review requirements, are contained in the Regulations of Connecticut State Agencies (RCSA) 22a-174-3a.

- For states in the OTR, the new source review major source threshold is reduced from the usual 100 tons per year for a moderate area to 50 tons per year for sources emitting VOCs [CAA 184(b)(2)]. Connecticut defines major sources and major modifications in RCSA 22a-174-1, and the thresholds are at least as stringent as required for moderate nonattainment areas located in the OTR. Further details demonstrating that Connecticut's SIP adheres to the requirements for nonattainment new source review can be found in our Nonattainment New Source Review Certification.

- Reasonably Available Control Technology (RACT) is required for all EPA-defined control technique guideline (CTG) sources and all major sources of VOC and NOx. Reasonably Available Control Measures (RACM) are required for all other sources. Plans to implement any necessary RACT and RACM were updated for the current designations under the 2015 NAAQS and submitted to EPA.

- Submittal of an inventory of sources and periodic emissions inventory updates every three years. Connecticut has been submitting periodic emissions inventories every three years since 1990 and continues to do so as required under the 2015 ozone NAAQS. Connecticut uses the 2016 inventory year as its base year in this Attainment Demonstration SIP for modeling and uses 2017 as the base year in determining reasonable further progress in securing emissions reductions. The point source sector of the inventory relies on the actual emissions reported though Connecticut's emissions statement program. Connecticut maintains its emissions statement program as approved in its infrastructure SIP for the 2015 NAAQS [85 FR 50953] and recently recertified.

Relevant portions of the SIP as described above are in process or have been revised, updated and recertified as required and are available for further review on DEEP's website.[14]

With this submittal, DEEP demonstrates fulfillment of the following remaining requirements:

- Basic Inspection and Maintenance (I/M) is required for light-duty motor vehicles. Connecticut continues to implement its more stringent enhanced I/M program statewide since earlier more stringent nonattainment designations. Connecticut's I/M rules are established in RCSA 22a-174-27 and in CGS 14-164c and regulations adopted thereunder and were approved into the SIP on December 5, 2008 [73 FR 74019]. Connecticut recertified this program as satisfying the moderate requirements when it made the submittals in 2017. The program was approved as satisfying moderate

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[14] https://portal.ct.gov/DEEP/Air/Planning/SIP/Air-SIP-Revisions--Other-State-Plans-for-Control-of-Air-Pollution

nonattainment requirements on March 29, 2019 [84 FR 11884] and the associated notice of proposed rulemaking [February 1, 2019; 84 FR 1015] recognized the program as enhanced. Because Connecticut is in the OTR, portions of Connecticut's nonattainment areas – those in metropolitan statistical areas with population exceeding 100,000 –are required to implement an enhanced I/M program pursuant to CAA 184(b)(1). Connecticut requires the enhanced program statewide, thus exceeding the federal requirements. All elements of the basic program are included in the enhanced program.

- Reasonable Further Progress (RFP) plans to achieve 15 percent VOC reduction within 6 years after the baseline year of 2017 (i.e., reductions must occur by 2023). Equivalent NOx reductions can be substituted for any portion of the required VOC reductions. Connecticut uses the 2017 inventory year as its base year in this SIP for determining reasonable further progress in securing emissions reductions.

- Transportation conformity budgets are included that are consistent with the attainment plan and are established for the RFP year and the attainment year (i.e., 2023).

- An attainment demonstration using modeling, monitoring data, and other technical analyses described in this report demonstrates that neither Greater Connecticut nor Southwest Connecticut are expected to attain the 2015 NAAQS by the attainment date and that attainment is assured only with increased emissions reductions from sources that are outside the authority of Connecticut to control.

- Contingency measures are infeasible and, in recognition of the likelihood of failure to attain, DEEP will continue making RFP reductions in emissions beyond the attainment date. This report documents that continued RFP reductions in emissions exceed reductions achievable under EPA contingency measures guidance.

1.5 Summary of Conclusions

The remainder of this document describes in detail the air quality trends analysis, emission inventories, emission control programs, photochemical modeling, and other weight of evidence evaluations that support the following conclusions:

1. Greater Connecticut is expected to attain and maintain compliance with the 2015 ozone standard at all monitors starting in the attainment year of 2023 with the exclusion of monitoring data that was influenced by exceptional events caused by fires.

2. Southwest Connecticut cannot attain the ozone standards without further emissions reductions from nearby upwind states and additional significant reductions from the mobile source sector. Though no longer considered significant contributors under EPA's

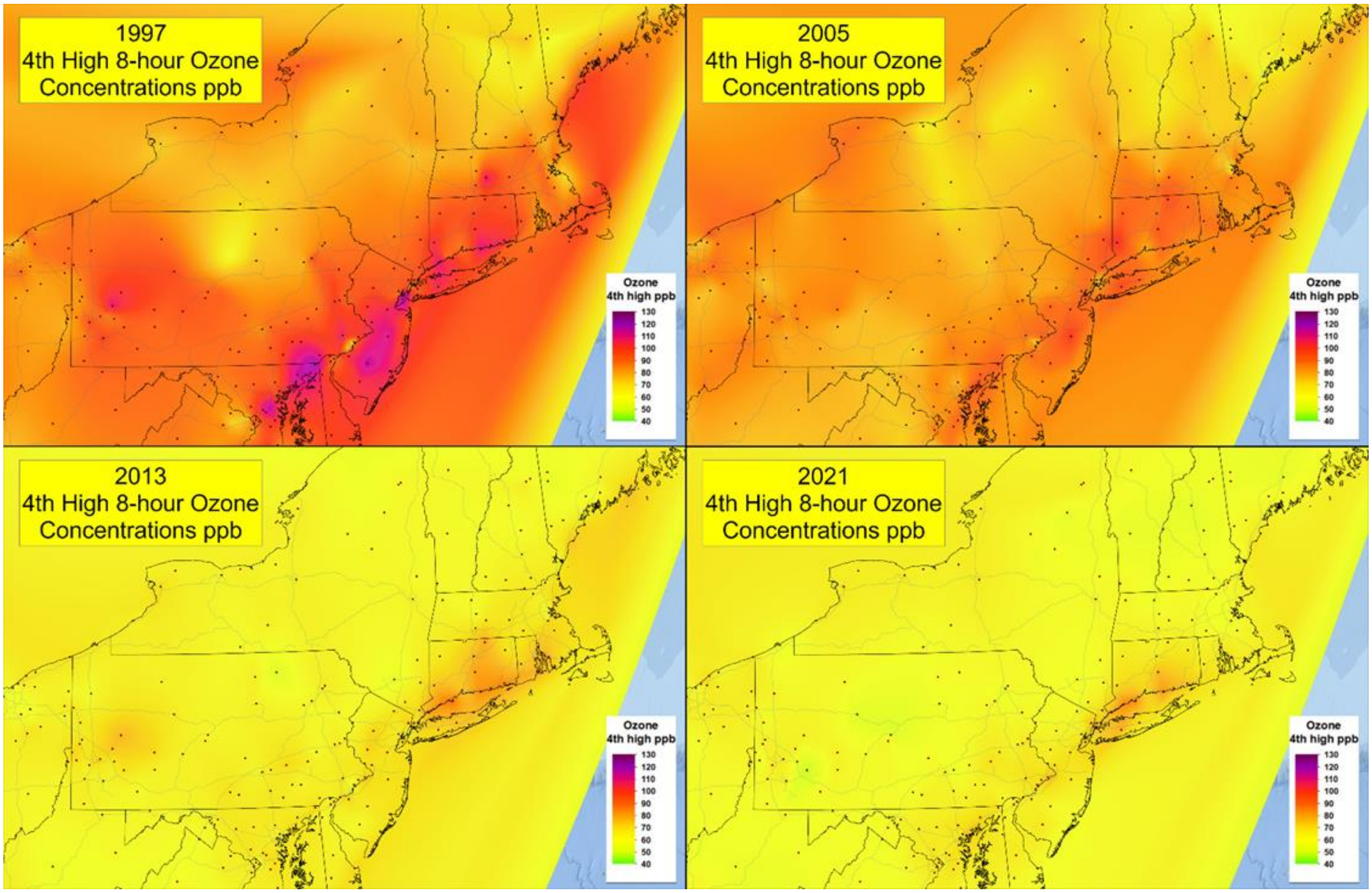
interpretation of the CAA, nearby upwind states still provide the highest contributions to ozone exceedances in Connecticut.

2 Nature of the Ozone Air Quality Problem in Connecticut and the Northeast

2.1 Introduction

This section provides a conceptual description of the ozone problem from a regional and local perspective. A detailed description of the regional perspective was addressed in a 2010 report developed by Northeast States for Coordinated Air Use Management (NESCAUM): "The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description."[15] While that conceptual model remains valid, the extent and magnitude of ozone episodes have since diminished (see **Error! Reference source not found.**) and emphasis is now on scenarios that favor more localized and coastal exceedances.

Figure 2-1. *Images showing a trend toward diminished extent and magnitude of ozone exceedances in the northeast. Source: https://portal.ct.gov/DEEP/Air/Monitoring/Trends/Ozone-Trends*



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[15] http://www.nescaum.org/documents/2010_o3_conceptual_model_final_revised_20100810.pdf

Here we provide updated information on the regional perspective and address the local aspects of ozone conducive emissions and meteorology related to the conceptual model, as recommended in EPA's "Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze".[16]

2.2 Regional Conceptual Description of the Ozone Problem

Ozone episodes in the eastern U.S. often begin with the passage of a large high-pressure area from the Midwest to the middle or southern Atlantic states, where it assimilates into and becomes an extension of the Atlantic (Bermuda) high-pressure system. These expansive weather systems favor the formation of ozone by creating a vast area of clear skies and high temperatures. Air masses moving east across the Midwest accumulate air pollutants emitted by large point sources, such as power plants, as well as other point, mobile and area sources. As the air mass moves across the OTR, local sources contribute to the air pollution burden. In the worse cases, high-pressure systems stall over the eastern United States, creating ozone episodes of strong intensity and long duration.

One transport mechanism that can play a key role in moving pollution long distances is the nocturnal low-level jet. After sunset, the ground cools faster than the air above it, creating a nocturnal temperature inversion. This stable boundary layer extends from the ground to only a few hundred meters in altitude. Above this layer, a nocturnal low-level jet can form with higher velocity winds relative to the surrounding air. It forms from the fairly abrupt removal of frictional forces induced by the ground that would otherwise slow the wind. Absent this friction, winds at this height are free to accelerate, forming the nocturnal low-level jet. Ozone above the stable nocturnal inversion layer is likewise cut off from the ground, and thus it is not subject to removal on surfaces or chemical destruction from low-level emissions, the two most important ozone removal processes. Ozone in high concentrations can be entrained in the nocturnal low-level jet and transported several hundred kilometers downwind overnight. The next morning as the sun heats the Earth's surface, the nocturnal boundary layer begins to break up, and the ozone transported aloft overnight mixes down to the surface where concentrations rise rapidly, partly from mixing and partly from ozone generated locally. By the afternoon, abundant sunshine combined with warm temperatures promotes additional photochemical production of ozone from local emissions. As a result, ozone concentrations reach their maximum levels through the combined effects of local and transported pollution. This combined air mass will then continue to blow along with the wind, carrying elevated concentrations of ozone to areas farther downwind, causing late afternoon and even overnight ozone peaks.

The nocturnal low-level jet has been observed just before or during ozone events. Channeled by the Appalachian Mountains, it can convey air pollution several hundreds of miles overnight from the southwest to the northeast, directly in line with the major population centers from

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[16] https://www.epa.gov/sites/default/files/2020-10/documents/o3-pm-rh-modeling_guidance-2018.pdf

Washington, DC to Boston, Massachusetts. It can also act to bring pollutants from different directions compared to the prevailing airflow outside the low-level jet. Thus, the nocturnal low-level jet transports ozone and other air pollutants into the OTR from outside the region and moves locally formed air pollution from one part of the OTR to another.

Other transport mechanisms include land, sea, mountain, and valley breezes that can selectively affect relatively local areas. For example, sea breezes can differ in wind direction, thereby bringing air masses trapped in a thin layer over the cooler water back onto shore. Ozone moving over water is, like ozone aloft, relatively isolated from destructive forces. This air pollution is also protected from vertical mixing and dilution by a relatively shallow mixing layer that occurs when the water is cooler than the air above it. When ozone is transported into coastal regions by bay, lake, and sea breezes arising from afternoon temperature contrasts between the land and water, it can arrive highly concentrated.

Occasionally, transport of air pollution is enhanced by wildfires or other anomalous events. The Fort McMurray fires that burned in Alberta, Canada in 2016 are an extreme example of the impact distant fires can have on ozone concentrations. In May of 2016, the Fort McMurray fires produced ozone precursor pollutants that were carried thousands of kilometers across areas of generally sparse emissions into southern New England and the Mid-Atlantic States to produce ozone concentrations enhanced by as much as 20 to 30 ppb.[17] Springtime agricultural burning in areas along the southeastern seaboard can have a less pronounced, but noticeable, effect on ozone levels in the northeast as do summertime wildfires that burn in the western United States.

2.3 A Connecticut Perspective on the Regional Ozone Problem

Connecticut’s location in relation to upwind emissions sources and ozone-favorable meteorological regimes makes the state particularly vulnerable to levels of transport that at times exceed the 8-hour ozone NAAQS at Connecticut’s upwind border monitors, even before the addition of in-state emissions. A general description of meteorological conditions conducive to ozone exceedances in Connecticut is presented below.

Meteorological Regimes Producing High Ozone in Connecticut

Ozone exceedances in Connecticut were historically classified into four categories based on spatial patterns of measured ozone and the contributing meteorological conditions. Typically, most exceedances occur on sunny summer days with inland maximum surface temperatures approaching or above 90°F, surface winds from the south and west (favorable for transport of pollutants from the Northeast Interstate-95 corridor) and aloft winds from the west-southwest to west-northwest (favorable for transport of pollutants from Midwest power plants). These are categorized as:

- Inland-only Exceedances,
- Coastal-only Exceedances,

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[17] https://portal.ct.gov/DEEP/Air/Planning/Ozone/May-2016-Exceptional-Event-Request

- Western Boundary-only Exceedances,
- Statewide Exceedances.

In more recent years, due to the success of regional control strategies, statewide exceedances rarely occur, and summertime exceedances are most likely to be coastal only.

The nature of the planetary boundary layer (PBL) over Long Island Sound (LIS) is a major factor in the ozone formation and transport process for these coastal only exceedance scenarios. Figure 2-2 illustrates a typical summer day PBL profile due to the cooler water temperature and the formation of the sea breeze over LIS. Figure 2-3 is a general illustration depicting when Connecticut can expect the higher ozone levels due to nearby upwind emission sources and the ozone transport that occurs during sea breeze circulation. As seen in the figures, pollutants over the cooler water are trapped in a shallow layer near the surface where high ozone concentrations develop. The sea breeze circulation then drives this concentrated ozone into the coastal area where a still shallow PBL rises at a sharp gradient as the winds warm and mix moving inland. This scenario is typical of the highest ozone exceedances produced at our coastal sites.

Figure 2-2. *Conceptual Model of Ozone Formation over LIS with Sea Breeze Circulation.*

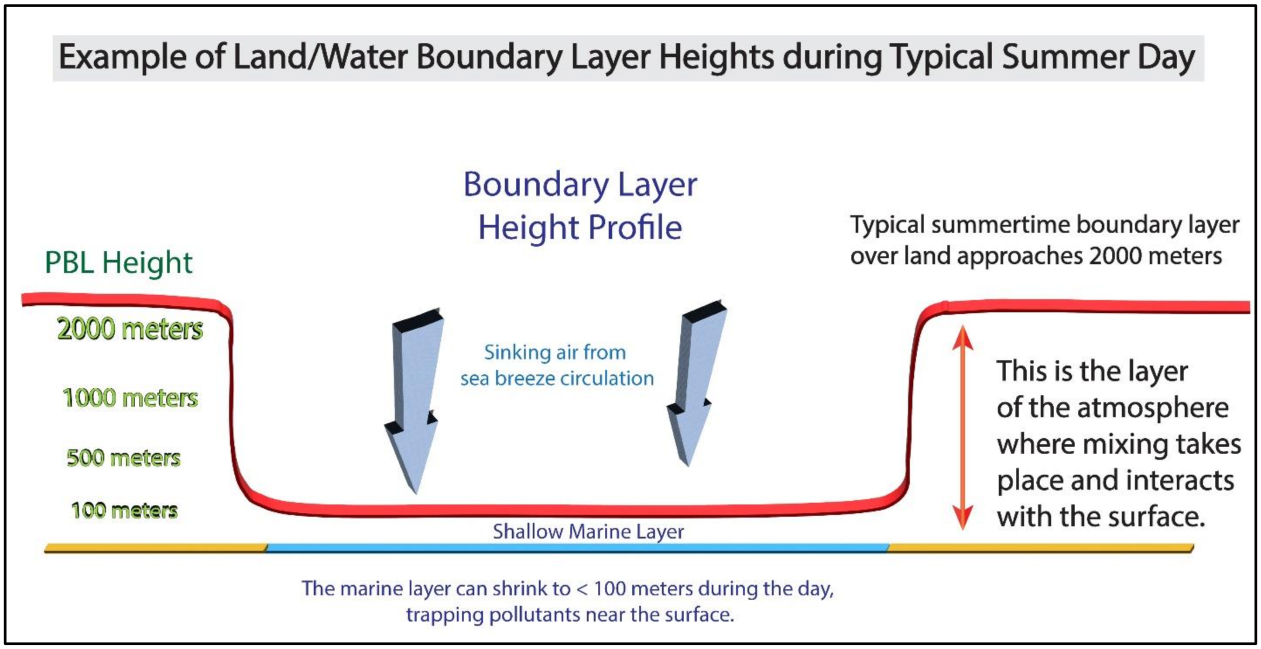
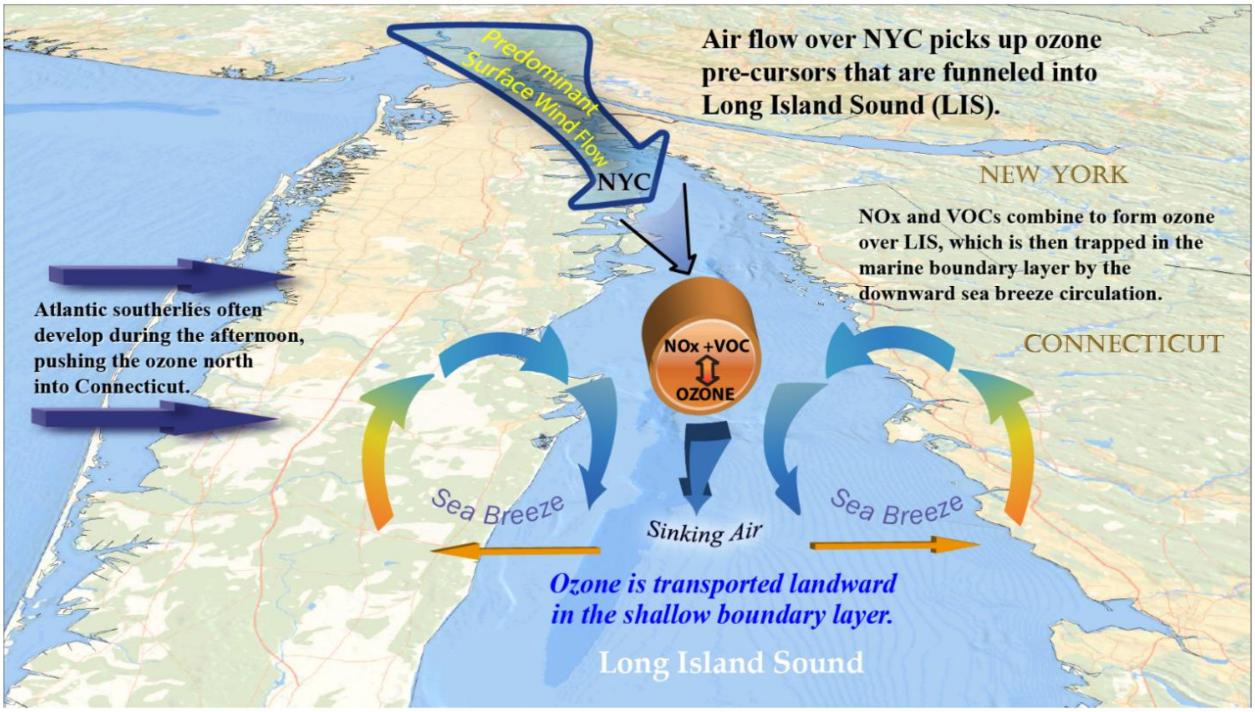


Figure 2-3. *Illustration of Typical Summer Day PBL Profile over LIS.*

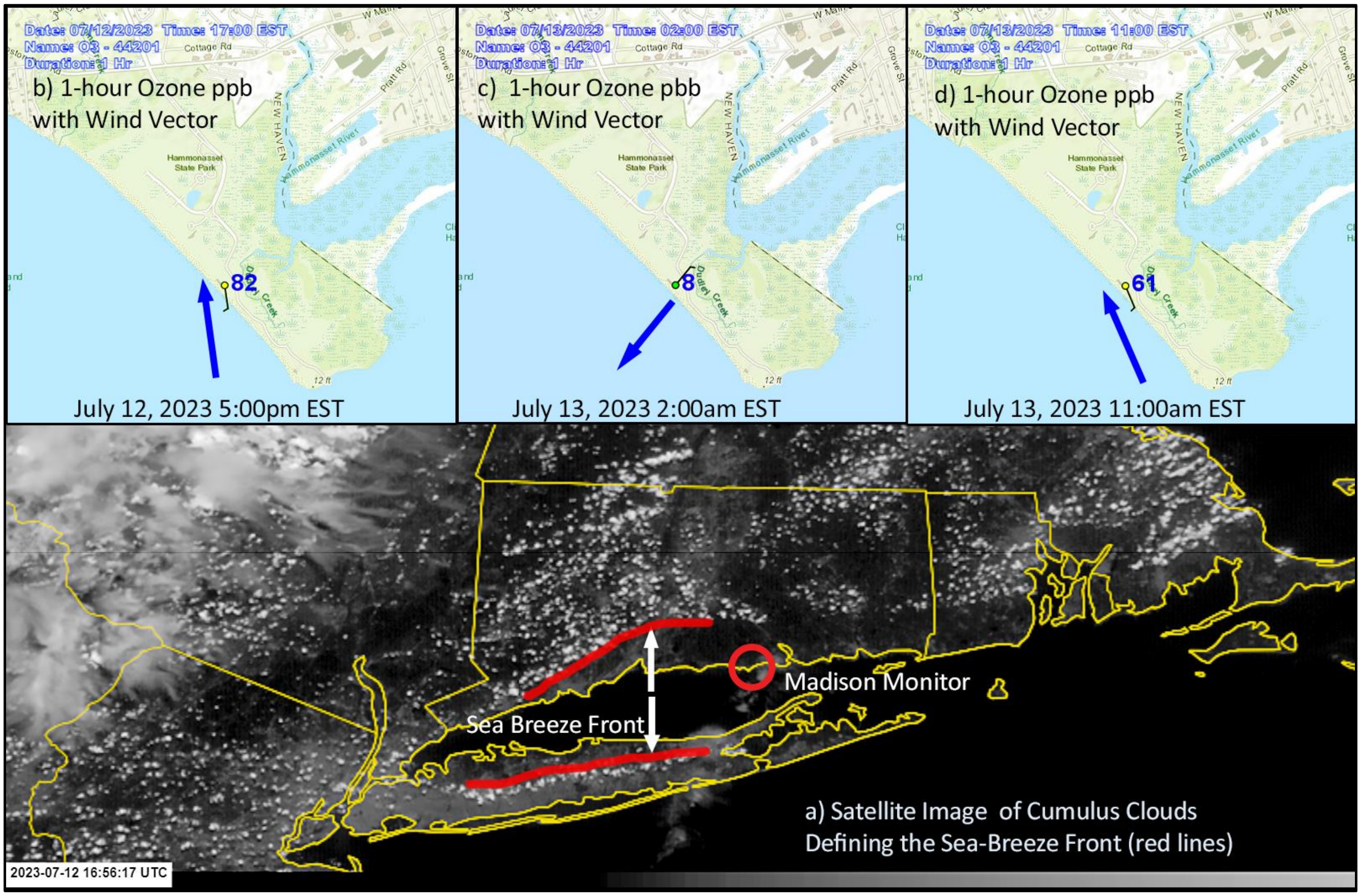


2.4 Wind Roses

Wind roses can be used to show the predominate direction of winds associated with pollutant concentrations. Summer season 2016 wind rose plots for ozone were prepared for three coastal sites, Westport, New Haven and Madison, and three inland sites, East Hartford, Cornwall and Danbury. Additionally, wind roses for NO2 and NOx were prepared for East Hartford and New Haven, respectively. The length of the wind rose petals (colored bars) in each plot indicate the frequency that surface-level winds originate from specific directions and the color bands within each petal indicate the frequency of measured pollutant concentrations occurring within a range for that direction. In addition to these pollutant wind roses, bar charts were produced that normalized the pollutant contributions from each of the wind rose sectors. This was done to illustrate pollutant levels in those sectors where the wind direction was much less frequent.

Wind direction patterns are generally similar for the three coastal sites, except that there is a greater frequency of southwest winds at Westport. The East Hartford site shows predominant wind directions from the south and north because of the channeling effect of the Connecticut River Valley during the summer while the coastal sites show a higher frequency of summer season southwest winds, because of the sea breeze that typically occurs. A northeast wind ‘reflection’ is also seen at the coastal sites, which is likely the result of the overnight land-breeze effect. Figure 2-4 illustrates this effect from our Madison coastal monitor. Figure 2-4(a) is the satellite image that shows the edge of the cumulus clouds that define the LIS sea breeze on many summer days. Figures 2-4 (b-d) shows how the southerly winds shift to the northeast overnight and back to the south the following day, as the ozone levels drop overnight.

Figure 2-4. *(a) Depicting the sea-breeze front by the edge of cumulus clouds on either side of LIS. (b) Late afternoon wind vector and ozone level at Madison on July 12, 2023. (c) Early morning wind vector and ozone at Madison showing the wind shift to the land-breeze. (d) Later morning next day wind vector and ozone at Madison showing wind shift back to sea-breeze.*



The strong wind channeling effect at East Hartford is due to the orientation of the Connecticut river valley (Figure 2-5). Although the bulk of the higher ozone occurs from the south and south-southwest wind directions the normalized chart (Figure 2-6) does show that some higher ozone occurs in the west quadrant due to the Fort McMurray fires.

The Cornwall site is located in far northwestern Connecticut at an altitude of about 1600 feet. This site is subject to long range transport of pollutants from outside of Connecticut and the wind patterns deviate significantly from the other sites due to the elevation. There is more of a westerly wind component with the greatest sector frequency from the north-northwest (Figure 2-7). Although much of the higher ozone levels (USG+) are from the south and south/southwest, there is a significant frequency of higher ozone spanning the westerly directions (Figure 2-8).

This may indicate the hours when ozone from the Fort McMurray wildfires was advected into Connecticut from the west and northwest during May 2016.

The Danbury site has the most evenly distributed wind directions, with frequency peaks at west-northwest and east-northeast (Figure 2-9). The highest ozone levels occur when the wind is from the south, although there were some high ozone levels in the westerly direction (Figure 2-10) due to transport from the Fort McMurray fire.

The Westport ozone wind rose shows a predominant wind direction from the south/southwest (Figure 2-11). Elevated ozone occurs nearly 15 percent of the time from that direction. Directions spanning the east to the west/southeast do contain elevated ozone, but much less frequently (Figure 2-12). The northeast land breeze ‘reflection’ is much less and contains mostly good air quality.

The New Haven ozone wind rose shows a predominant south and south/southwest wind direction with the highest frequency of elevated ozone (Figure 2-13). The north/northeast land breeze ‘reflection’ is also evident, but the normalized chart shows no elevated ozone from that sector (Figure 2-14). The only sectors showing elevated ozone range from the west/southwest to southeast sectors, suggesting most, if not all ozone contribution from off the Connecticut coast.

Wind rose plots of NOx concentrations at New Haven show the influence of local NOx emissions, with the highest concentrations occurring when the winds are from the southwest, carrying emissions from the direction of Long Island Sound, possibly from tankers in the harbor, and then crossing Interstate 95 to the monitor. High NOx levels also occur from the north/northeast direction due to other local sources and possibly the Interstate-91 traffic. Plots for the East Hartford NO2 monitor (located further from high traffic areas than the other sites) show a less variable NO2 concentration distribution (Figure 2-5).

The coastal Madison ozone wind rose shows a strong southwesterly wind frequency with a northeasterly ‘reflection’ (Figure 2-15). Nearly all the ozone occurs from the southwest quadrant, however a noticeable amount of high ozone occurs when the wind is from the west (Figure 2-16).

In general, high ozone levels predominately occur when surface winds at the coastal sites are from the south and southwesterly directions. There are virtually no elevated ozone levels observed at any of the sites during periods when wind directions have a northerly component, even though high NOx/NO2 concentrations can occur when winds are from a more northerly direction. This demonstrates the important role that meteorology plays in producing high ozone events in Connecticut from sources further upwind to the south and southwest.

Figure 2-5. *Ozone and NO2 Wind Roses for East Hartford, CT in 2016.*

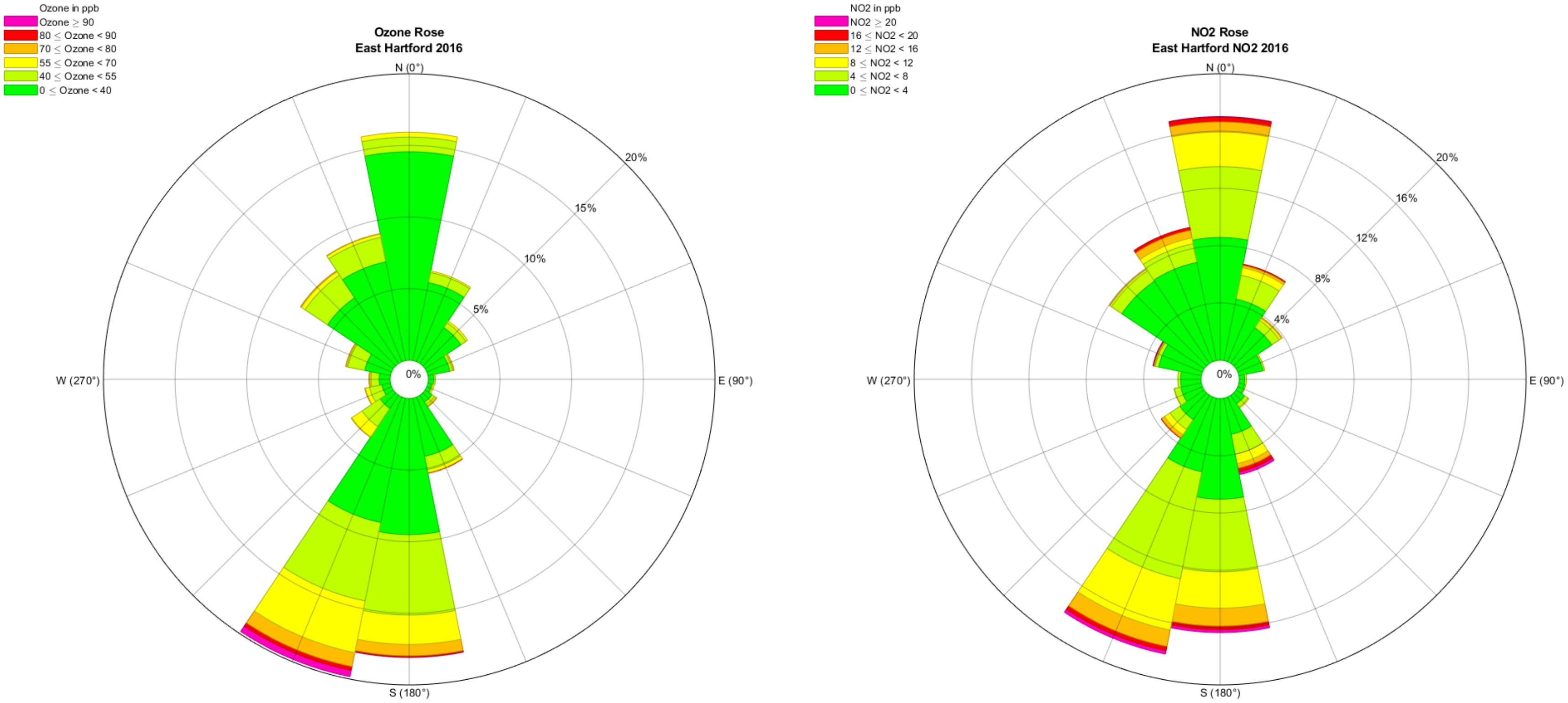


Figure 2-6. *Normalized Ozone Wind Chart for East Hartford, CT 2016.*

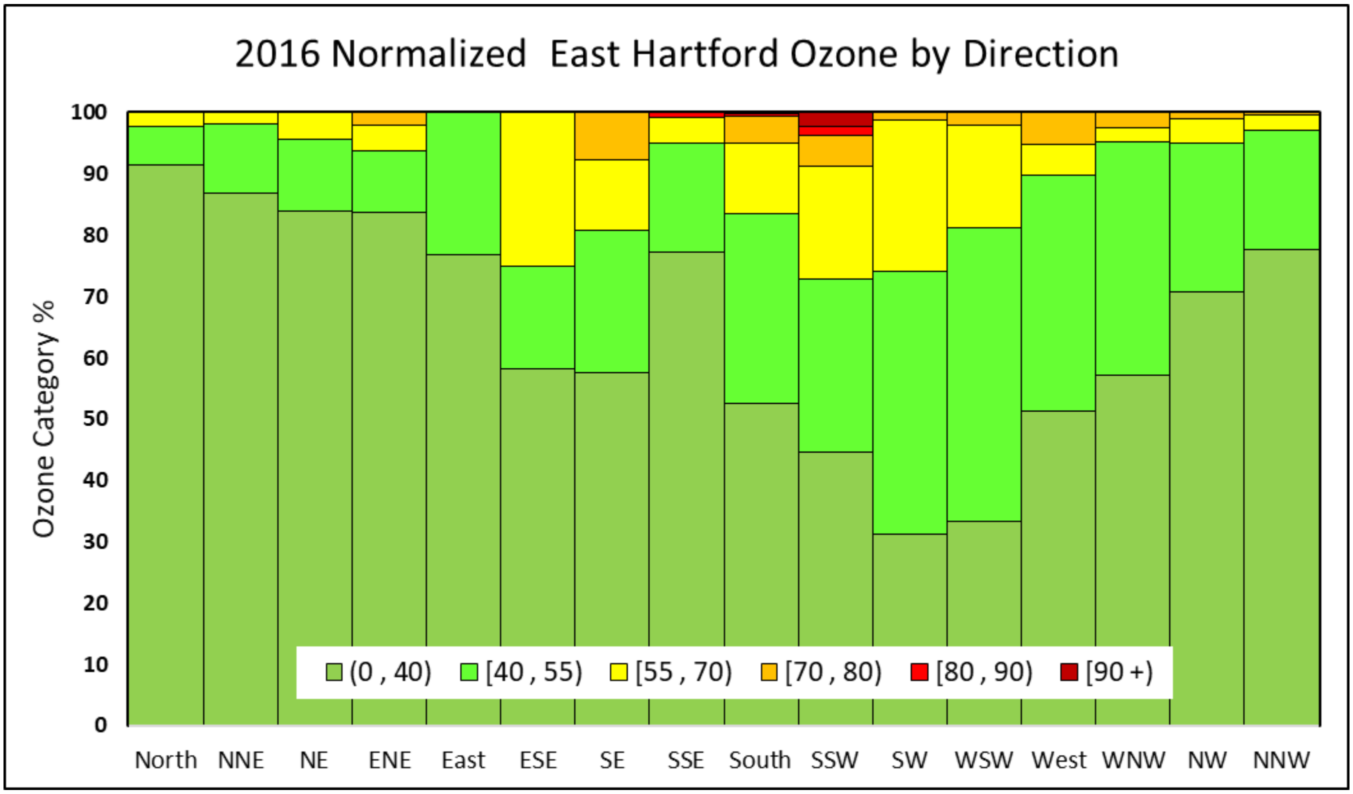


Figure 2-7. *Ozone Wind Rose for Cornwall, CT in 2016.*

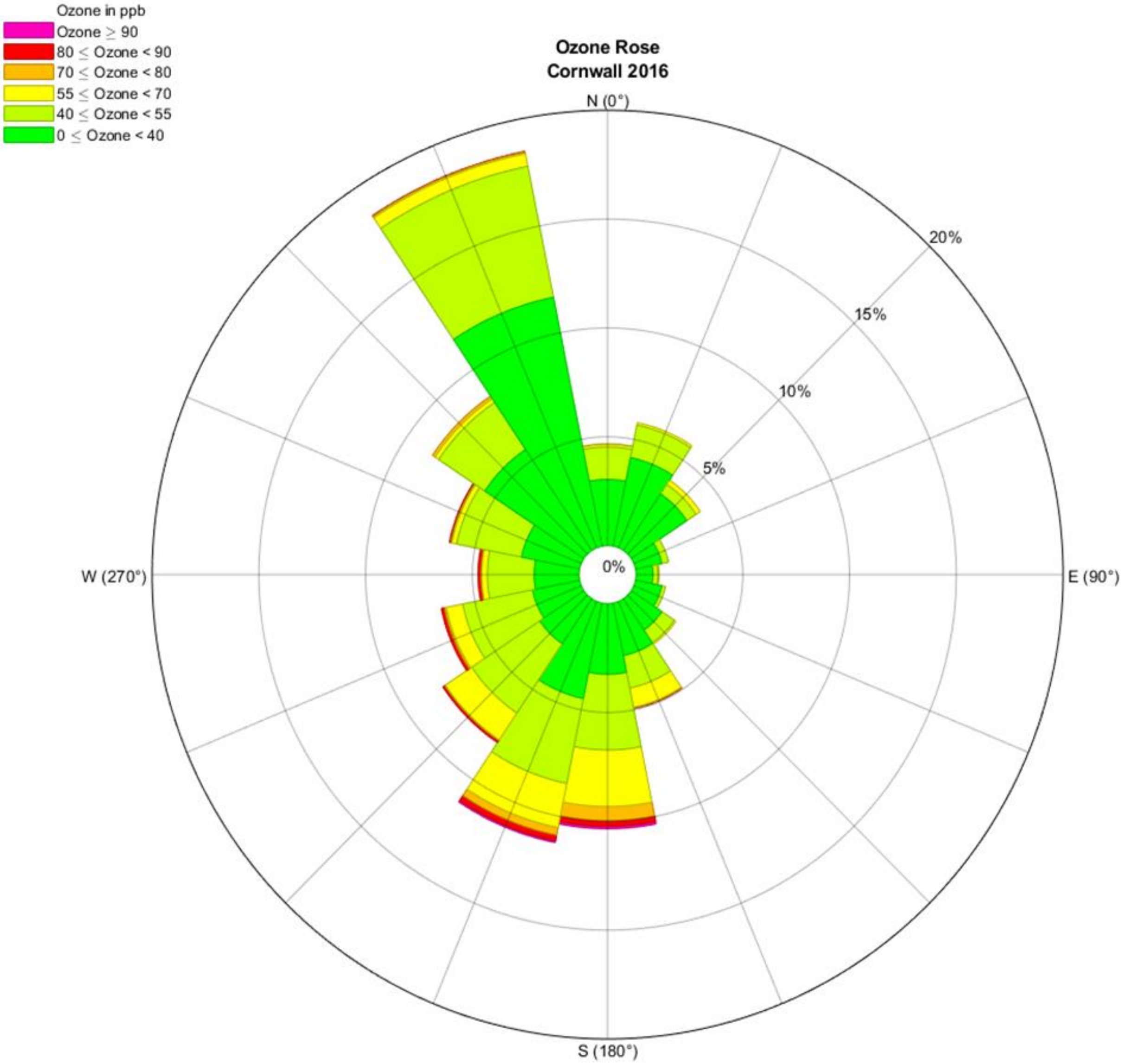


Figure 2-8. *Normalized Ozone Wind Chart for Cornwall, CT 2016.*

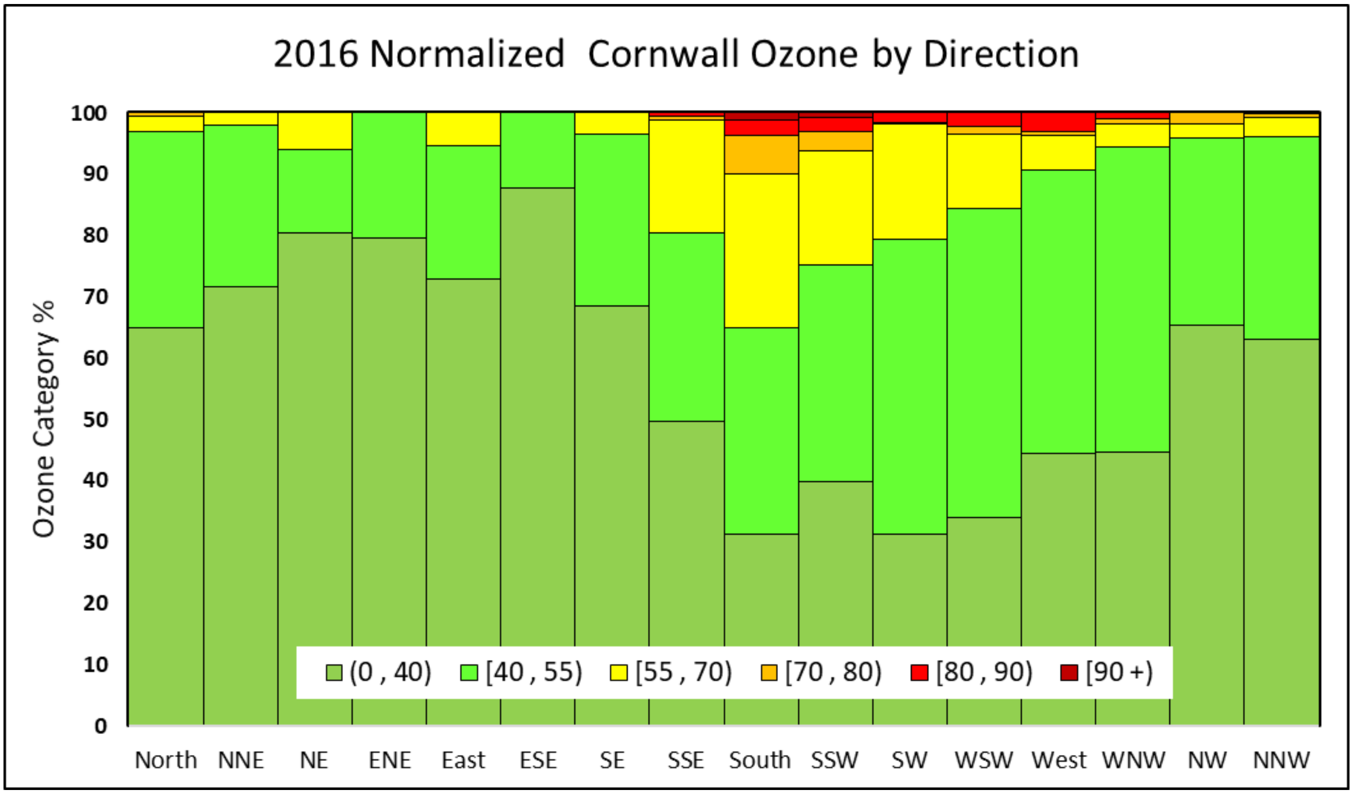


Figure 2-9. *Ozone Wind Rose for Danbury, CT in 2016.*

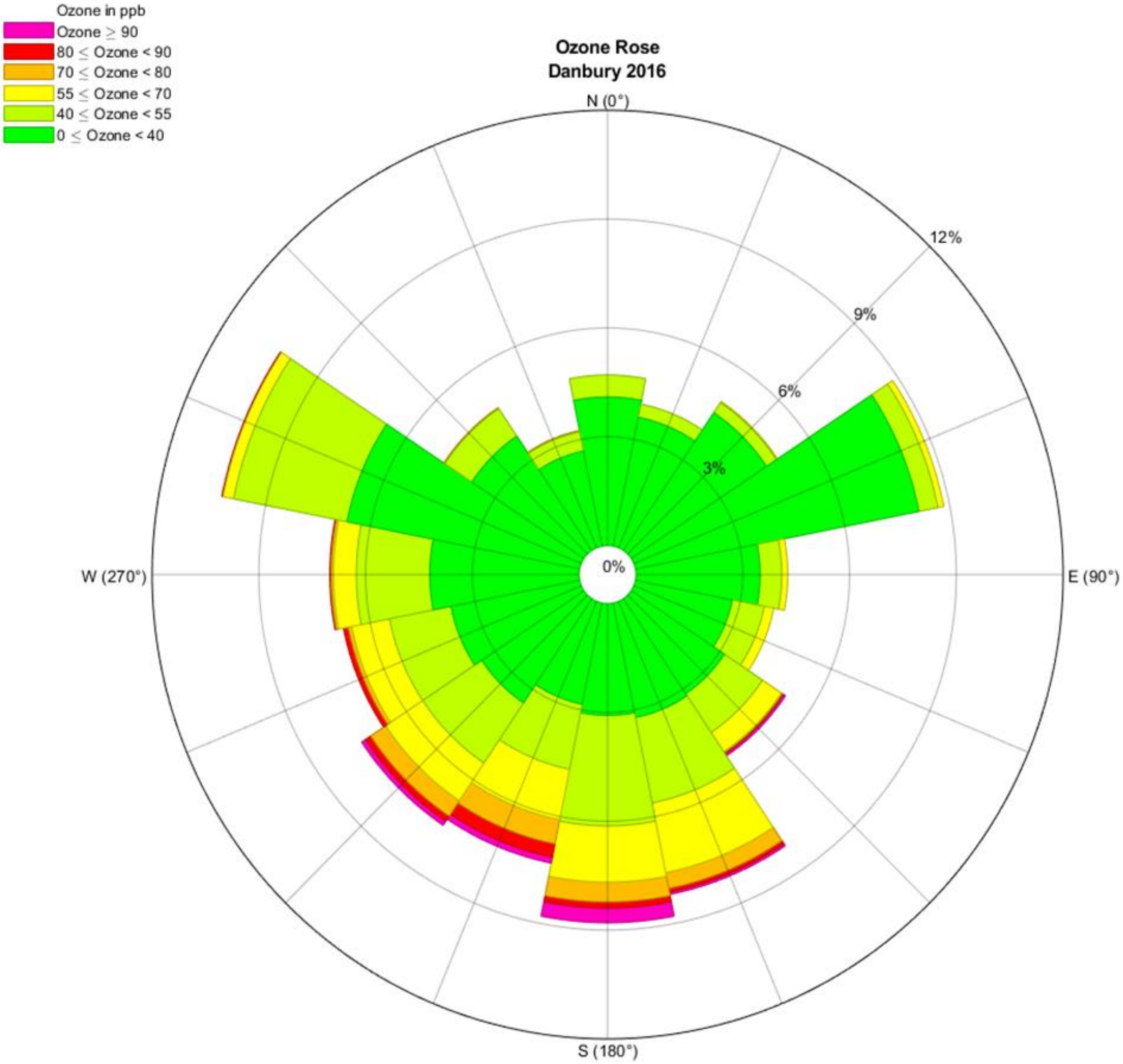


Figure 2-10. *Normalized Ozone Wind Chart for Danbury, CT 2016.*

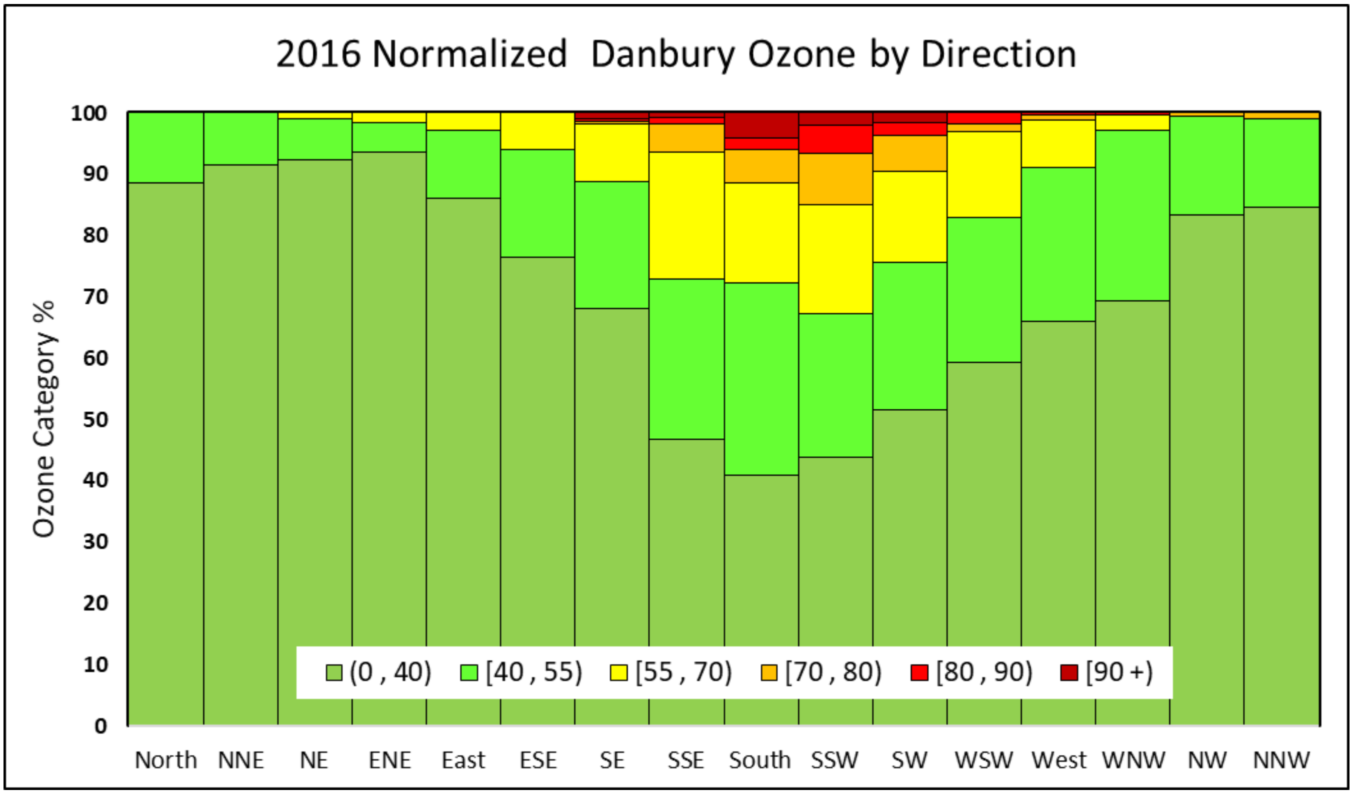


Figure 2-11. *Ozone Wind Rose for Westport, CT in 2016.*

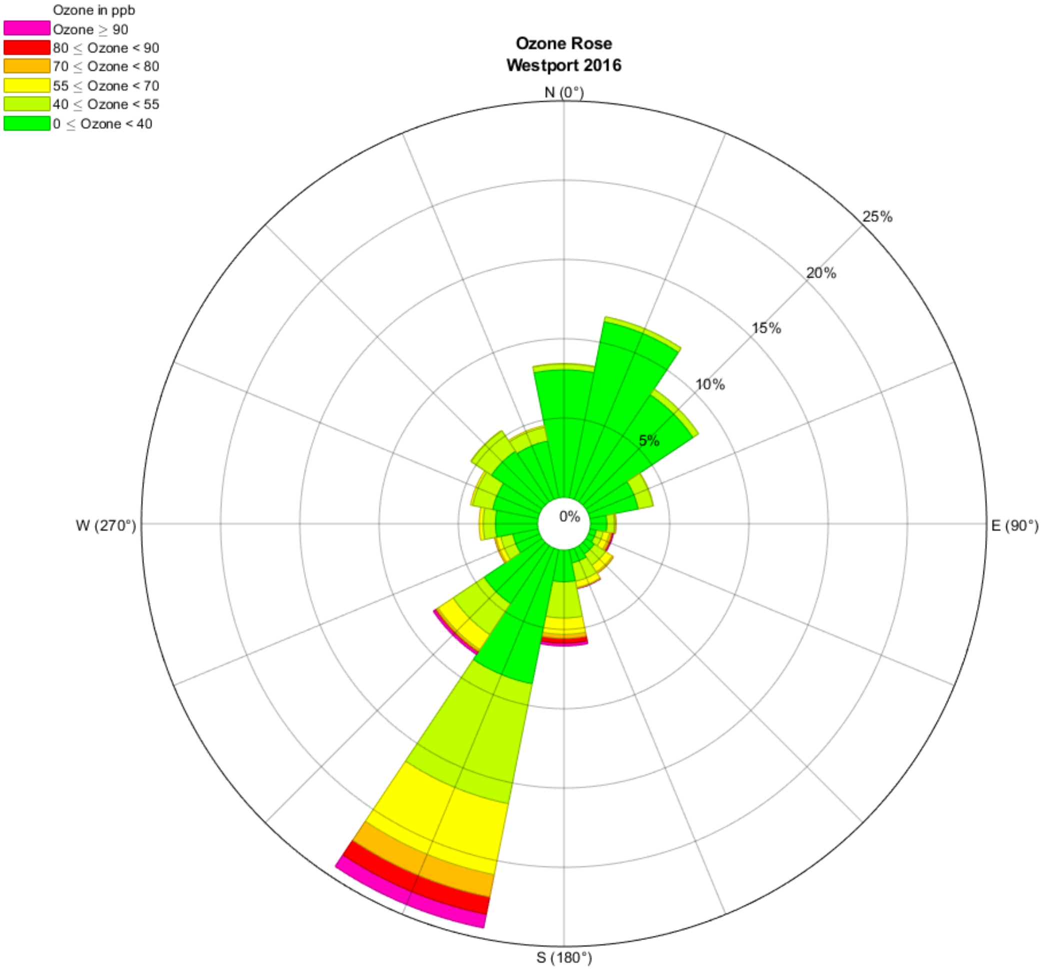


Figure 2-12. *Normalized Ozone Wind Chart for Westport, CT 2016.*

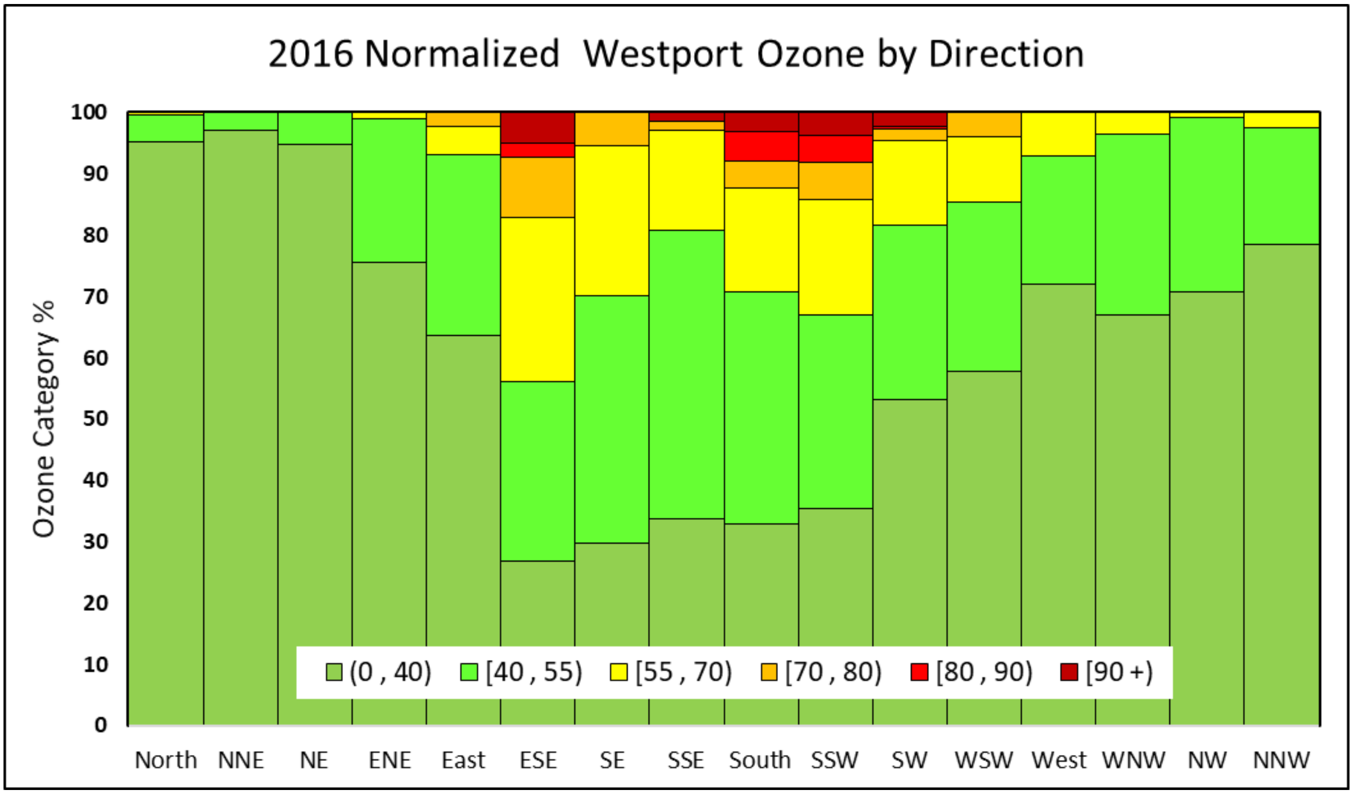


Figure 2-13. *Ozone and NO2 Wind Rose for New Haven, CT in 2016.*

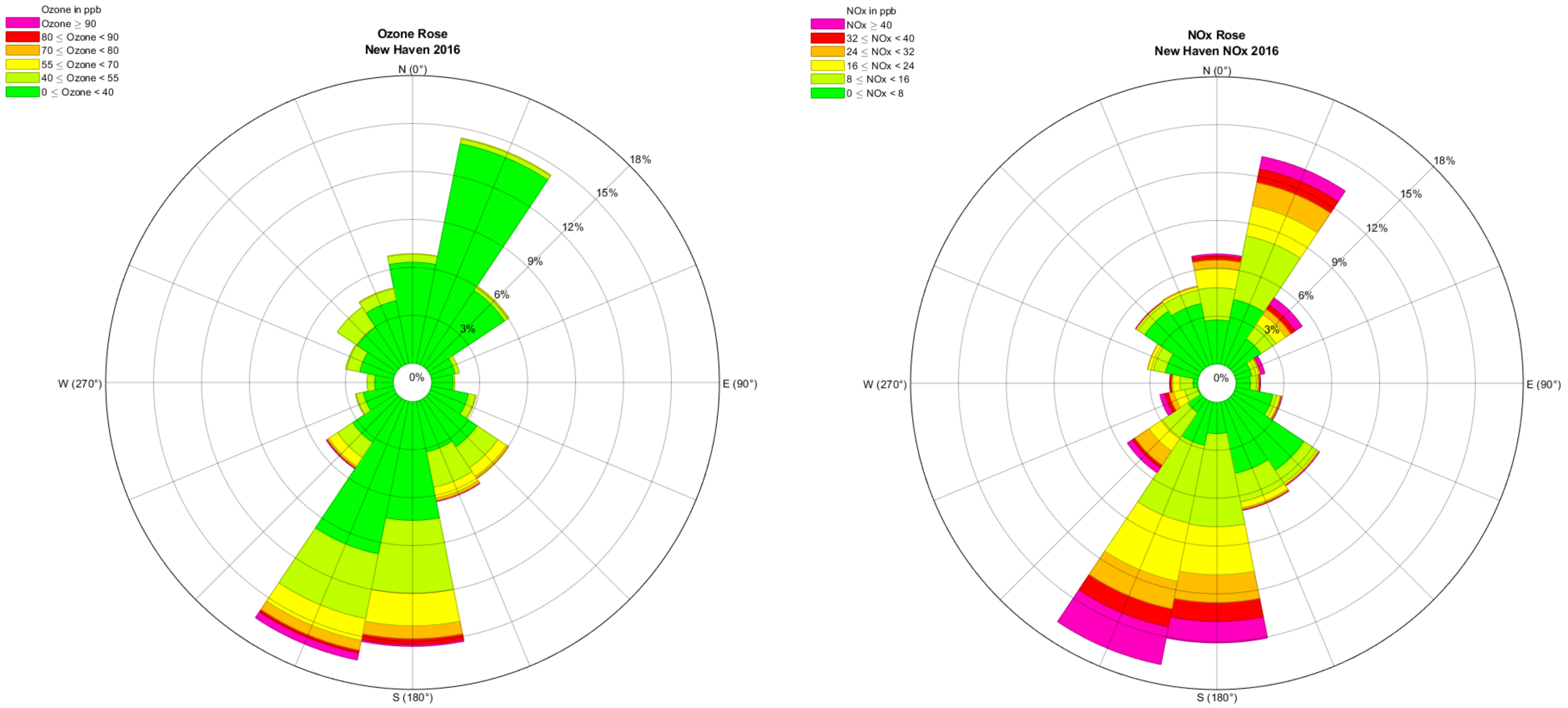


Figure 2-14. *Normalized Ozone Wind Chart for New Haven, CT 2016.*

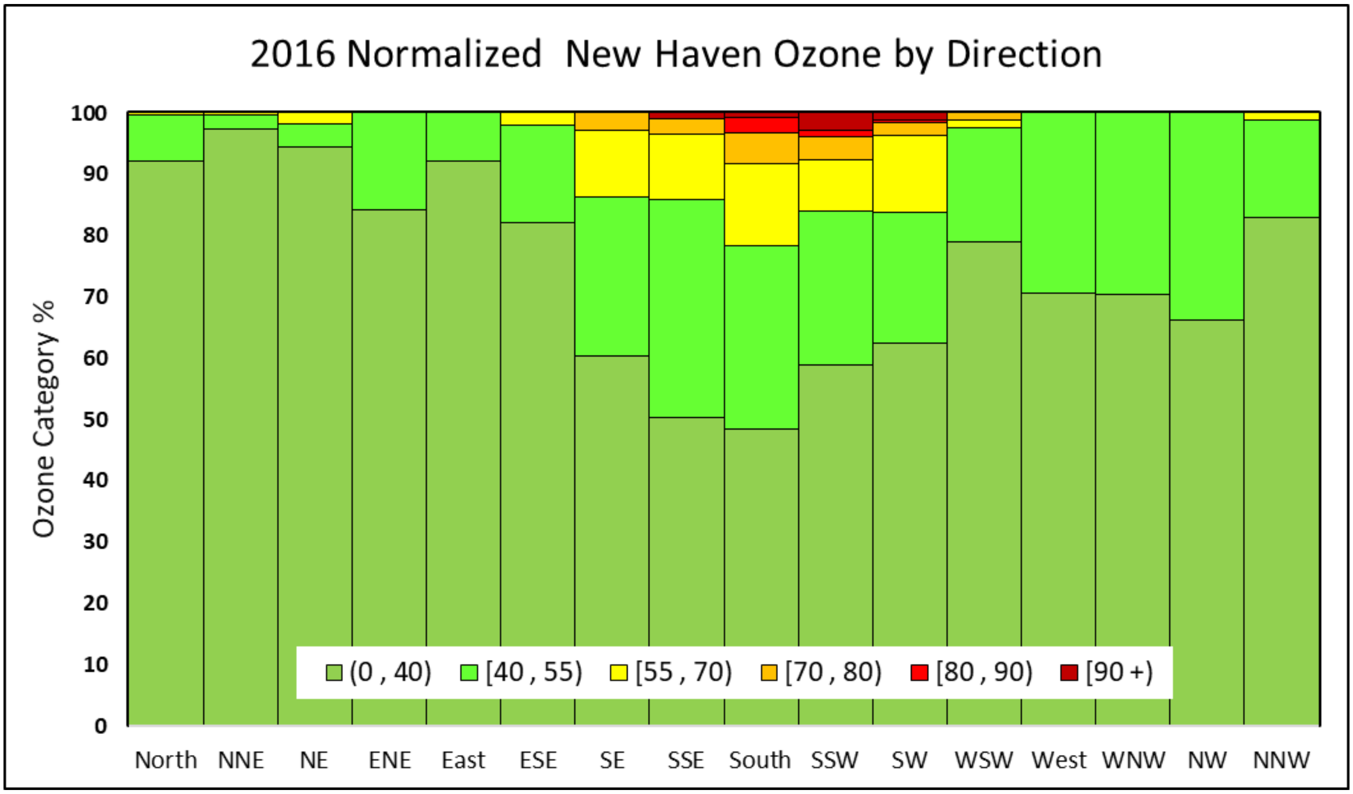


Figure 2-15. *Ozone Wind Rose for Madison, CT in 2016*

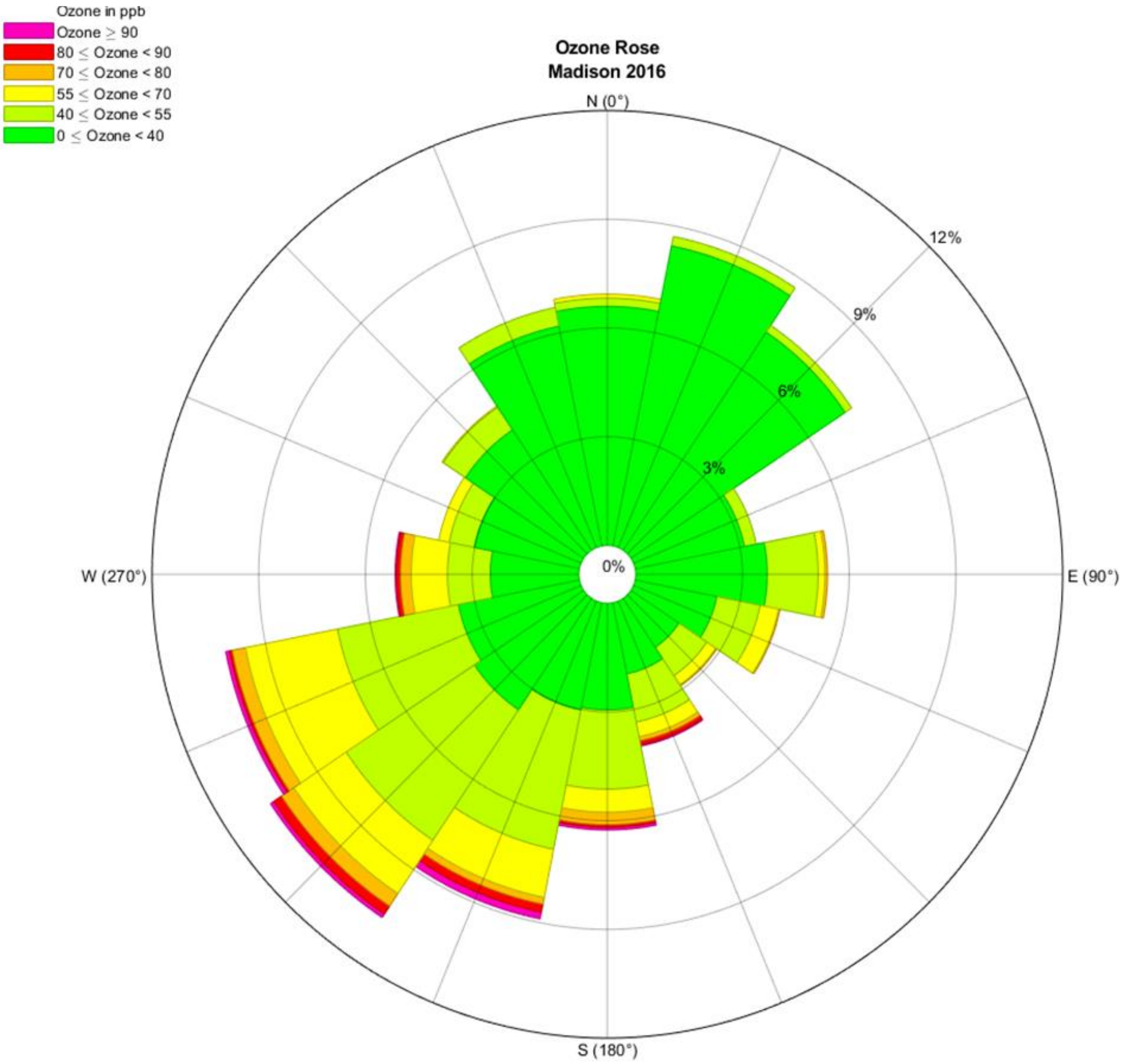
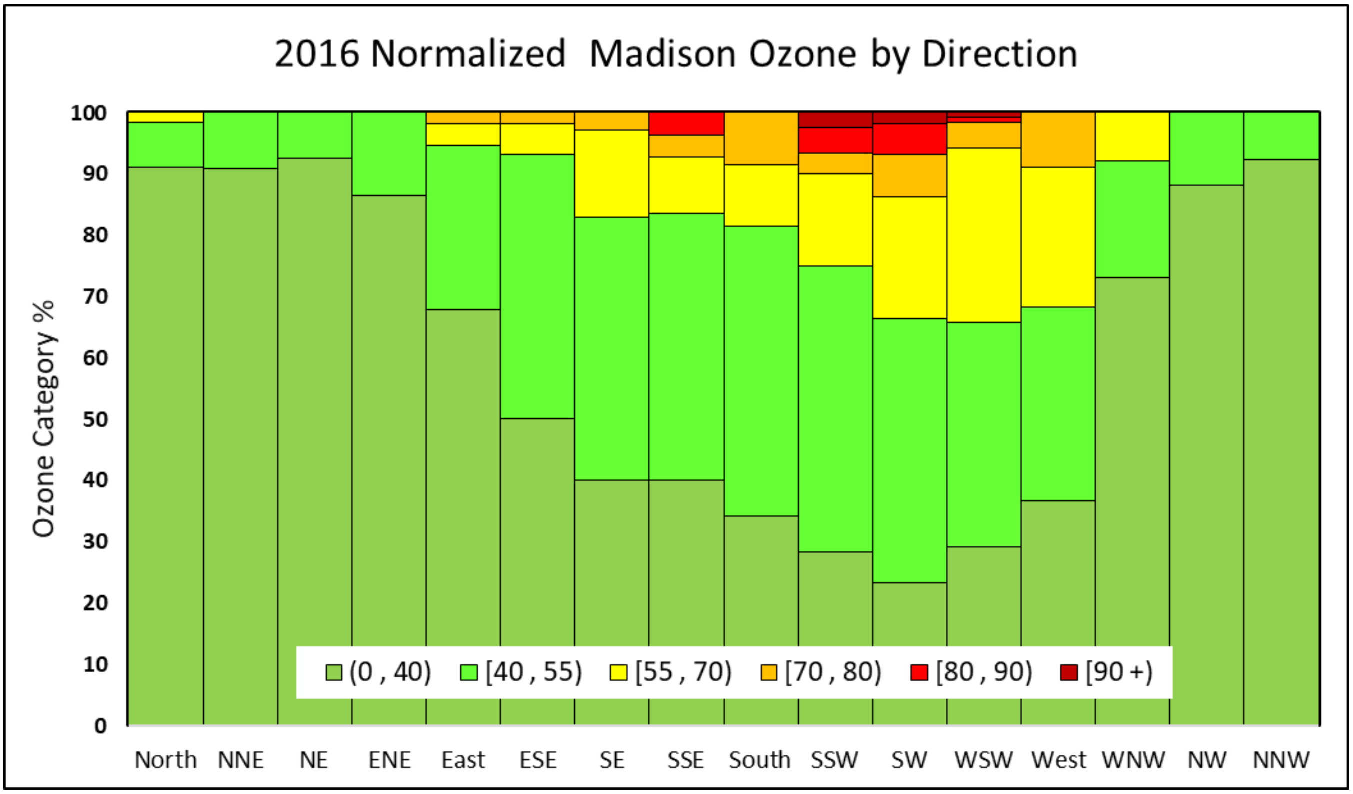


Figure 2-16. *Normalized Ozone Wind Chart for Madison, CT 2016.*



2.5 Ozone Chemistry

In addition to understanding the role that meteorological regimes and source emissions play in producing high ozone events, it is also important to consider the relative balance of ozone precursors in the air shed. An air shed may be more limited in its ozone forming potential by either NOx or VOC. Chemical reactions are not one directional, there is an ebb and flow of production and destruction reactions depending on the availability of the various species involved. In other words, control strategies implemented with a focus on a particular pollutant can have a more beneficial effect if ozone reactions in that air shed tend to be limited by that pollutant.

On-going studies conducted by the Lamont-Doherty Earth Observatory at Columbia University make use of NASA data from air column NO2 and formaldehyde (HCHO as a surrogate for VOC) as measured by ozone monitoring instruments (OMI) on satellites and correlated to ozone episodes in the Northeast. Figure 2-17 shows maps of HCHO, NO2 and the resultant HCHO/NO2 ratios for 19 non-exceedance days versus 19 exceedance days in 2018 over NYC (as in Tao et al. 2022)[18]. The transitional regime is based on values reported in Jin et al. (2020) calculated by linking satellite columns directly with maximum surface ozone exceedance probability, which falls between the NOx-saturated regime (HCHO/NO2 < 2.9) and the NOx-limited regime (HCHO/NO2 > 3.8)[19]. The NOx saturated region (<2.9) persists over NYC, but is slightly less on exceedance days. It has been suggested that since exceedance days generally occur on hotter days, that the increased HCHO concentrations from biogenic sources are responsible for increasing the HCHO/NO2 ratio.

Tao et al.[4] produced updated time series of monthly average HCHO/NO2 for gridded areas averaged over New York City on cloud-free days (QA>0.75) for all months (Figure 2-18) and only during the summer months of June, July and August (Figure 2-19). In both charts, the HCHO/NO2 trends are increasing, especially for the summer months, where the transition to a NOx limited regime may occur in several years over the NYC area.

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[18] https://pubs.acs.org/doi/10.1021/acs.est.2c02972 : Investigating Changes in Ozone Formation Chemistry during Summertime Pollution Events over the Northeastern United States.

[19] Jin, X.; Fiore, A.; Boersma, K. F.; De Smedt, I.; Valin, L. Inferring Changes in Summertime Surface Ozone-NOx-VOC Chemistry Over U.S. Urban Areas from Two Decades of Satellite and Ground-Based Observations. Environ. Sci. Technol. 2020, 54, 6518– 6529, DOI: 10.1021/acs.est.9b07785

Figure 2-17. *Increasing HCHO, NO2, and HCHO/NO2 on Exceedance Days (right) as Compared to Non-exceedance Days (left) in the NYC Metropolitan Region.*

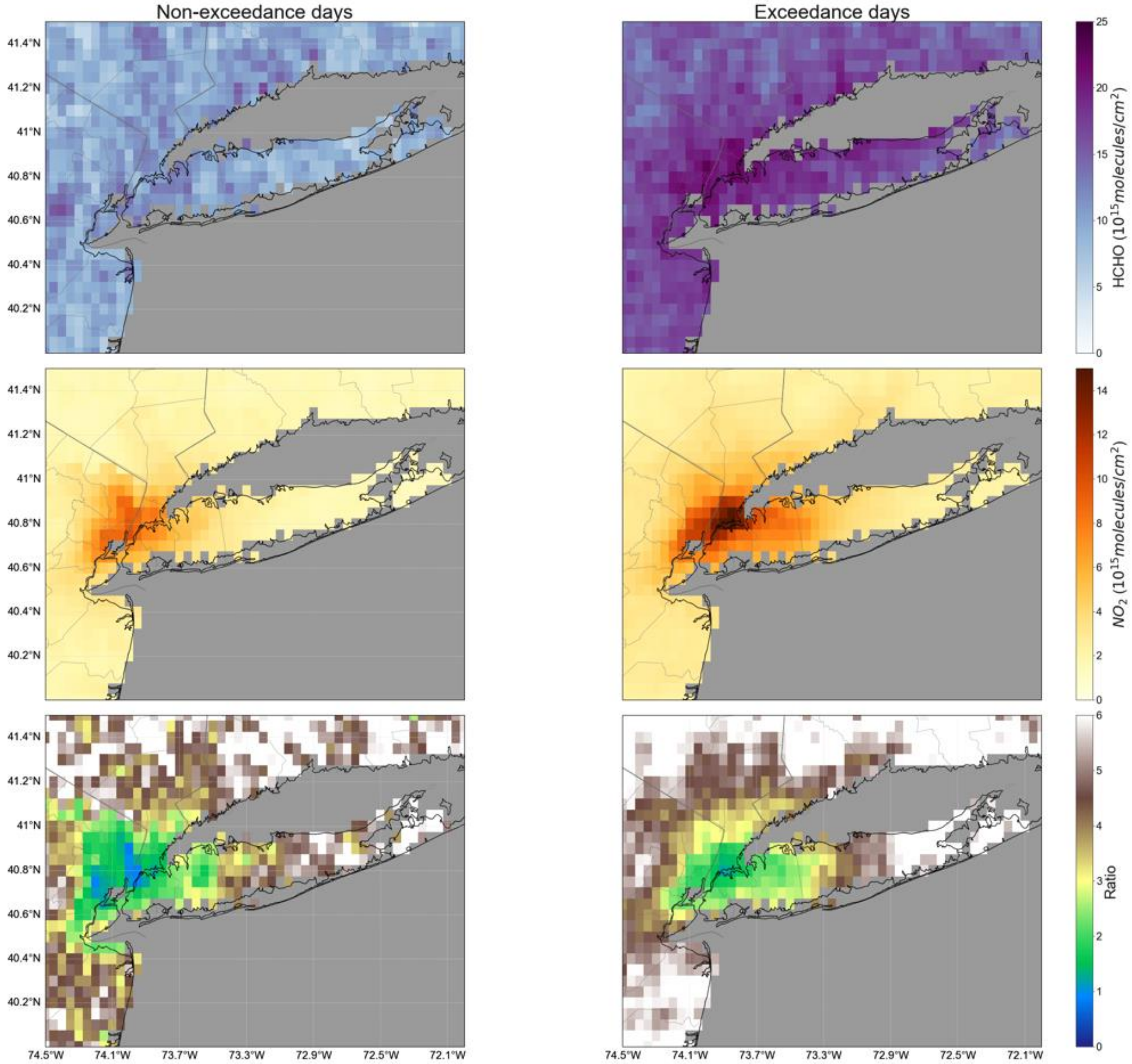


Figure 2-18. *HCHO/NO2 Monthly Trends over NYC from 2004 to 2022.*

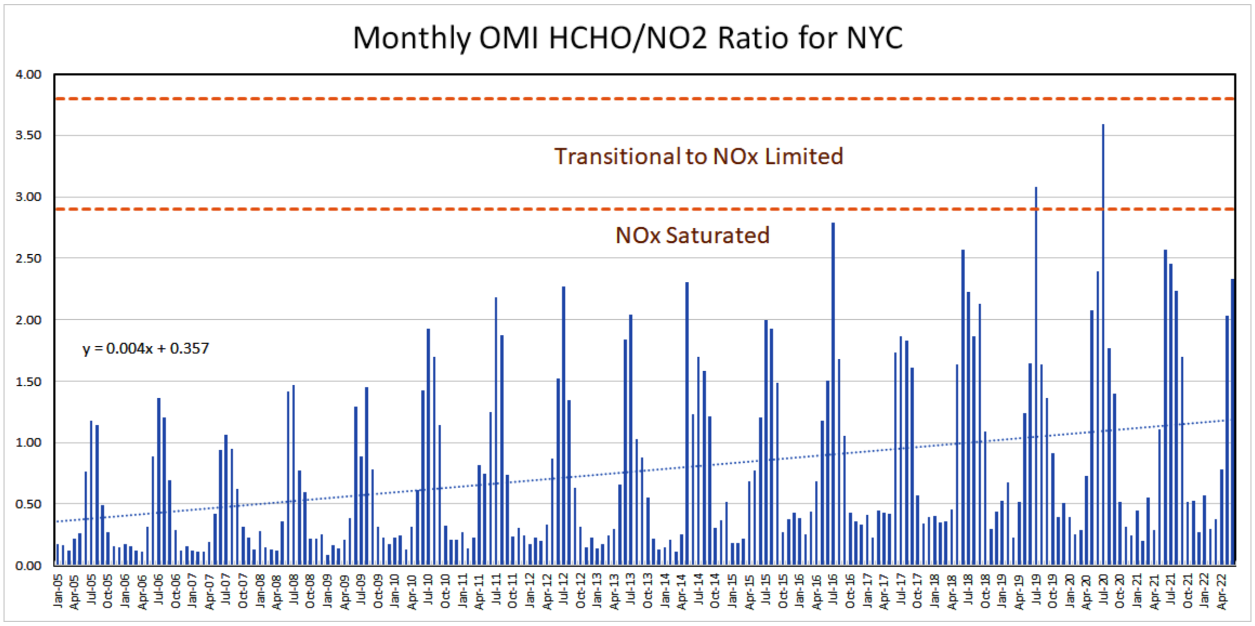
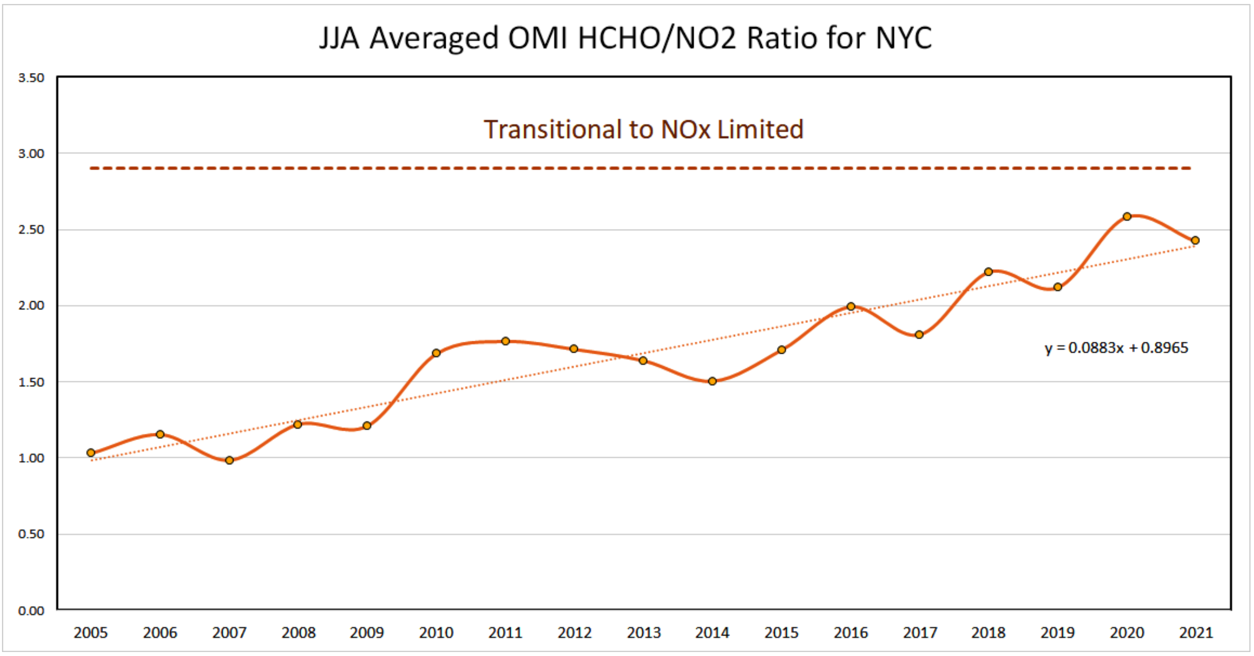


Figure 2-19. *HCHO/NO2 Trends for the Summer Months of June, July and August (JJA) 2005-2021.*



Pandora Trends

To further investigate ozone chemistry in Connecticut and in the land/water interface near Long Island Sound, EPA and DEEP installed and operated Pandora Monitors at several sites. The New Haven and Madison monitors are capable of measuring nitrogen dioxide and formaldehyde in the air column above the site. In this case, a more simplified approach to the ratio of formaldehyde to nitrogen oxides is used. This approach, used in previous SIP submittals, does not rely on city specific data. In this approach, if the ratio of HCHO to NO2 is less than one, it is a VOC limited regime. If the ratio is between one and two it is a transition regime. If the ratio is greater than two, it is a NOx limited regime.[20]

Data from the Madison site was selected as best representing conditions in southwest Connecticut.[21] Based on the data in Figure 2-20, Madison is in a primarily VOC limited regime during the late fall, winter, and early spring, which is the time of year when ozone levels are typically the lowest. When ozone values typically begin to increase in the early spring and when ozone values begin to subside in the late fall, Madison is in a transitional regime. During the summer, represented by the gray shaded area, when ozone levels are the highest, Madison is NOx limited with many transitional ratios as well.

For days with ozone values above 60 ppb, HCHO to NO2 ratios are mostly near or above 1.5 indicating high ozone values tend to be NOx limited at Madison. Control strategies implemented with a focus on a particular pollutant can have a more beneficial effect if ozone reactions in that air shed tend to be limited by that pollutant.[22] Therefore, the Pandora data confirms it remains appropriate to favor NOx control strategies in Connecticut.

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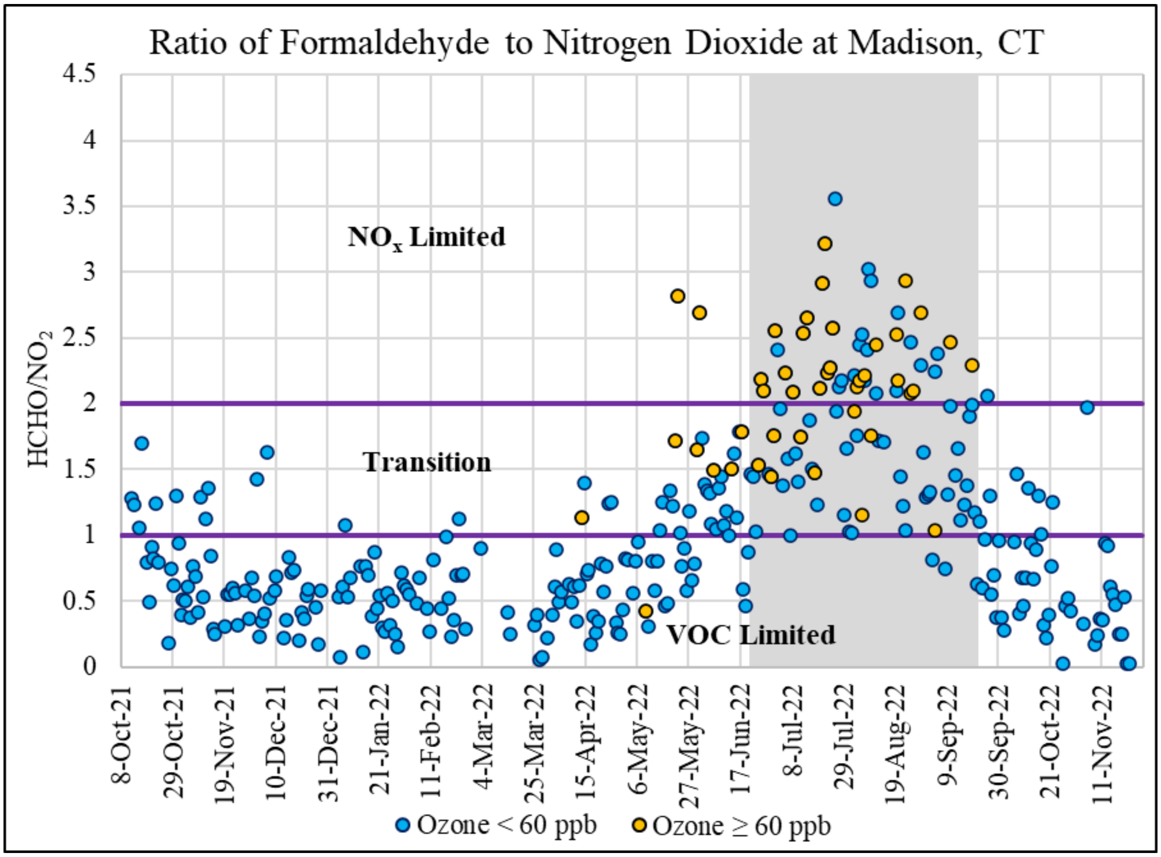
[20] Jin, X., Fiore, A., & Geigert, M. "Using satellite observed formaldehyde (HCHO) and nitrogen dioxide (NO2) as an indicator of ozone sensitivity in a SIP." HAQAST, 12 June 2018.

21 http://data.pandonia-global-network.org/ Note that at the time of data retrieval the formaldehyde data was preliminary and the NO2 data was official.

22 Jin, X., Fiore, A. M., Murray, L. T., Valin, L. C., Lamsal, L. N., Duncan, B., Folkert Boersma, K., De Smedt, I., Abad, G. G., Chance, K., & Tonnesen, G. S. 'Evaluating a Space-Based Indicator of Surface Ozone-NOx-VOC Sensitivity Over Midlatitude Source Regions and Application to Decadal Trends." *Journal of Geophysical Research: Atmospheres*, 122(19), 10, 439–410, 461. 10 September 2017.

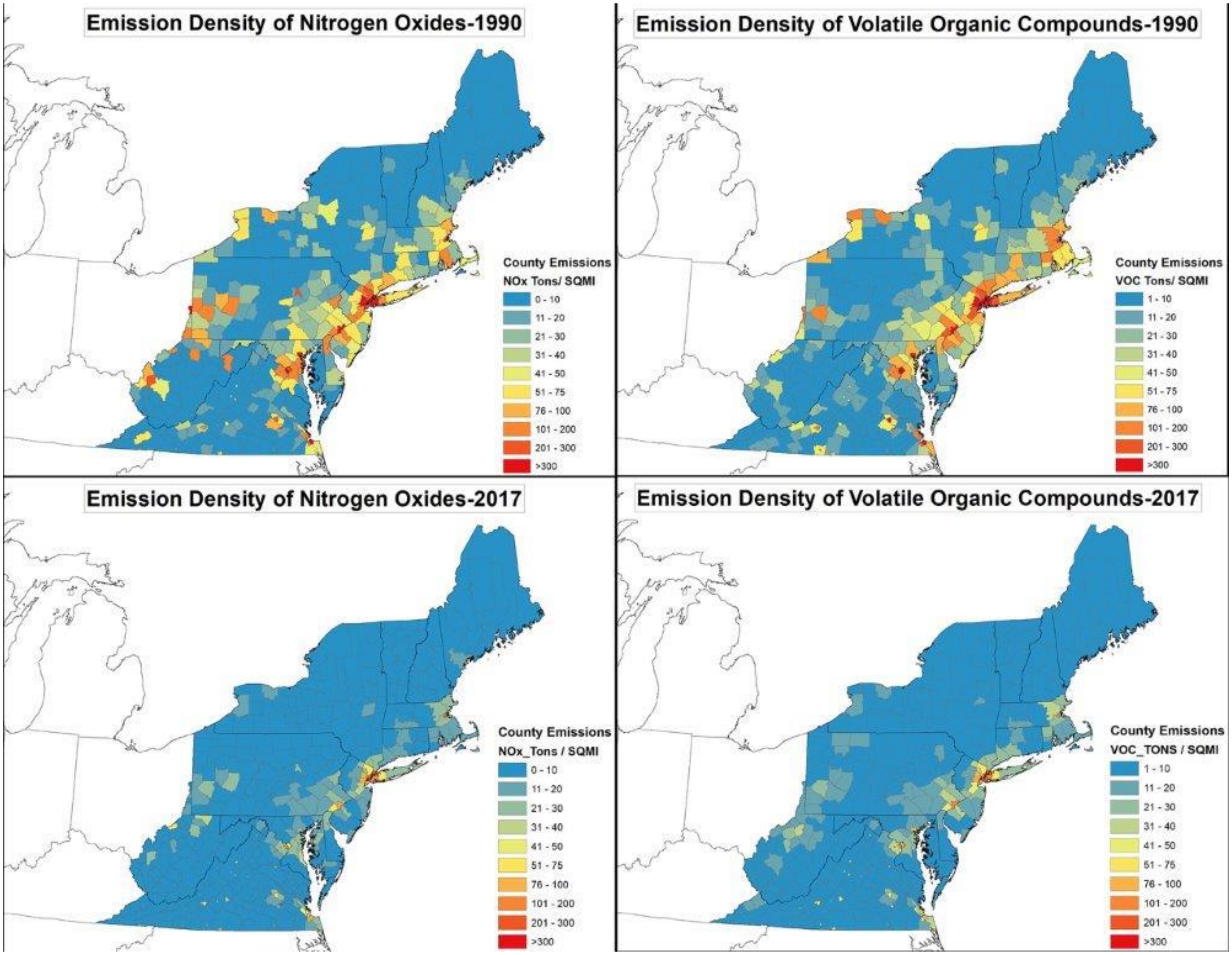
Figure 2-20. *Ratio of Formaldehyde to Nitrogen Dioxide at Madison, CT using Pandora Data for the Calculations.*



2.6 Regional and Local Ozone Precursor Emissions

Regional strategies targeting control of ozone precursor emissions have helped to lessen the severity and extent of ozone episodes. Figure 2-21 displays county-level anthropogenic NOx and VOC emission density maps (tons/square mile) in the Northeast for 1990 and 2017. The reductions in emission density is comparable to the reduction in extent and magnitude of ozone concentrations seen in **Error! Reference source not found.** for ozone concentrations. Whereas in 1990 there were multiple counties in the area with high concentrations of emissions, by 2017 few high-emissions density counties remain.

Figure 2-21. *NEI County level anthropogenic NOx Emission Density (left) and VOC Emission Density (right) as changed from 1990 (top) to 2017 (bottom).*



Emissions within the nonattainment areas taken from the 2017 NEI are described below.

Table 2-1. *Annual anthropogenic NOx and VOC emissions from each State portion of the two nonattainment areas which include Connecticut. Data taken from the 2017 NEI.*

	NOx (tons per year)	VOC (tons per year)
Greater Connecticut	21,501	28,518
CT portion of NY-NJ-CT	24,816	29,827
NJ portion of NY-NJ-CT	55,376	126,278
NY portion of NY-NJ-CT	114,495	123,030
TOTAL	216,188	301,653

On-road vehicles make up a large proportion of total NOx and total VOC emissions, with the highest density of emissions occurring in urban areas.

On December 20, 2022, the EPA adopted a final rule, “Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards,” that sets stronger emissions standards to further reduce air pollution, including pollutants that create ozone and particulate matter, from heavy-duty vehicles and engines starting in model year 2027.[23] This rule will further reduce the ozone forming precursors but will not become effective for several more years. Figure 2-22 is a depiction of the 2017 National Emissions Inventory (NEI) modeled non-point NOx regridded to a 1km grid. This clearly shows the NOx emissions from the area and mobile on-road NOx sources around New York City.

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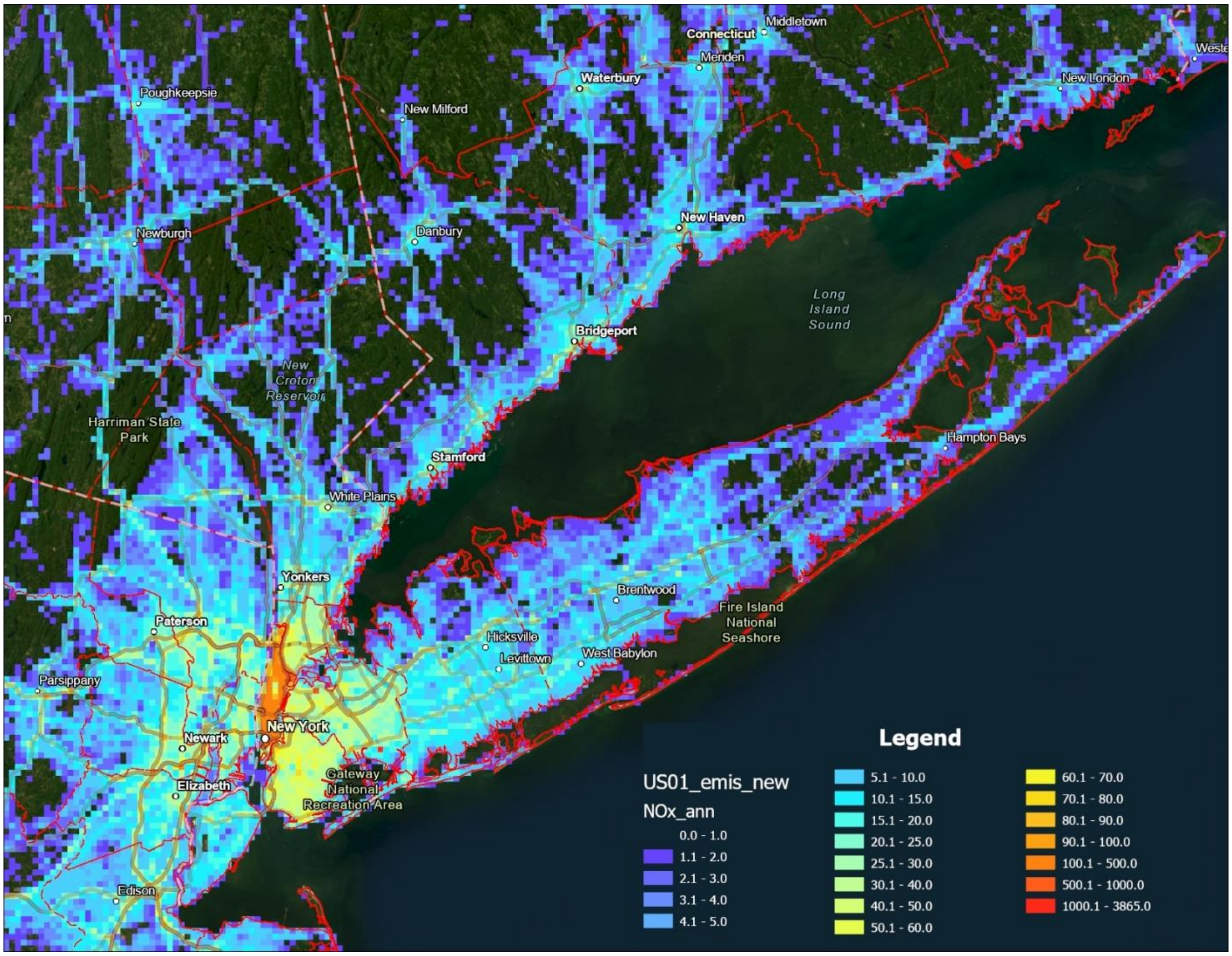
[23] https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-and-related-materials-control-air-pollution

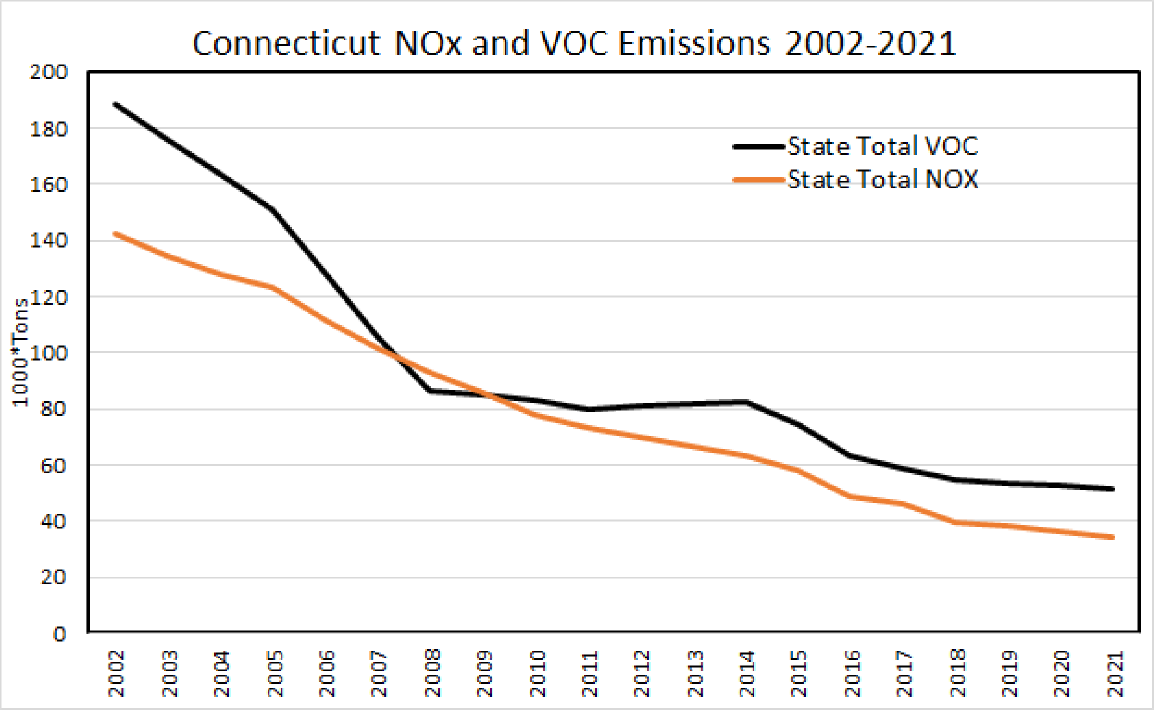
Figure 2-22. *2017 NEI Modeled Non-point NOx Regridded to a 1km Grid. Developed by Dr. Daniel Tong, George Mason University.*



Emissions of ozone precursors in Connecticut have significantly declined over the years. Figure 2-23 displays estimated trends in statewide anthropogenic NOx and VOC between 2002 and 2021. Emission reduction programs achieved 76 percent reduction in NOx and 73 percent reduction in VOCs over the period. Additional reductions are likely to continue as a result of planned and existing control measures.

Biogenic emissions are not included in these trends as they do not change as a result of control programs. Nevertheless, it is important to consider that statewide biogenic NOx emissions are typically between 400 and 600 tons per year, which is small even in comparison to recent anthropogenic emissions that are approximately 40,000 tons per year. The situation reverses somewhat when considering biogenic VOC emissions which are on the order of 65,000 tons per year and nearly twice the recent statewide anthropogenic VOC emissions.

Figure 2-23. *Trend in Annual Statewide Anthropogenic Emissions of NOx and VOC.*



Source: https:/www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data

National Emissions Inventory (NEI) trends are plotted for each of Connecticut's attainment area using the triennial data from 2002 through 2017 as shown in Figure 2-24 and Figure 2-25 for NOx and VOC, respectively. Annual emissions of NOx have decreased by approximately 45,000 tons in each of the areas while VOC emissions have decreased approximately 60,000 tons in each area over the interval.

Figure 2-24. *Connecticut NEI NOx Annual Anthropogenic Emissions Trends.*

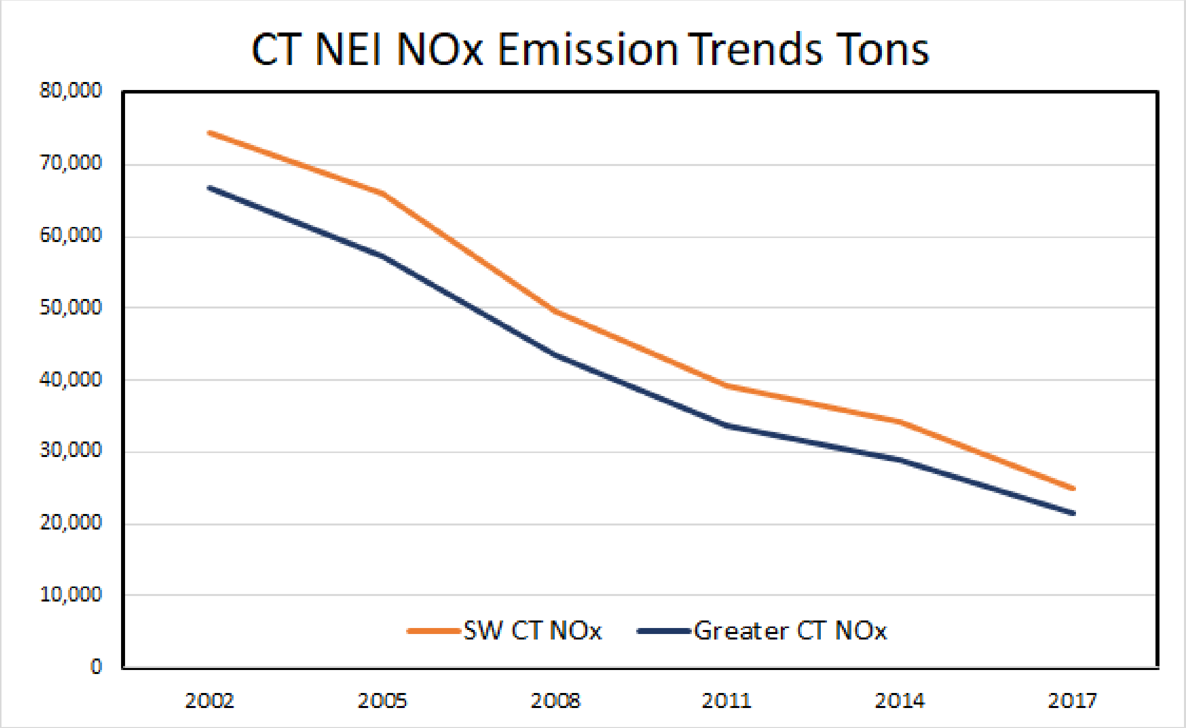
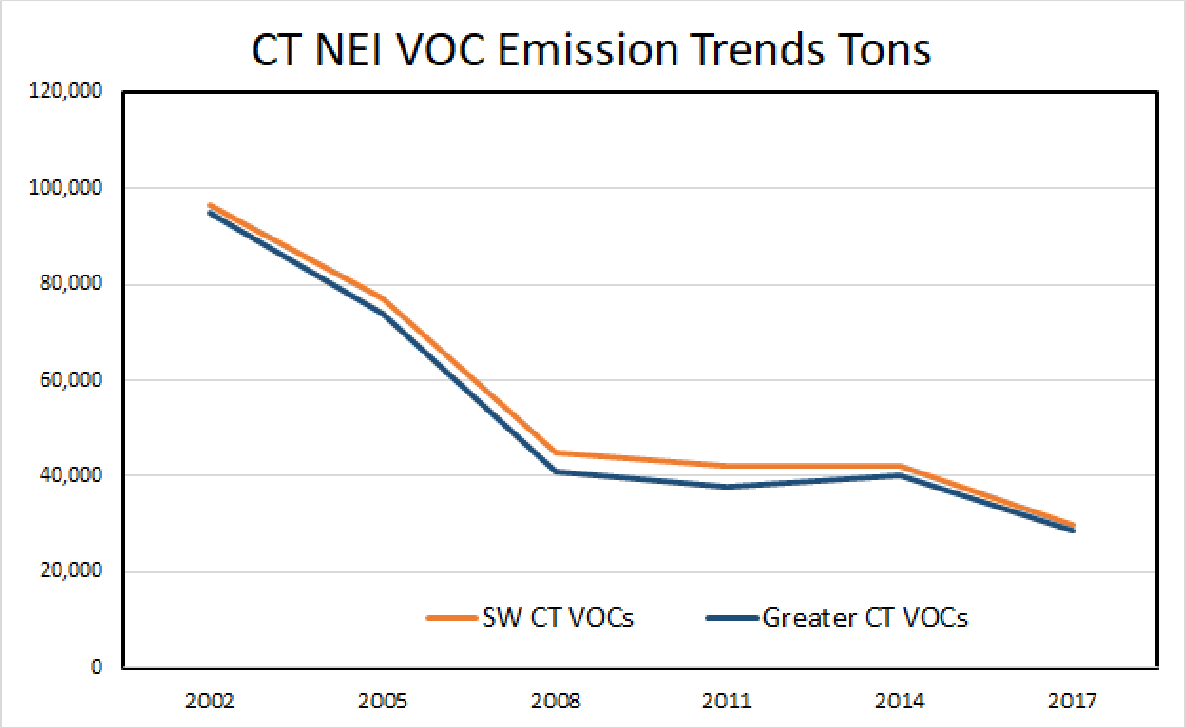


Figure 2-25. *Connecticut NEI VOC Annual Anthropogenic Emissions Trends.*



2.7 Conclusion

Synoptic scale weather patterns, and pollution patterns associated with them, support the need for NOx controls across the broader eastern United States. Studies and characterizations of nocturnal low-level jets also support the need for local and regional controls on NOx and VOC sources, as transported pollution and locally generated pollutants can both be entrained in nocturnal low-level jets formed during nighttime hours. The presence of land, sea, mountain, and valley breezes indicate that there are unique aspects of pollution accumulation and transport that are area specific. These smaller scale weather patterns underscore the importance of local controls for emissions of NOx and VOC. Sea breezes and the accumulation of pollutants from nearby upwind States over Long Island Sound are particularly critical to exceedances in Connecticut.

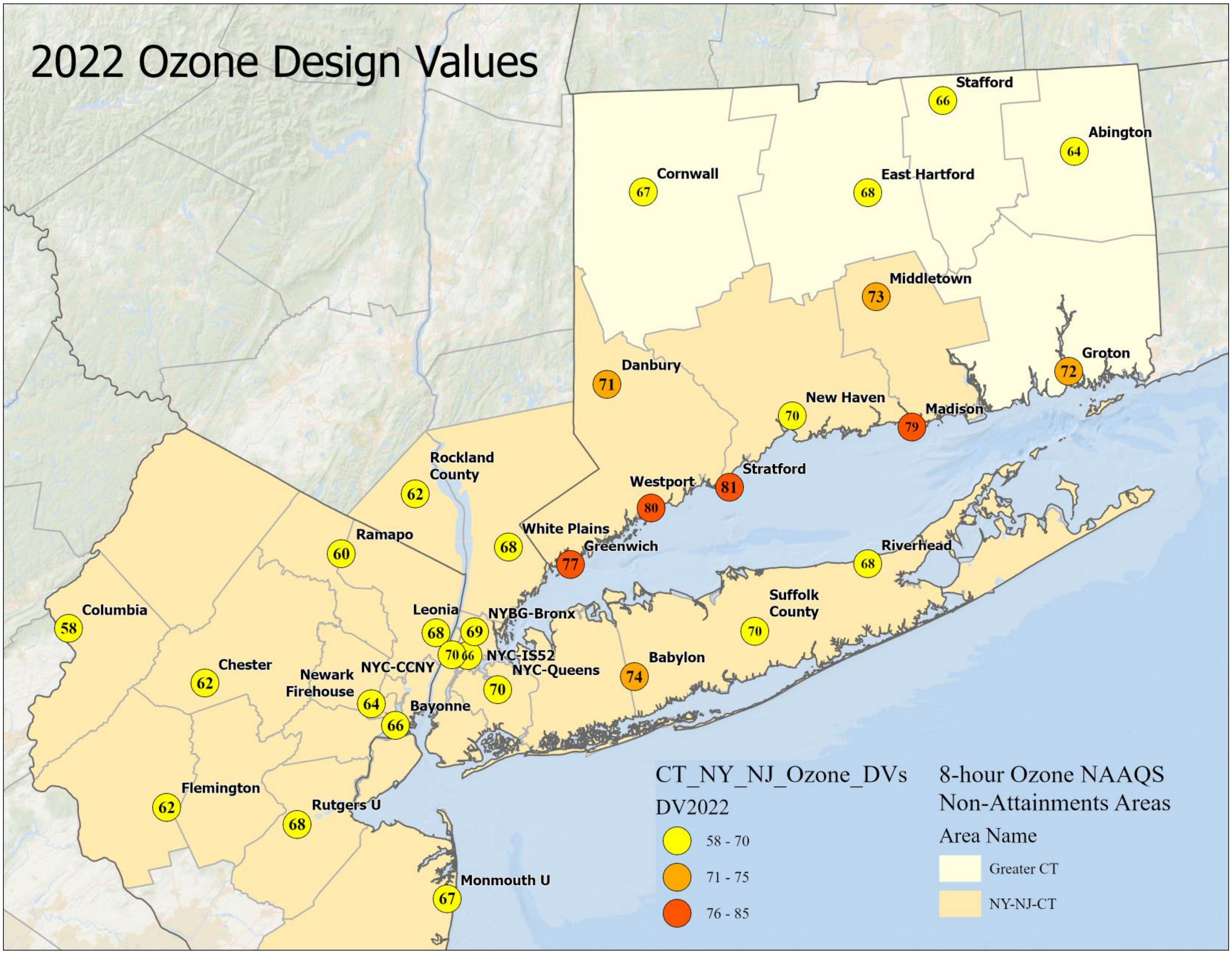
Studies indicate the continued need for reductions in emissions of nitrogen oxides, particularly in the NY metropolitan urban area, for Connecticut to attain the ozone standards.

3 Ozone Related Air Quality Levels in Connecticut and Recent Trends

DEEP has been monitoring ambient ozone levels throughout the state since the early 1970s. The current ozone network consists of twelve sites within the overall monitoring network. In addition to ozone monitoring, Connecticut implements an enhanced monitoring plan for ozone, which includes monitoring of nitrogen oxides and other parameters to help assess the causes of ozone exceedances in Connecticut.

A monitor's design value is the average of the fourth highest daily maximum 8-hour ozone level recorded at the monitor over each of the three most recent years. Compliance with the 2015 ozone standards is achieved when all design values in a nonattainment area are less than 0.071 parts per million (71 parts per billion). Figure 3-1 shows the 2022 design values for monitors in the Greater Connecticut and NY-NJ-CT nonattainment areas. Monitoring data is generally finalized with certification of data by May 1st of the following year. Nearly all monitors in Southwest Connecticut exceed the level of the standard, with the greatest exceedances occurring in the coastal area, and these are the critical monitors for attainment in the NY-NJ-CT area. In Greater Connecticut, only the coastal Groton monitor exceeds the standard.

Figure 3-1. *Final Design Values for 2022. Current design values for each of the monitors in the two Connecticut nonattainment areas, indicating violations of the 2015 NAAQS (orange) in both areas and violations of the 2008 and 2015 NAAQS (red) in Southwest Connecticut.*



3.1 Enhanced Monitoring

Section 182(c)(1) of the CAA directed EPA to promulgate rules (40 CFR 58) that would require states to establish Photochemical Assessment Monitoring Stations (PAMS) as part of their monitoring networks in serious, severe, or extreme ozone nonattainment areas. DEEP established three PAMS sites during the mid-1990s: Westport (Sherwood Island), New Haven, and East Hartford (see Figure 3-1 for locations).

Additionally, areas within the OTR are required under CAA Section 184(d) to adhere to EPA criteria established for best available air quality monitoring. Therefore, areas with moderate or higher levels of ozone nonattainment, as well as all areas within in the OTR, are required to develop Enhanced Monitoring Plans (EMPs).[24] EMPs are required to provide for additional monitoring beyond the minimum requirements for State and Local Air Monitoring Stations (SLAMS) that would be beneficial in identifying pollutant levels, sources, transport, and progress towards attainment. Appendix D of 40 CFR 58 describes SLAMS ozone monitoring requirements for the 2015 ozone NAAQS.

Recognizing the peculiarities of ozone formation over large bodies of water and the predominance of transported ozone and precursor pollutants into Connecticut from nearby upwind states, the Northeast States for Coordinated Air Use Management (NESCAUM) launched the Long Island Sound Tropospheric Ozone Study (LISTOS).[25] LISTOS is a multi-organization effort designed to characterize the meteorology and chemistry of ozone formation using enhanced monitoring capabilities such as satellite data and coordinated use of aircraft and surface based instruments including lidar, spectrometers and ozonesondes.

The LISTOS study has indicated that the atmospheric mixing height is among the critical factors in producing high ozone along Connecticut's coastal border. Therefore, DEEP has committed to monitor mixing height at its Westport and New Haven locations as part of its Enhanced Monitoring Plan. Additionally, as the ratio of volatile organic compounds (VOCs) to nitrogen oxides (NOx) is significant in ozone formation, DEEP intends to commence formaldehyde monitoring in Westport as well. Formaldehyde is a surrogate for VOC and has the potential to be monitored more efficiently. In the meantime, DEEP provides access and technical support for EPA's Pandora spectro-photometers, which continuously monitor total column nitrogen dioxide and formaldehyde, at four sites (Westport Sherwood Island, New Haven Criscuolo Park, Cornwall Mohawk Mountain, and Madison Hammonasset State Park).

DEEP submitted its first enhanced monitoring plan in 2019. Subsequent plan revisions are required every five years thereafter. DEEP continues to satisfy requirements for enhanced monitoring in accordance with its plan submittal and commits to update its plan every five years as required. Details of DEEP's Enhanced Monitoring Plan are found in Connecticut's Annual Air Monitoring Network Plan.[26]

3.2 Trends in Design Values

Trends in design values for each site in the Southwest Connecticut and Greater Connecticut nonattainment areas are plotted in Figure 3-2 and Figure 3-3, respectively. The maximum design values in Southwest Connecticut have decreased by nearly fifty percent since the mid-1980s, from nearly 160 ppb at Stratford to below 82 ppb in 2022 at all sites. The maximum design values in Greater Connecticut have also decreased approximately fifty percent since the mid-1980s, from over 140 ppb in 1983 to 72 ppb in 2022, just above the 70 ppb NAAQS.

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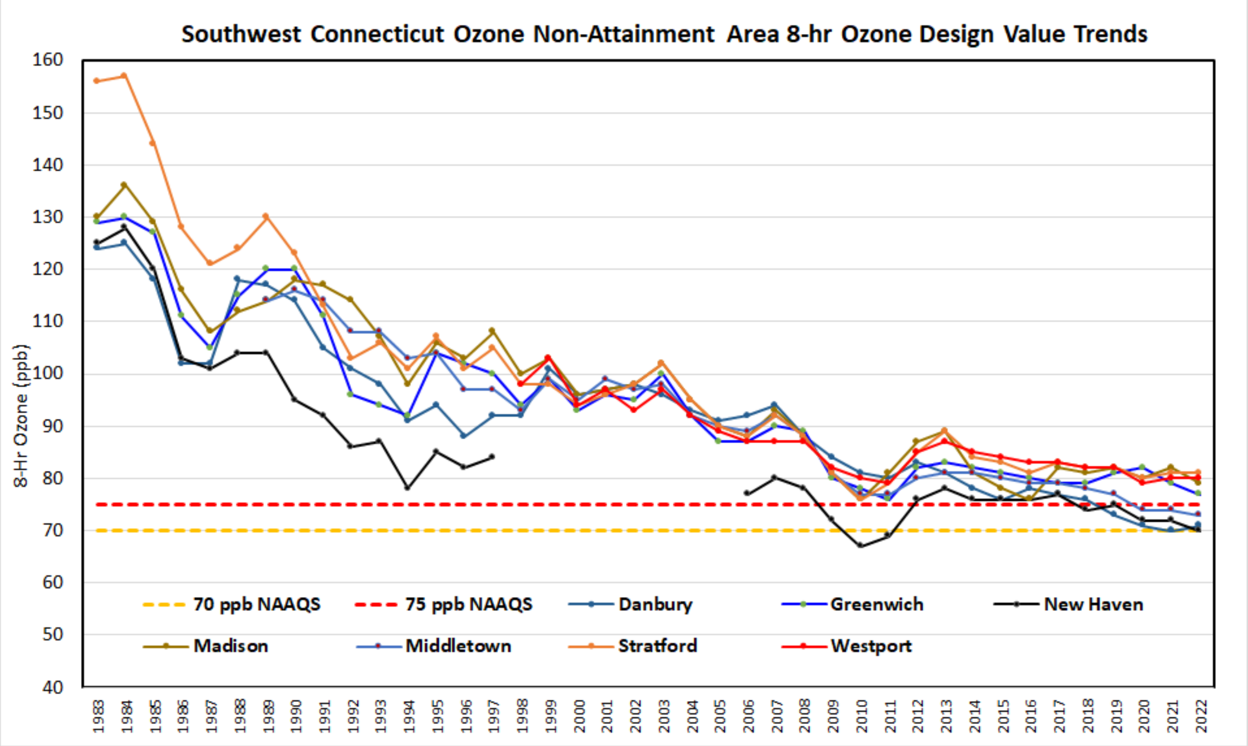
[24] 40 CFR 58 Appendix D paragraph 5(h).

[25] Long Island Sound Tropospheric Ozone Study — NESCAUM

[26] DEEP's Annual Monitoring Network Plan can be found at https://portal.ct.gov/DEEP/Air/Monitoring/Air-Monitoring-Network

The figures also indicate the levels of the 2015 and 2008 ozone NAAQS. Monitors in Southwest Connecticut continue to show exceedances of both standards. Monitors in Greater Connecticut, with the exception of the coastal Groton site, have trended below both standards in recent years and all monitors in Greater Connecticut, including Groton, have attained the less stringent 2008 standard since 2019.[27,28]

Figure 3-2. *Southwest Connecticut 8-Hour Ozone Design Value Trends.*



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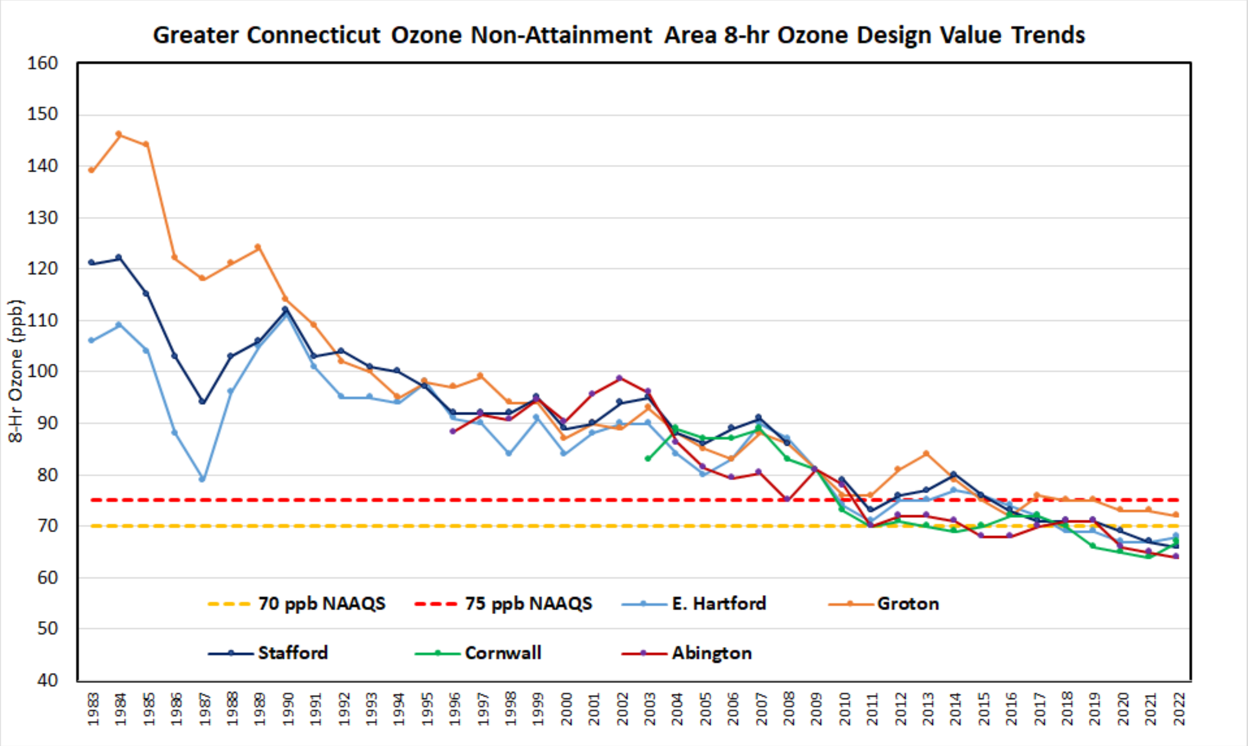
[27] On July 13, 2020 EPA finalized a clean data determination for Greater Connecticut [85 FR 41924] finding that the area attained the 2008 standards based on data from 2016-2019.

[28] EPA's Final Determinations of Attainment by the Attainment Date, Extensions of the Attainment Date, and Reclassification of Areas Classified as Serious for the 2008 Ozone National Ambient Air Quality Standards finds that Greater Connecticut has attained the 2008 ozone NAAQS.

Figure 3-3. *Greater Connecticut 8-hour Ozone Design Value Trends.*

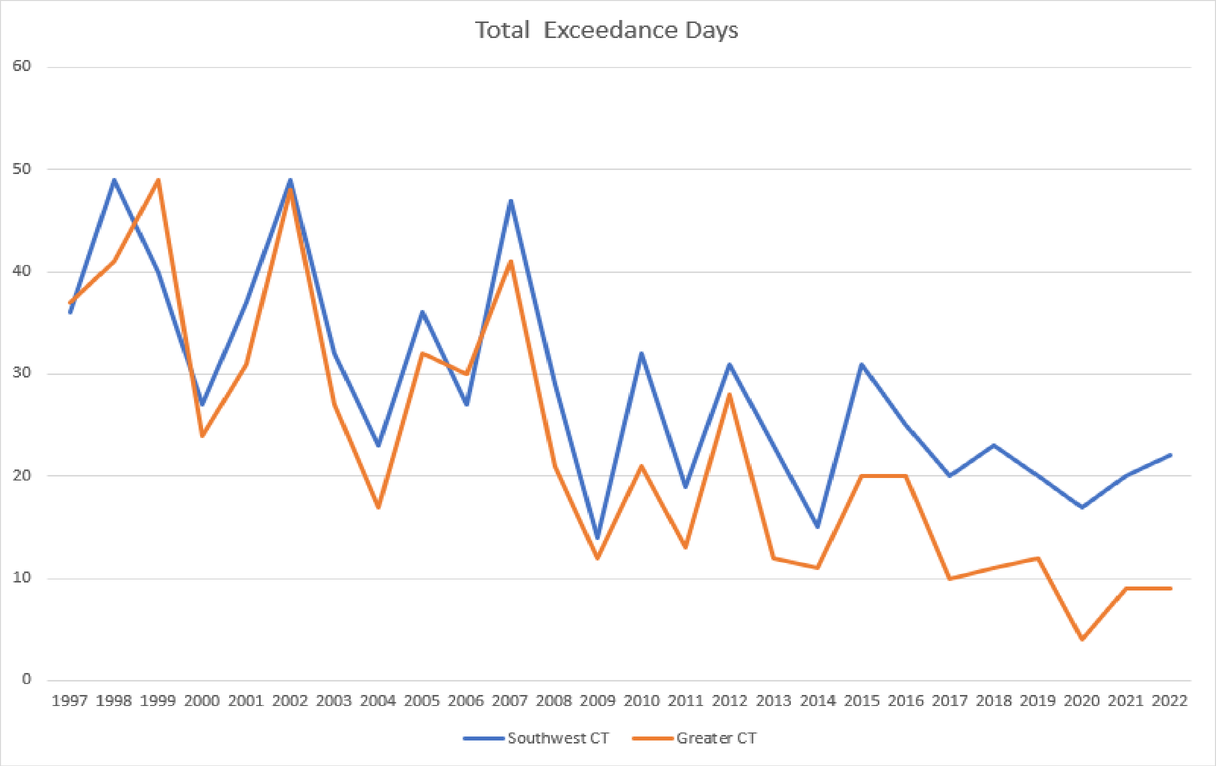


3.3 Trends in Ozone Exceedance Days

An exceedance day for the 8-hour ozone NAAQS is defined as a day, measured from midnight to midnight, on which any one or more monitors in the state record a forward 8-hour ozone concentration greater than or equal to the standard. The total number of annual exceedance days measured in Connecticut from 1997 to 2022 is shown in Figure 3-4 for both the Greater Connecticut and Southwest Connecticut nonattainment areas. Exceedance days were back calculated for years prior to establishment of 2015 NAAQS. The number of Connecticut exceedance days has decreased by over fifty percent over the interval.

In 2022, there were 22 days when at least one monitor in Southwest Connecticut exceeded the standard and only nine days in Greater Connecticut. A decrease in both areas in 2020 is attributable to decreased emissions activity resulting from the COVID lockdowns. Notwithstanding this decrease, Greater Connecticut shows a strong downward trend in exceedance days in recent years while Southwest Connecticut's trend is fairly flat. Consistent with the ozone design values, exceedance days are driven by the coastal sites.

Figure 3-4. *Trend in Annual Ozone Exceedance Days by Nonattainment Area.*



3.4 Trend in 8-Hour Ozone Percentiles

The trends addressed previously focus on peak ozone concentrations measured at Connecticut monitors. Another way of looking at long-term trends is to plot the full distribution of concentrations including the lowest to the highest percentiles measured during the ozone-monitoring season. The figures below display distributions since 2007 for selected monitors in the Southwest Connecticut and the Greater Connecticut nonattainment areas.

Fifty percent of the data fairly consistently lie below the 50 ppb level at all sites and, more recently, below 45 ppb at the inland sites. More pronounced downward trends in the data occur at all levels when comparing the inland sites to coastal sites. Downward trends are most evident at the higher percentiles at inland sites. While the coastal sites indicate a flat trend above the standard at the 98th percentile, generally all sites show that ninety percent of the data lie below the standard.

The charts show greater variability at the higher percentiles. A pattern of decreases from 2007 to 2009, which then generally peak in 2012, is evident in all the charts. This pattern may be influenced by a cooler than normal summer in 2009 together with the economic collapse of 2008 and subsequent recovery. A cooler summer in 2014 is also reflected in the data, particularly at the higher percentiles. A similar drop is evident in 2017, also a cooler year. A further drop occurs in 2020 followed by increases in 2021. The figures show an additional decline in the 98th percentile into 2020, which may be attributed to lockdowns in response to

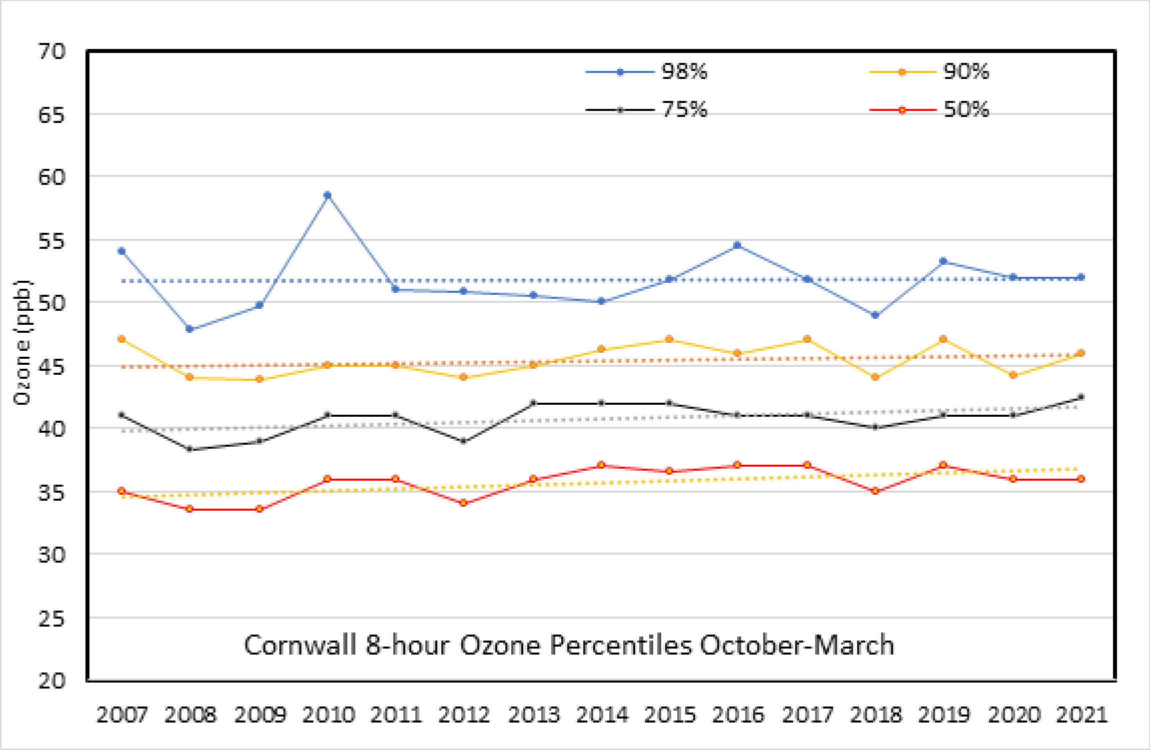
COVID-19. The lower percentiles show a decline in all sites in recent years and, unlike the higher percentiles, maintain this decline in 2021 indicating a baseline reduction in ozone may have occurred as a result of ongoing work-from-home practices and may be an indication of the importance of the mobile source sector in ozone production.

Figure 3-5. *Southwest Connecticut 8-hour Ozone Percentile Trends – April through September.*

Figure 3-6. *Greater Connecticut 8-hour Ozone Percentile Trends – April through September.*

Connecticut's Cornwall site has been measuring ozone values throughout the year. Wintertime ozone values can be used to indicate background ozone concentrations. In Figure 3-7, the higher percentiles would indicate the months nearer the warmer ozone season and the lower percentiles would occur during the colder winter months. A slight upward trend of about two parts per billion has occurred since 2007 in the lower percentiles, indicating a likely increase in global background.

Figure 3-7. *Trends in Non-ozone Season Percentiles as Cornwall – October through March.*



3.5 Temperature Influences on Ozone Levels

Ozone is not emitted directly into the atmosphere but is formed by photochemical reactions between VOCs and NOx in the presence of sunlight. The highest ozone concentrations in Connecticut typically occur along the shoreline on hot summer days, with surface winds from the southwest and winds aloft from the west. The photochemical reactions that produce ozone are enhanced by long summer days and elevated temperatures (which also lead to increased levels of evaporative VOC emissions). In addition, transported ozone and precursor species are enhanced by winds coming from areas with high emissions of stationary and mobile sources along the Interstate-95 corridor at the surface and from Electrical Generation Unit (EGU) power plants from upwind states at elevated levels. Hot summers can result in several extended periods of elevated ozone production, while cooler summers are typically characterized by fewer days of elevated ozone levels.

Meteorological data from Bradley International Airport (Windsor Locks, CT) were used to examine the year-to-year relationship between the frequencies of high ozone and high temperature days in Connecticut. Figure 3-8 shows the trend from 1997 through 2022 of average of statewide daily maximum 8-hour ozone levels, from May 1 through September 30, binned by daily maximum temperature. It shows that the highest ozone levels occur on the hottest days (days with maximum temperatures above 90 degrees Fahrenheit) and the trend of high ozone on the hottest days is generally downward. The trends in ozone levels decrease more gradually on days with cooler temperatures consistent with decreasing ozone productivity with decreasing temperature. Note too that the days with temperature below 70° trends along the 40 ppb level similar to the 75th percentile data for Cornwall during cooler non-ozone season winter months as shown in Figure 3-7.

Figure 3-8. *Connecticut 8-hour Ozone Percentile Trends by Temperature Range.*

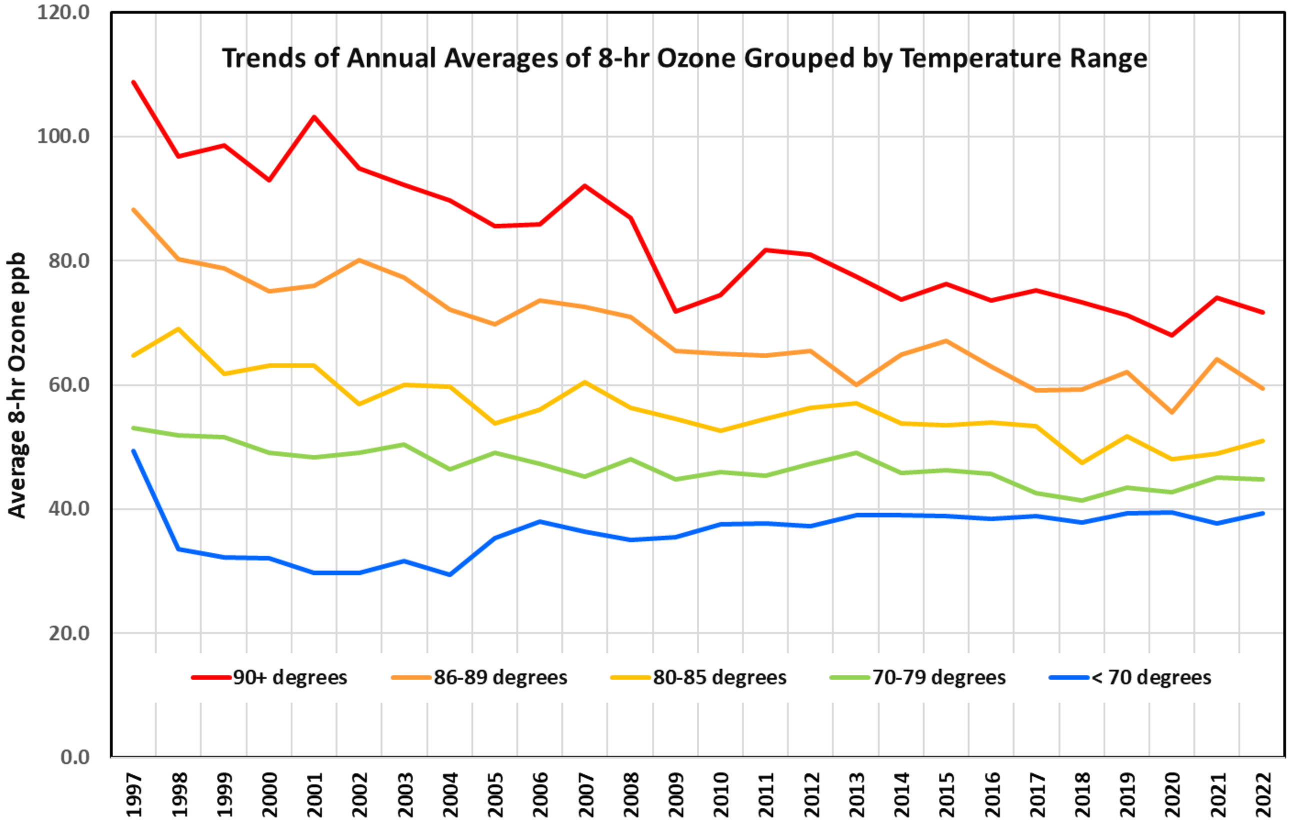
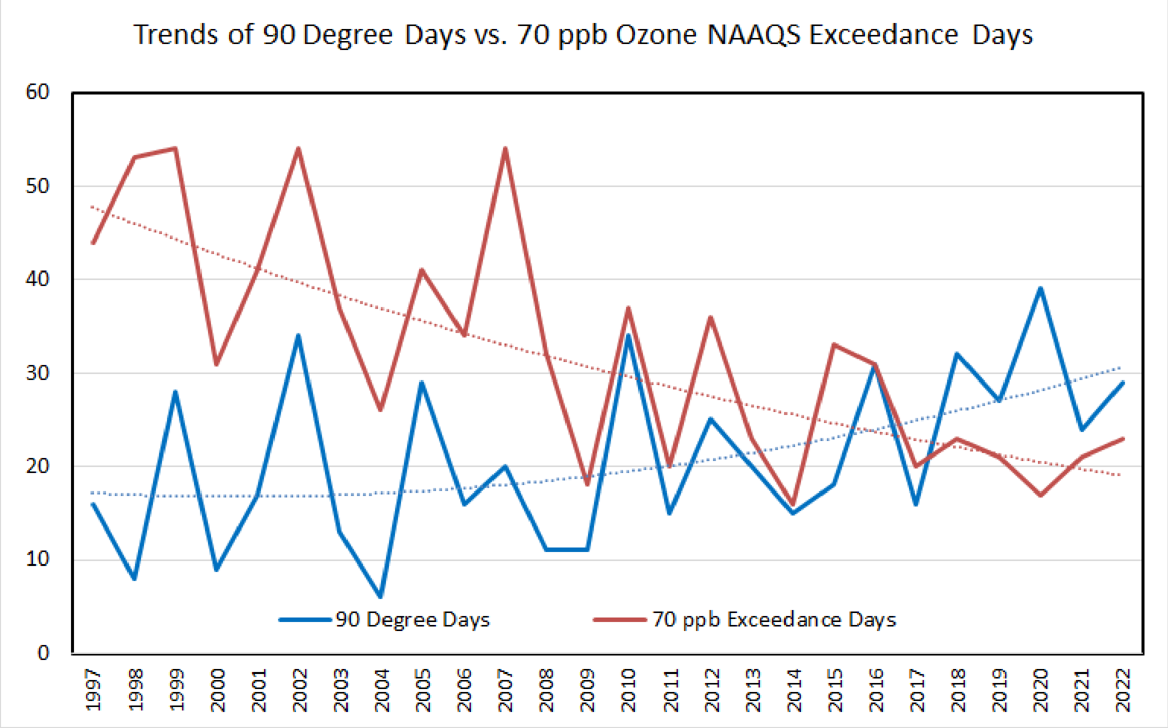


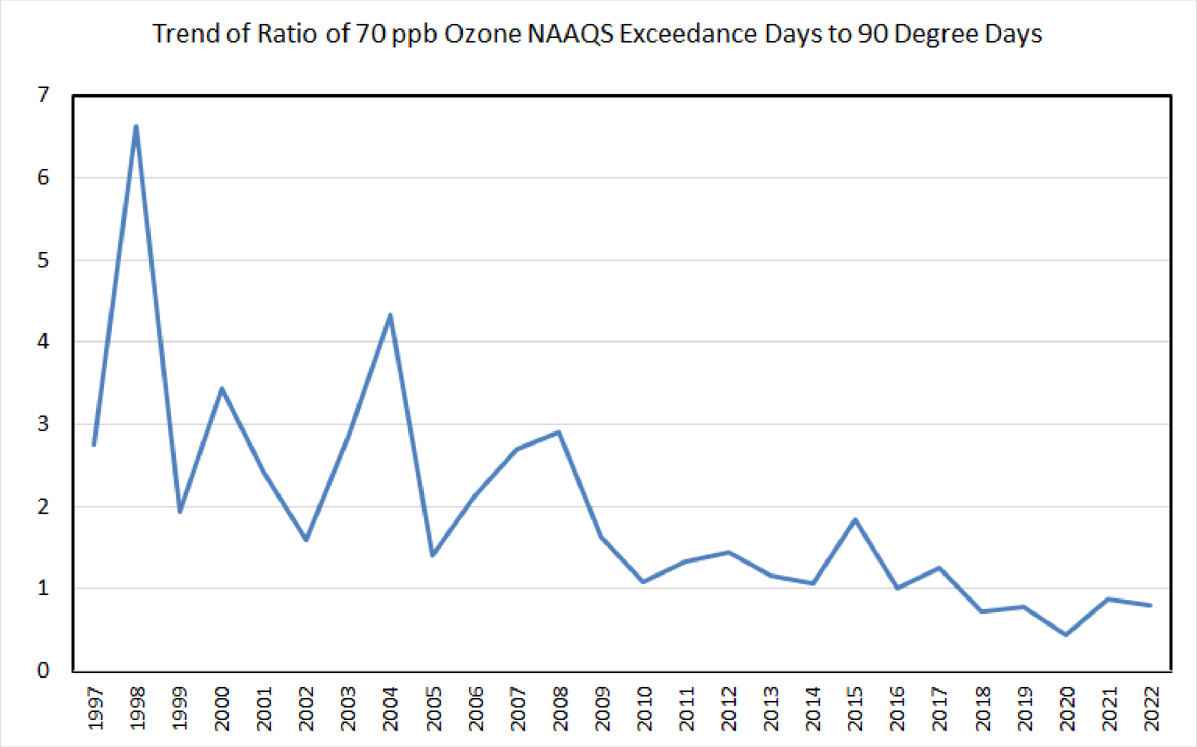
Figure 3-9 is a plot of the number of days with exceedances of the 2015 NAAQS in Connecticut for the period from 1997 through 2022, along with the number of "hot" days -- days with maximum temperatures of 90˚F or above at Bradley International Airport (BDL). Although the number of exceedance days tends to track with the number of hot days, the frequency of high ozone days has decreased over time, even for years with similar numbers of hot days. The group of hottest years (i.e., 2002, 2010, 2016, 2018, and 2020 all with at least 30 days of ≥ 90˚F temperatures), show a steady improvement in the number of exceedance days (i.e., 54, 37, 31, 23, and 17 exceedance days, respectively) for each of those hottest years.

Figure 3-9. *Statewide Annual 8-hour Ozone Exceedance Days Compared to ≥ 90°F Days.*



The decline in ozone exceedances, after adjusting for temperature effects, is depicted in an alternate way in Figure 3-10, which plots the ratio of exceedance days to the number of 90˚F or above days for each ozone season from 1997 to 2022. The ratios have improved over the period, from values generally in the two to four range in the early 2000's, improving to values around one. This trend signifies additional improvements in ozone levels when temperature influences are considered.

Figure 3-10. *Statewide Ratio of Annual 8-hour Ozone Exceedance Days to Number of ≥ 90°F Days.*

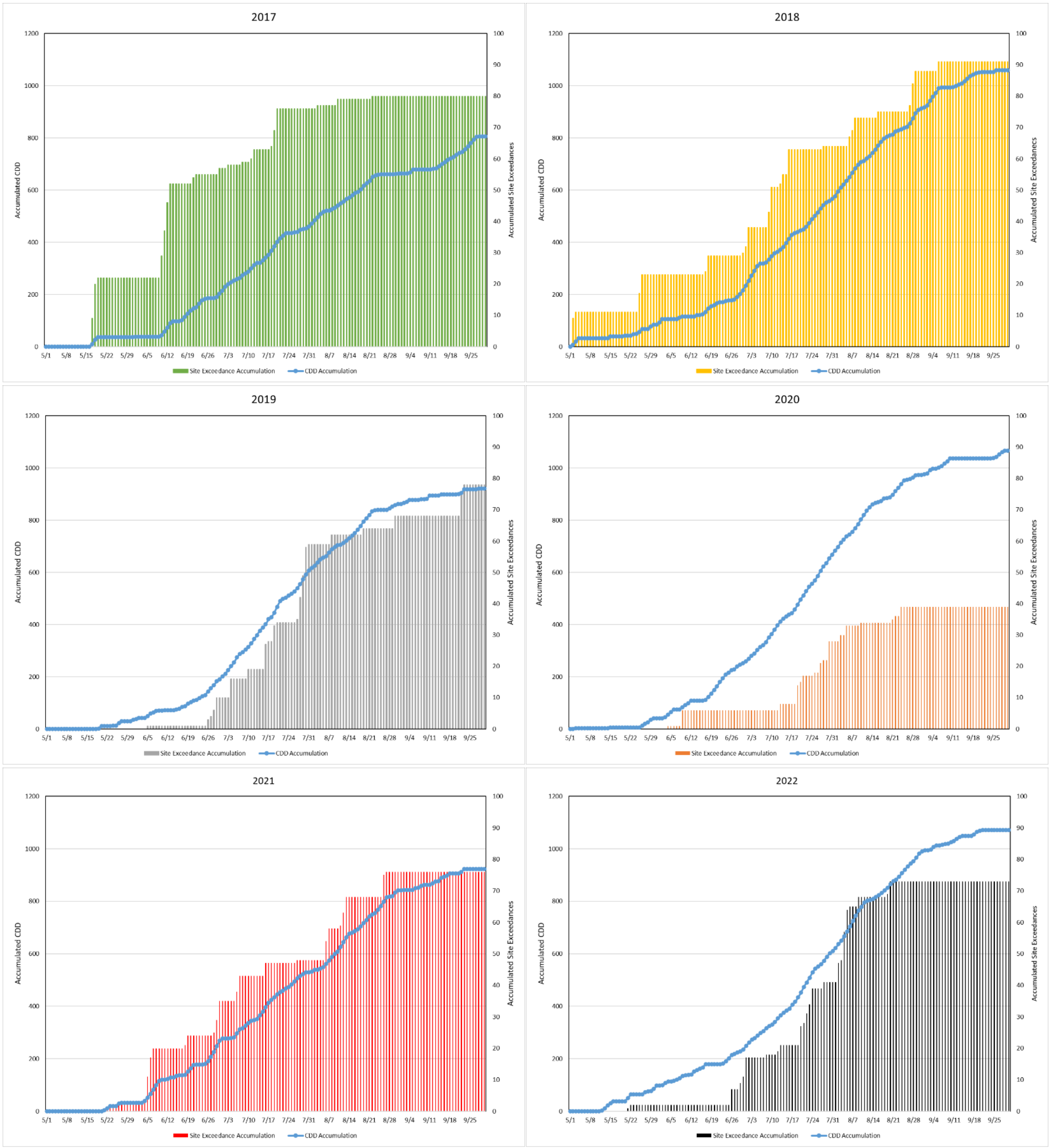


3.6 Trends in Cooling Degree Days

A cooling degree day (CDD) is a measure of how hot the average temperature was on a given day compared to a threshold of 65 degrees Fahrenheit (°F). For example, if a day's average temperature is 80°F, that day has a CDD of 15. As hot sunny days are conducive to ozone formation and when electricity demand is highest, CDDs are a surrogate for both ozone formation and emissions from electric generation units. Therefore, DEEP gathered CDD data from the Northeast Regional Climate Center website (http://climod2.nrcc.cornell.edu/) to compare CDD accumulation from 2017 to 2022 with the number of site exceedances within the state.

Figure 3-11 compares ozone site exceedances with CDDs as the ozone season progresses for the years 2017 through 2022. Each step in the chart of ozone exceedances represents an ozone event and the height of the step indicates the extent of the event while the length of the step indicates the interval between events. The charts indicate initial season events trending later and less widespread. While 2017 was the coolest year, it was near the highest in accumulated site exceedances. Though comparable in CDD trends and among the warmer years, site exceedances drop appreciably from 2018 to 2022. With a similar CDD profile, 2020 is anomalously low in site exceedances likely due in large part to the COVID lockdowns. While these charts show year to year variability in meteorology, they also indicate that under similar circumstances the number and extent of ozone exceedances in Connecticut are declining.

Figure 3-11. *Accumulated Cooling Degree Days vs. Accumulated Site Exceedances 2017 through 2022.*



3.7 Trends in Nitrogen Oxides

Nitrogen dioxide (NO2) is used as an indicator for nitrogen oxides (NOx) and is monitored at multiple DEEP monitoring locations. Figure 3-12 through Figure 3-14 are plots of the average monthly NO2 concentrations from 2007 to 2022 for the East Hartford, Westport, and New Haven sites, respectively. NOx concentrations are at their highest levels in the winter months and lowest in the summer months. Both the winter peak and summer baseline levels of NO2 have been slowly trending downward for all sites.

Figure 3-12. *East Hartford Monthly NO2 Trends from 2007-2022.*

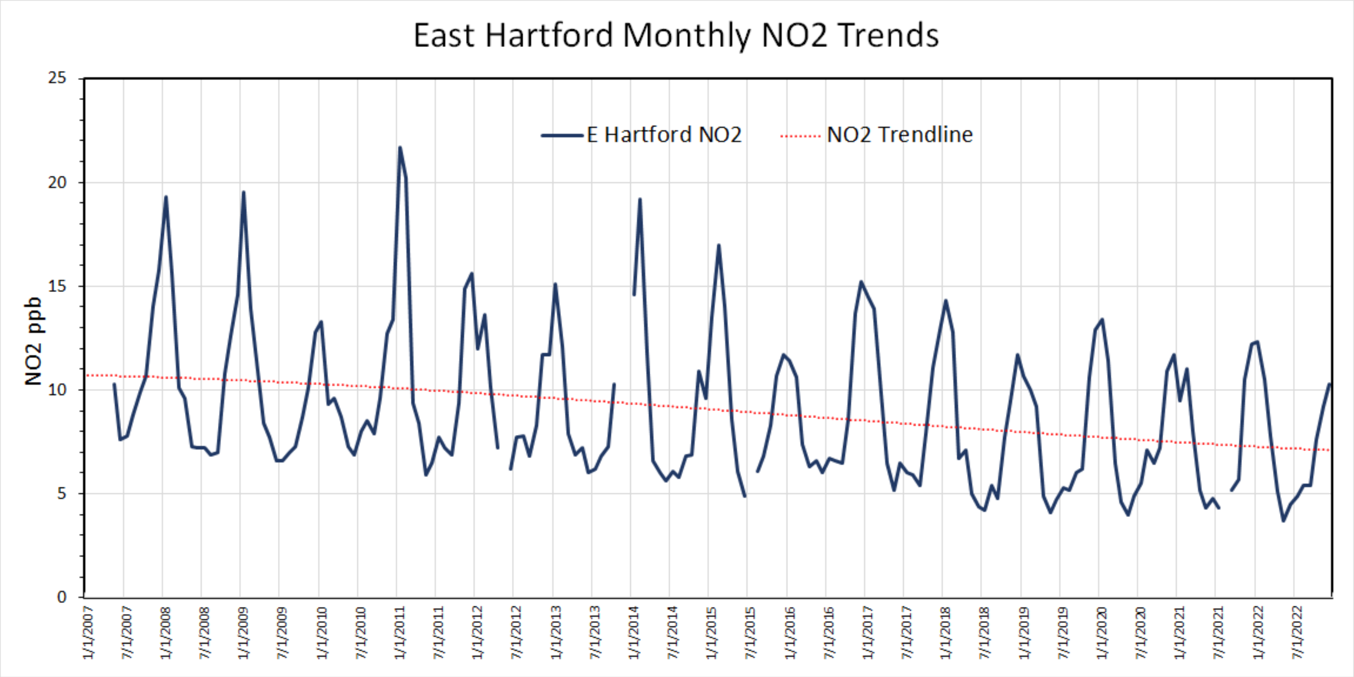


Figure 3-13. *Westport Monthly NO2 Trends from 2007-2022.*

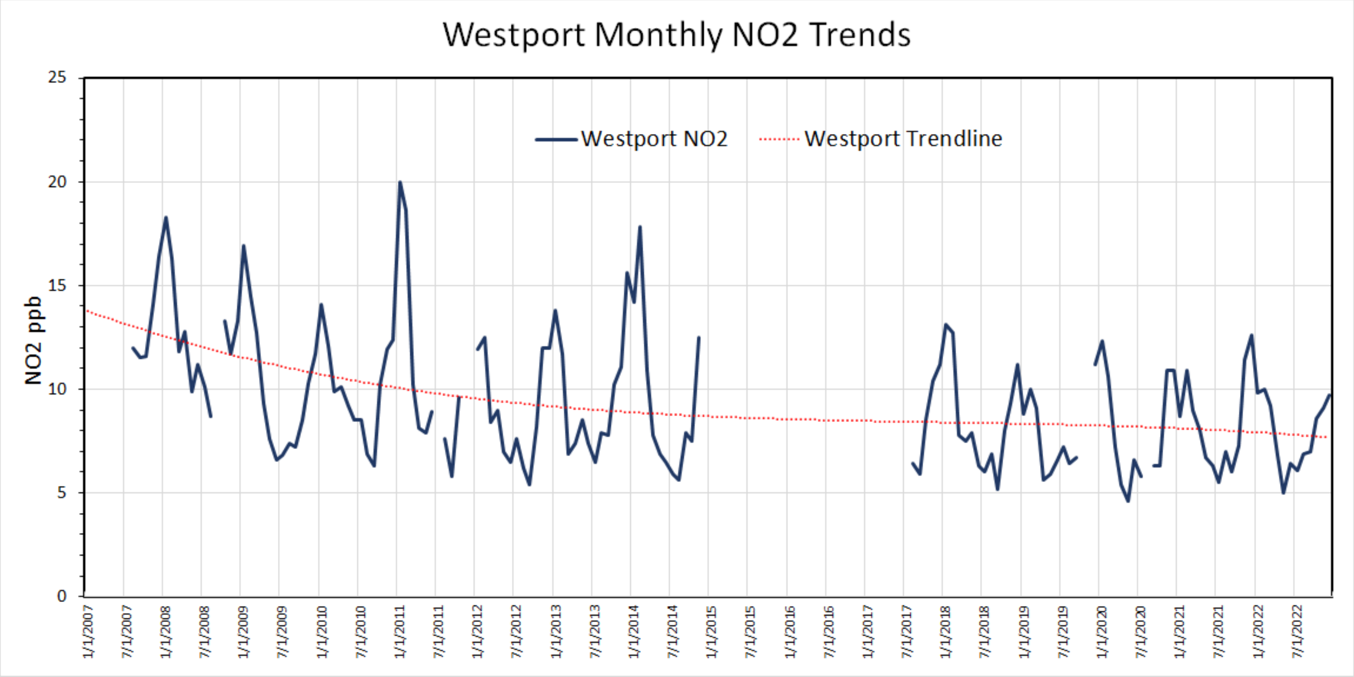
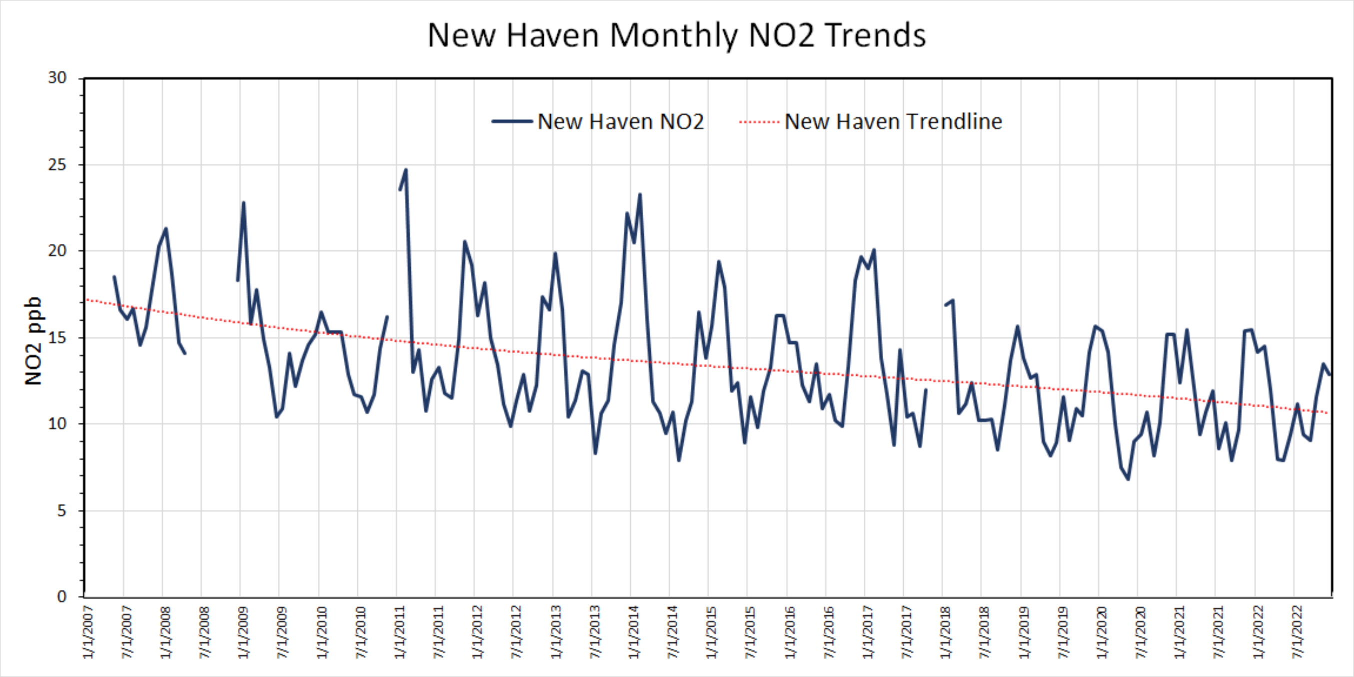


Figure 3-14. *New Haven Monthly NO2 Trends from 2007-2022.*



3.8 LISTOS 2018

To investigate the evolving nature of ozone formation and transport in the NYC region and downwind, NESCAUM launched the Long Island Sound Tropospheric Ozone Study (LISTOS) during Spring 2018[29]. LISTOS involved a large group of researchers with state and federal agencies and academia that brought together resources, expertise, and instrumentation skills. This included satellite, aircraft, balloon (ozonesondes), marine, and ground-based data collection and analysis methods to probe the New York City pollution plume and its evolution over and around Long Island Sound.

Figure 3-15. *New York Metropolitan Area NO2 Column. NO2 column recorded September 6, 2018 by the GeoCAPE Airborne Simulator (GCAS) spectrometers on the NASA Langley Research Center B200 aircraft. Distinct plumes of NO2 can be observed to correlate to positions of airports and larger sources found in EPA's eGRID inventory of emission units.*

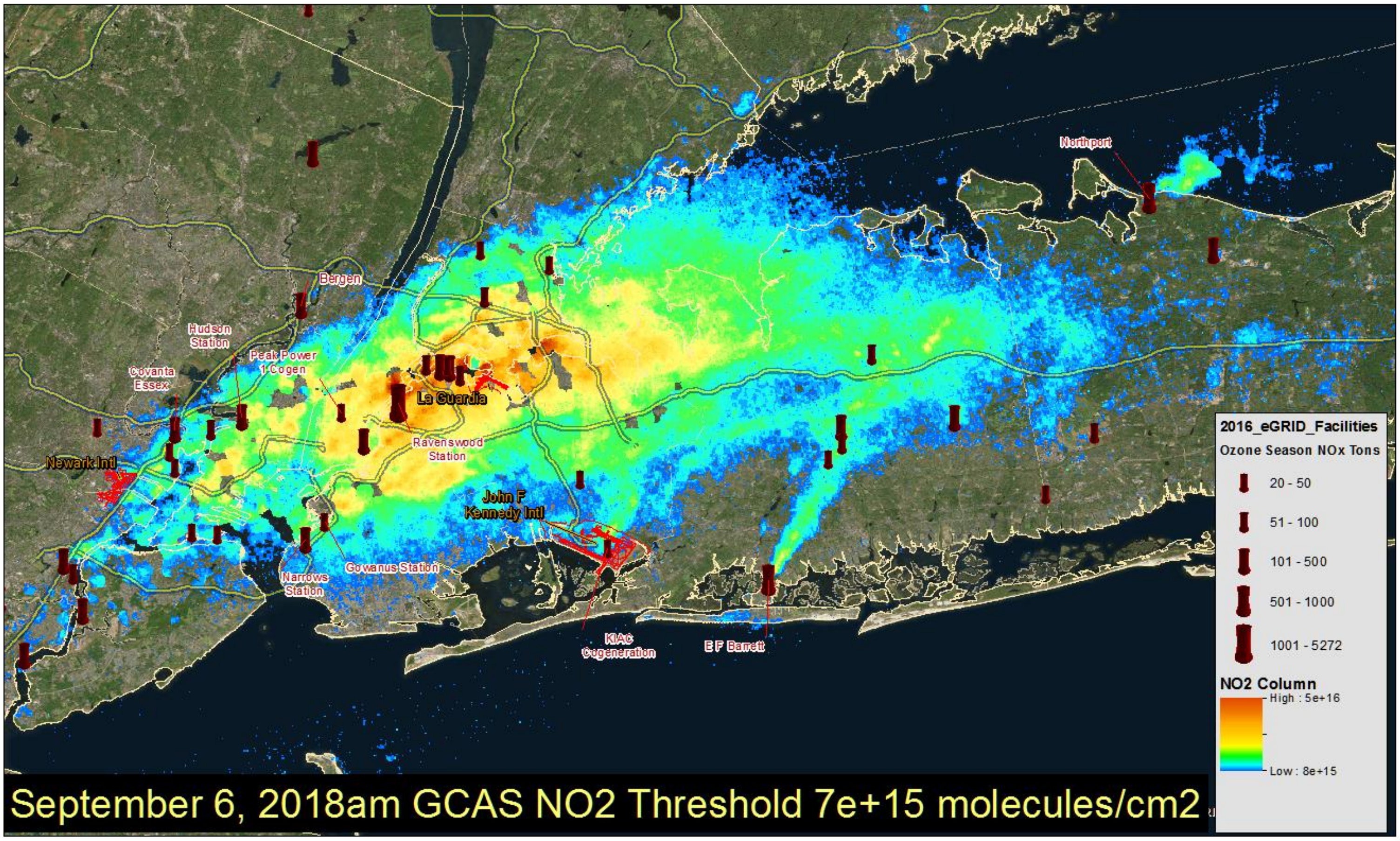


Figure 3-15 shows an example of an NO2 column concentration during the morning of September 6, 2018, recorded by the GeoCAPE Airborne Simulator (GCAS) spectrometers on the NASA Langley Research Center B200 aircraft. Flights were conducted during multiple ozone events in the summer of 2018 over western LIS and New York City. The GCAS spectrometers produced high resolution pixel images of 250 meters, and at this resolution NO2 point source

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[29] The Northeast States for Coordinated Air Use Management: NESCAUM https://www.nescaum.org/initiatives/listos

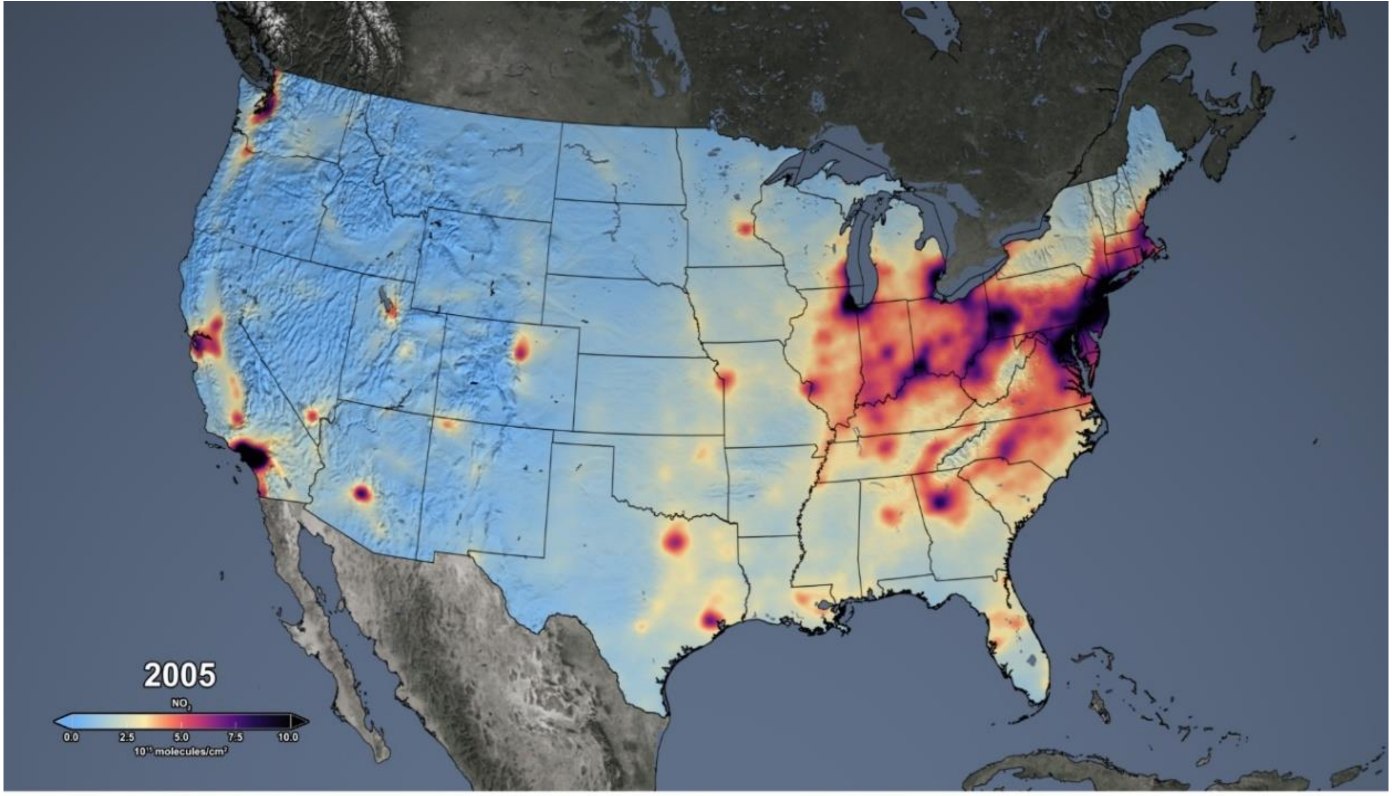
plumes can be clearly distinguished. On this image, locations of known EGU point sources were indicated on the map near where the plumes where emanating. Plumes correlate to the locations of airports and power plants. The highest sources of NO2 emissions were located right over New York City.

3.9 Satellite Trends

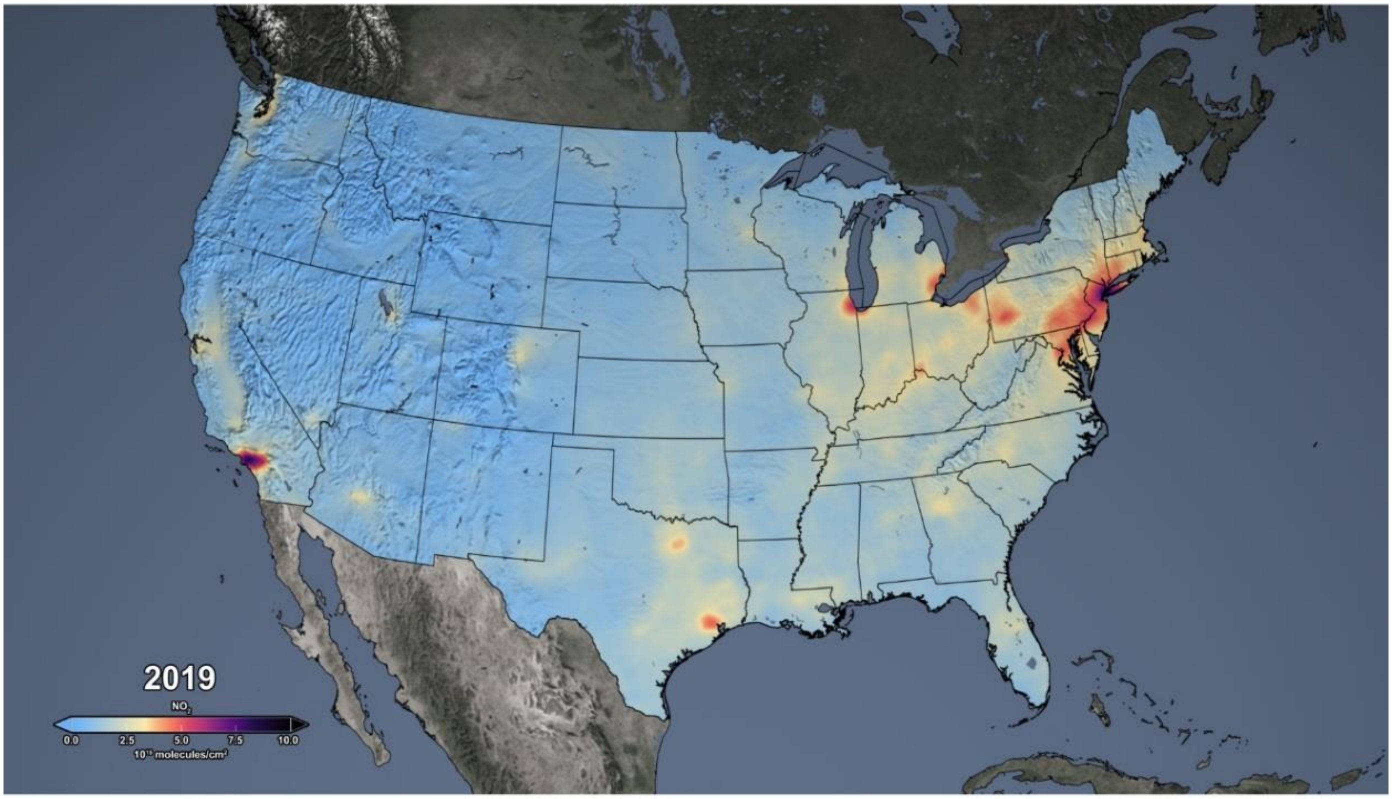
The Ozone Monitoring Instrument (OMI)

As part of the Earth Observing System (EOS), the Aura satellite with four instruments to monitor atmospheric chemistry and climate was launched in July 2004 and has been providing valuable pollutant trends since 2005. Aura's Ozone Monitoring Instrument (OMI) has been providing daily records of both total column ozone and nitrogen dioxide (NO2) during this period. Since NO2 is an important pollutant is the formation of tropospheric ozone, these trends using satellite data are a good indication on how well NOx control strategies have been working nationwide and what areas still need reductions. Figure 3-16 shows the annual averaged NO2 for the years 2005 and 2019 using the OMI data. Despite any annual variations that may occur in NO2 emissions, it is obvious that significant emission reductions have occurred, but the area between Washington D.C and New York City remains a high NO2 source region.

Figure 3-16. *Annual Averaged NO2 for (a) 2005 and (b) 2019 from the Aura Satellite Data.*



(a) 2005 annual averaged total column nitrogen dioxide from the OMI satellite instrument (courtesy of NASA Goddard Space Flight Center)

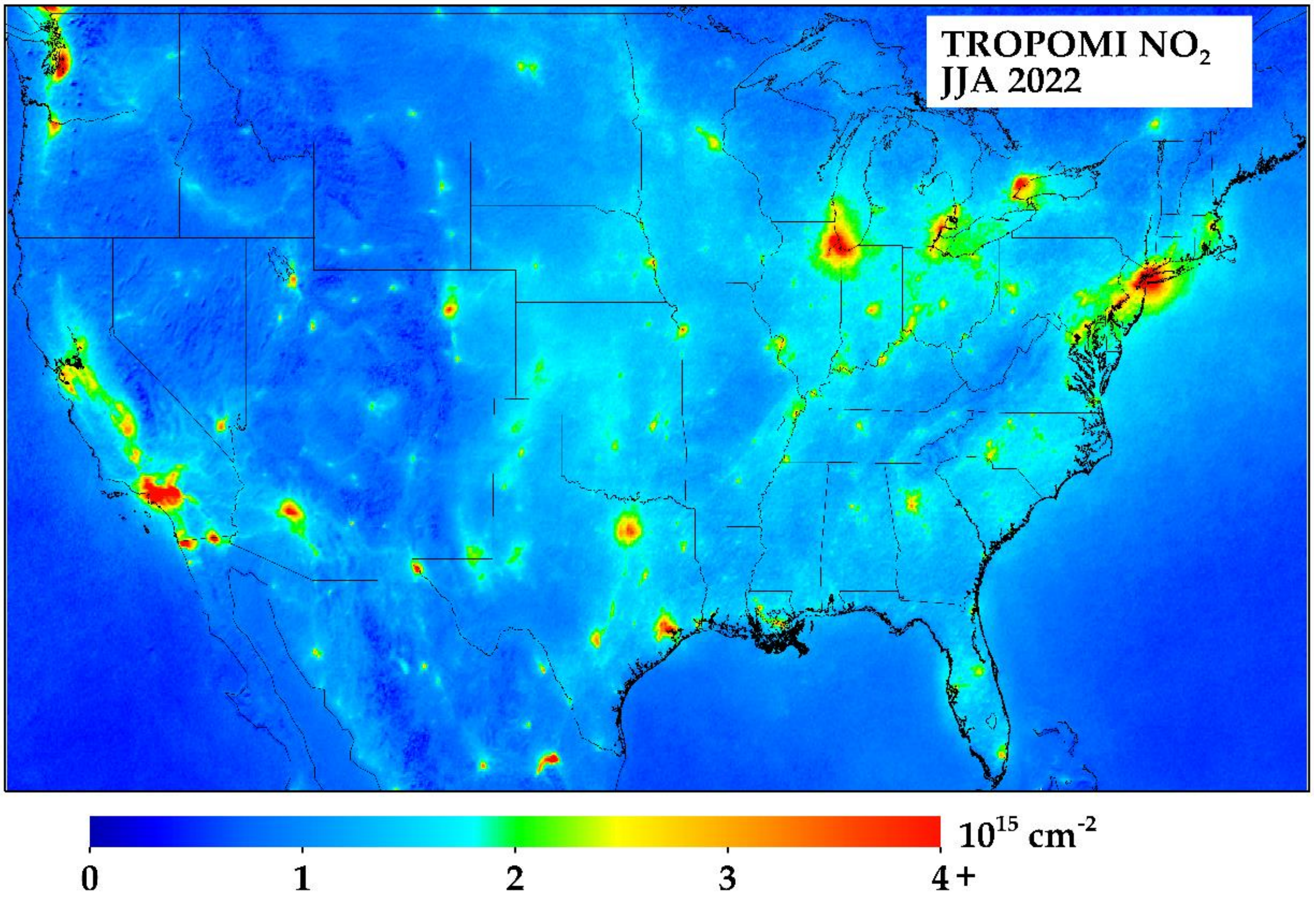


(b) 2019 annual averaged total column nitrogen dioxide from the OMI satellite instrument (courtesy of NASA Goddard Space Flight Center)

The Tropospheric Monitoring Instrument (TROPOMI)

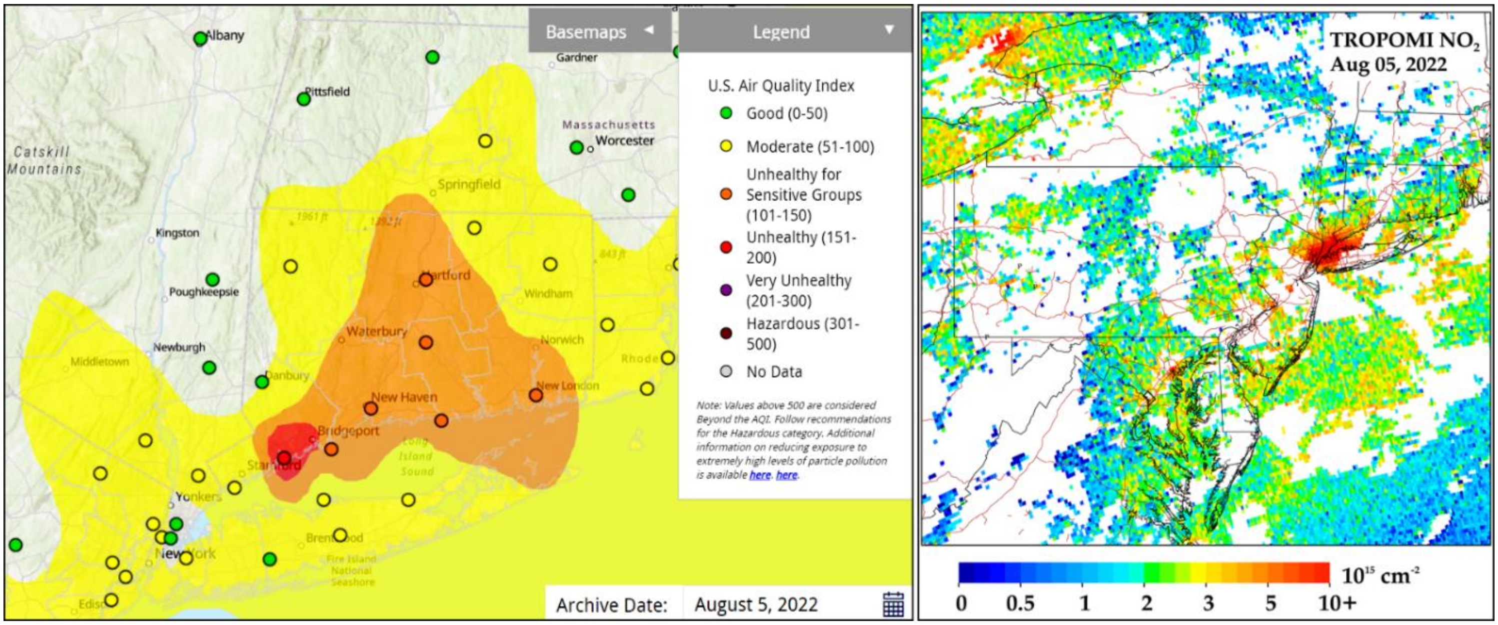
The Tropospheric Monitoring Instrument (TROPOMI) is the satellite instrument on board the European Copernicus Sentinel-5 Precursor satellite. The Sentinel-5 Precursor (S5P) is the first of the atmospheric composition Sentinels, launched on October 13, 2017. Like its predecessor, it orbits the earth every 100 minutes and records data every day at about 1:30 pm local standard time overhead Connecticut. The instrument sees the most important components of the atmosphere, including ozone, nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), methane (CH4), formaldehyde (HCHO) and particulate matter/aerosols. This new generation instrument has a pixel resolution of 5 km, which can detect emissions on an urban scale. Figure 3-17 is an image of the daily averaged NO2 emissions over the continental U.S.A. for just the summer months of June, July and August (JJA) of 2022. This clearly shows the NO2 source regions around the major metropolitan areas, especially around New York City and the Interstate-95 corridor from southwest Connecticut and south to the New Jersey-Pennsylvania border.

Figure 3-17. *Daily Averaged NO2 Emissions over the U.S.A. for the Summer Months (JJA) of 2022. Courtesy of Dan Goldberg, Ph.D., George Mason University.*



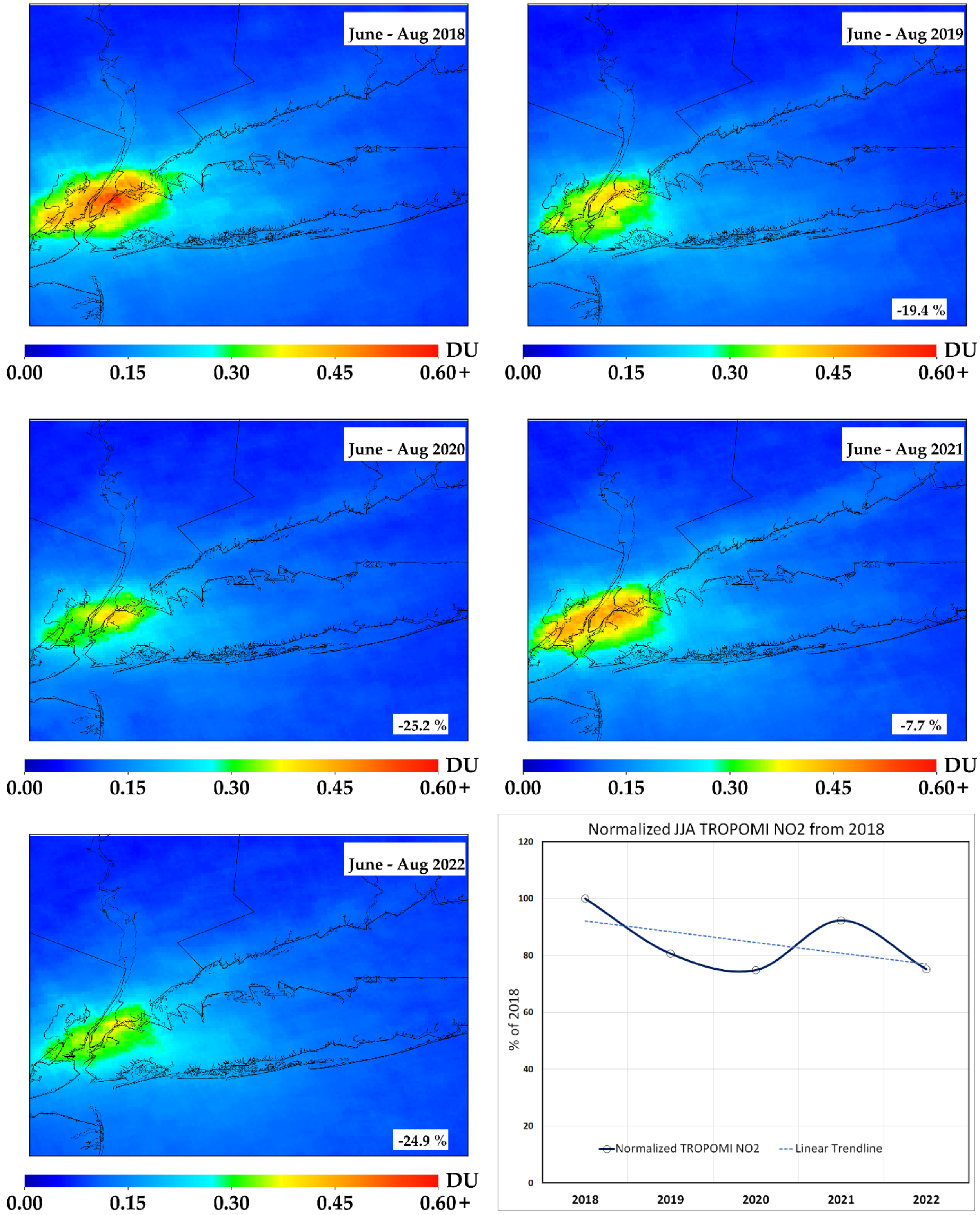
During ozone events in Connecticut, NO2 images from TROPOMI have verified that nearby NO2 emissions from the New York Metropolitan area have the highest impact on ozone formation over LIS and transport into Connecticut. Figure 3-18 shows the August 5, 2022 ozone event over Connecticut (AirNow map left) and the TROPOMI NO2 column (right). The AirNow map shows monitor locations and estimated extent of concentrations within various levels of the Air Quality Index (AQI). AQI levels above 100 are above the NAAQS. Note that most of the NO2 column, which resides in the lower troposphere, extends from NYC into LIS and Connecticut, where ozone formation takes place. TROPOMI areas in white are areas where no readings were recorded due to interference from cloud cover.

Figure 3-18. *August 5, 2022 Ozone event showing ozone AQI levels (left) and TROPOMI column NO2 concentrations.*



TROPOMI data in Figure 3-19, analyzed and plotted by Dr. Dan Goldberg, George Mason University, shows the JJA NO2 column trends from 2018 through 2022. During the summer of 2020, the NO2 JJA averaged column shows the lowest levels of the five years shown, likely due to the economic downturn caused by COVID-19. NO2 emissions can be highly variable during the summer months also due to meteorological variables, since hotter summers generally produce more NO2 emissions with increased power generation for refrigeration and air conditioning. The final chart in the figure shows that, despite these annual variations, the TROPOMI NO2 column concentrations over the NYC area have been decreasing since 2018.

Figure 3-19. *Summer Month (JJA) TROPOMI NO2 Column Averages Produced by Dr. Dan Goldberg, George Mason University. NO2 concentration is indicated in Dobson Units (DU) and percentages are relative to 2018.*



3.10 Conclusion

Trends indicate that reductions of nitrogen oxide emissions have been effective in reducing the extent of ozone exceedances in the OTR such that the focus of exceedances is now generally only on the coastal areas of Long Island Sound. However, in spite of continued reductions of precursor emissions throughout the region, the magnitude of exceedances remains at levels seen in coastal Connecticut since 2017. The New York Metropolitan area and heavy traffic along the Interstate-95 corridor remain strong sources of nitrogen oxide precursors contributing to the formation of ozone over Long Island Sound and the Connecticut shoreline.

4 Base Year and Future Year Emission Estimates

The Implementation Rule for the 2015 National Ambient Air Quality Standards (Implementation Rule)[30] established the requirements for a base year inventory and a periodic emissions inventory (PEI) every three years thereafter for states to satisfy sections 182(a)(1) and 182(a)(3)(A) of the CAA, respectively.

The Implementation Rule establishes that the base year inventory should be consistent with the baseline year for demonstrating Reasonable Further Progress (RFP) to obtain minimum required emission reductions. The Implementation Rule further specifies that the baseline emissions inventory for RFP should be the triennial emissions inventory year nearest to the time of designation as nonattainment. Connecticut was designated nonattainment for the 2015 standards in 2018, at which time the most recent triennial inventory year was 2017. Therefore, Connecticut is using 2017 for the base year inventory.

Additional guidance on development of inventories used is provided by EPA in Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations, EPA-454/B-17-002, May 2017. DEEP has worked with EPA to develop these triennial inventories and commits to continue to develop and submit PEI.

This section summarizes the emissions of ozone precursors (i.e., VOC and NOx) from Connecticut's two nonattainment areas, Greater Connecticut and the Southwest Connecticut portion of the NY-NJ-CT nonattainment area, in the baseline year of 2017. This section also provides descriptions of control measures, including those relied upon to meet CAA reasonable further progress (RFP) and attainment requirements, and provides estimates of projected 2023 emissions in Connecticut's nonattainment areas resulting from state and federal measures.

4.1 2017 Base Year Ozone Season Day Inventory

Connecticut's 2017 RFP base year inventory draws on data from the 2017 National Emissions Inventory (NEI). The data in the NEI is developed primarily from source information submitted by State and Local agencies and supplemented by EPA. The NEI provides annual estimates of VOC and NOx emissions with sources grouped into the following general categories:

- **Stationary Point Sources:** Industrial or commercial operations classified in 2017 as major sources of VOC or NOx are included in the point source inventory. Examples include power plants (also referred to as electric generating units or EGUs), municipal waste combustors (MWC), factories, large industrial and commercial boilers and other fuel burning equipment. Also included in the point source inventory are emissions from aircraft (landings and take-offs), airport ground support equipment (GSE), and railyard locomotives.

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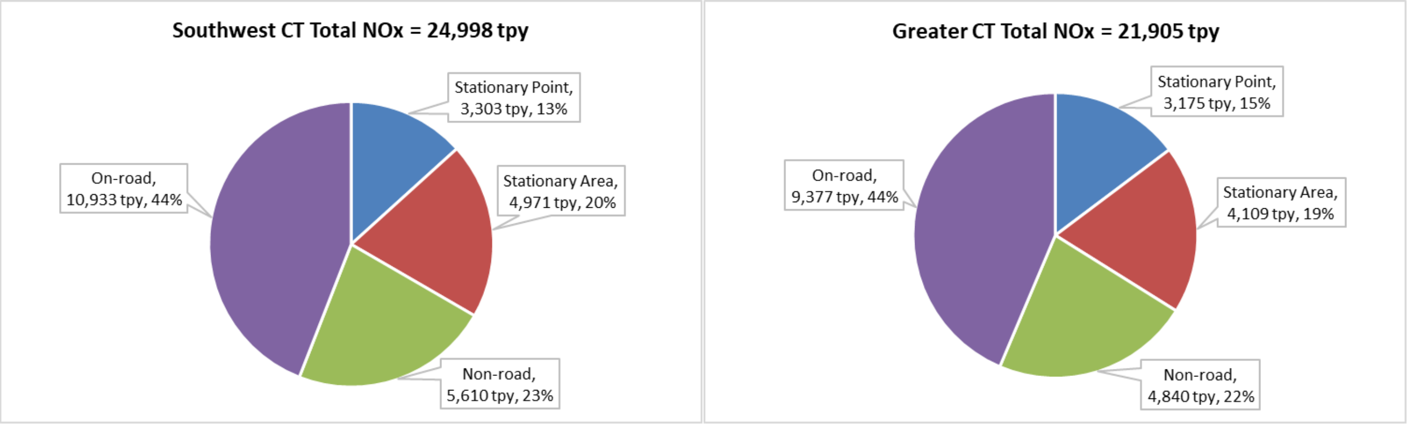
[30] "Implementation of the 2015 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements"; 83 FR 62998; December 6, 2018.

- **Stationary Area Sources**: Also called nonpoint sources these stationary sources are too small to be inventoried individually as stationary point sources and are grouped by category in the inventory on a county total basis. Example categories include residential heating, commercial combustion, and commercial and consumer solvent use.

- **On-Road Mobile Sources:** Also referred to as highway mobile sources, these include exhaust and evaporative emissions from cars, buses, motorcycles, and trucks traveling on state and local roads. On-road emissions for 2017 were developed by the Connecticut Department of Transportation (CTDOT) using the MOVES model and were approved into Connecticut's SIPs for the 2008 ozone NAAQS for both the Greater Connecticut and Southwest Connecticut nonattainment areas.[31] Section 6 further explains the 2017 and 2023 motor vehicle emissions budgets used.

- **Non-Road Mobile Sources:** Also referred to as off-highway mobile sources, these include exhaust and evaporative emissions from mobile sources that are not generally traveling on state and local roads. Examples include construction equipment such as backhoes and graders; recreational equipment such as all-terrain vehicles and off-road motorcycles; commercial and residential lawn and garden equipment such as lawn mowers and leaf blowers; industrial equipment such as forklifts and sweepers and marine equipment such as recreational watercraft.

Figure 4-1. *2017 National Emissions Inventory NOx Emissions for Connecticut Nonattainment Areas in Tons per Year (tpy).*



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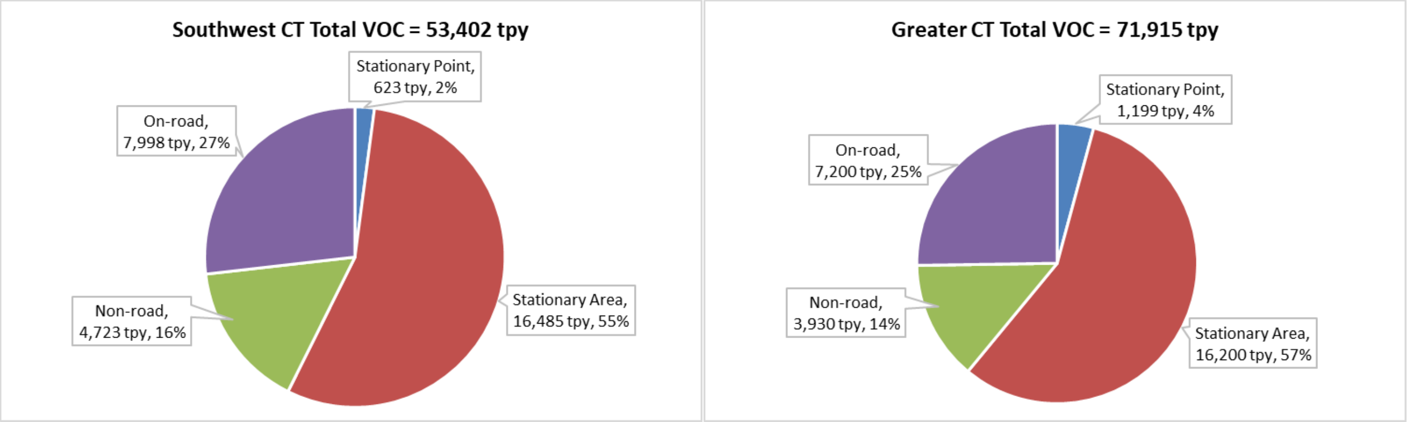
[31] 83 FR 49297

Figure 4-2. *2017 National Emissions Inventory VOC Emissions for Connecticut Nonattainment Areas in Tons per Year (tpy).*



Ozone Season Day (OSD) Emissions

To determine ozone season day emissions, DEEP started with detailed modeling platform data based on the 2017 NEI. DEEP used the 2017gb inventory which is documented in EPA's *Technical Support Document (TSD): Preparation of Emissions Inventories for the 2017 North American Emissions Modeling Platform* and available for download at EPA's website: https://gaftp.epa.gov/Air/emismod/2017/.

July was selected as the month most representative of the ozone season based on combined NOx and VOC emissions profiles shown for the modeling platform (see *Figure 4-3* and *Figure 4-4*, below).

Figure 4-3. *2017 Ozone Precursor Emissions by Month in Southwest Connecticut.*

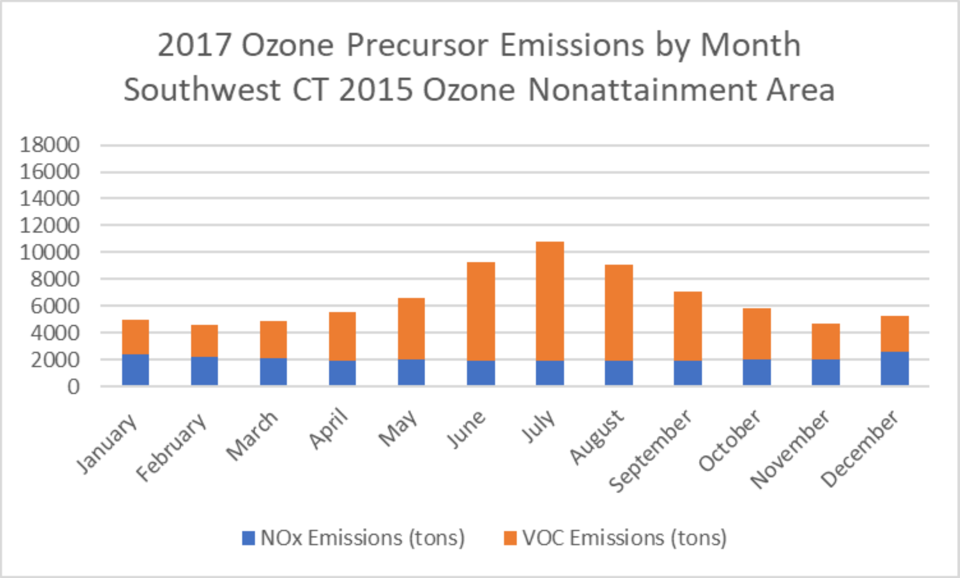
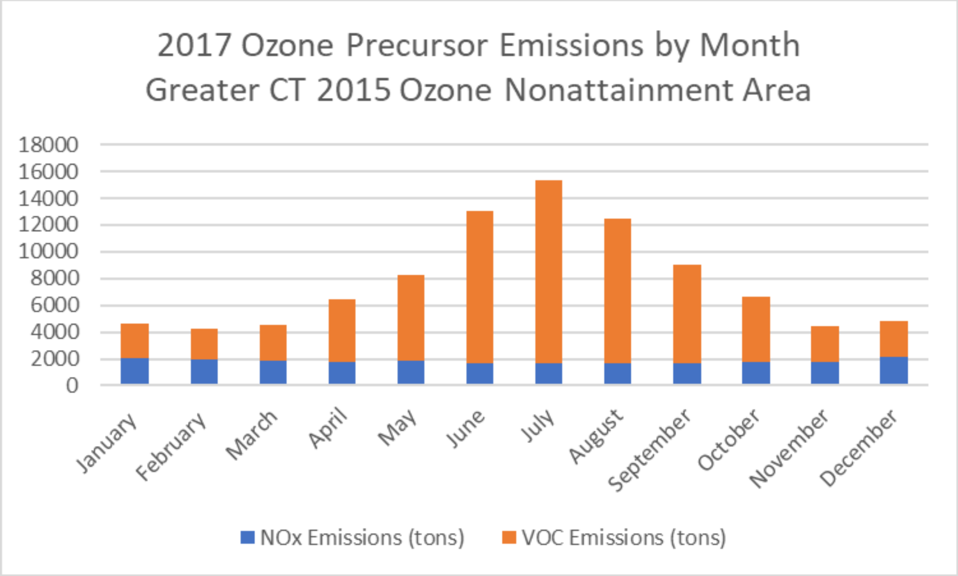
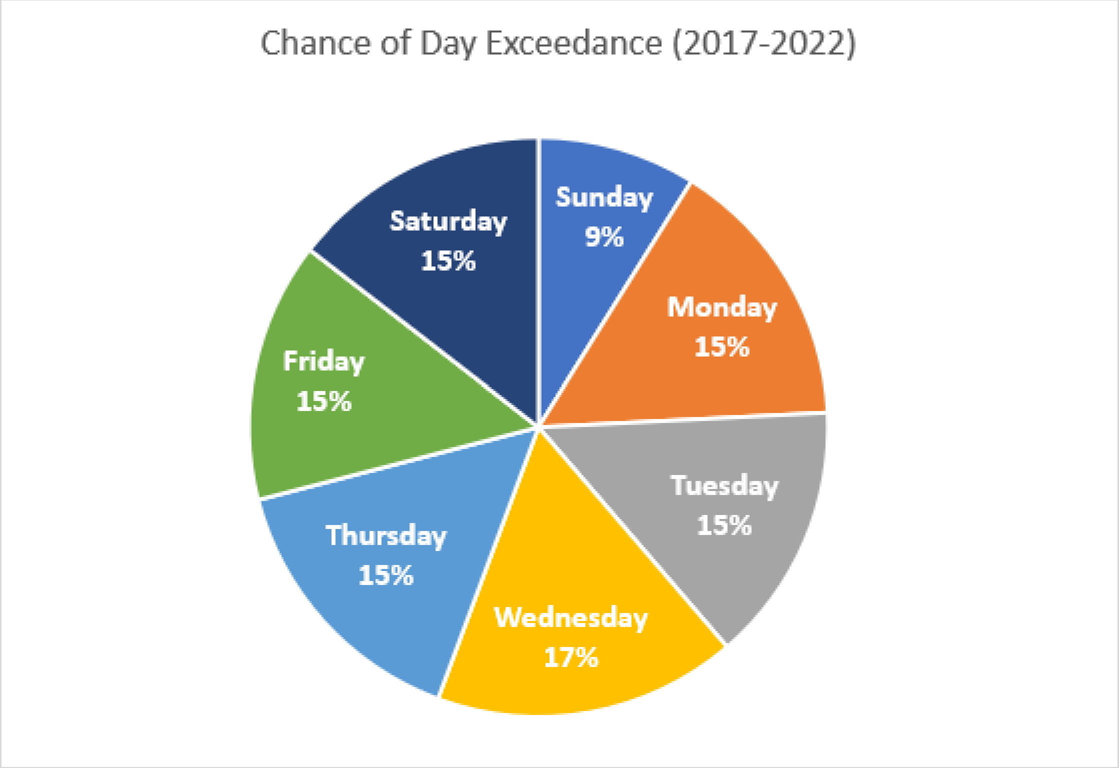


Figure 4-4. *2017 Ozone Precursor Emissions by Month in Greater Connecticut.*



Using data from 2017 through 2022, DEEP analyzed the typical occurrence of ozone events to determine if there was a day of week bias. If there were no bias then the likelihood of an exceedance on any particular day of the week would be approximately 14.3 percent. Data in Figure 4-5 shows a slight bias toward Wednesday and away from Sunday. A Saturday exceedance is as likely to occur as most weekdays. Given the distribution of ozone exceedances and the likelihood of weekend exceedances, DEEP decided it was appropriate to include weekend emissions in the calculation of ozone season day emissions.

Figure 4-5. *Day of Week on which an Exceedance of the Ozone Standards in Connecticut occurred from 2017-2022 as Percentage.*



Therefore, ozone season day emissions were calculated based on emissions from July supplemented with motor vehicle emissions budgets. Summaries of Connecticut's 2017 base year anthropogenic emissions inventory, in tons per ozone season day, are provided in Table 4-1 and Table 4-2 below.

Table 4-1. *Summary of Southwest Connecticut Anthropogenic NOx and VOC Emissions for 2017 Ozone Season Day.*

Source Category	Ozone Season Day NOx (tons/ozone season day)	Ozone Season Day VOC (tons/ozone season day)
Stationary Point	7.7	1.6
Stationary Area	10.4	42.7
On-Road Mobile	24.6	17.6
Non-Road Mobile	15.0	18.5
Total Anthropogenic	57.7	80.4

Source: Estimates of 2017 emissions are based on EPA's 2017 inventory except for on-road mobile emissions which are from CTDOT's Air Quality Conformity Determination.

Table 4-2. *Summary of Greater Connecticut Anthropogenic NOx and VOC Emissions for 2017 Ozone Season Day.*

Source Category	Ozone Season Day NOx (tons/ozone season day)	Ozone Season Day VOC (tons/ozone season day)
Stationary Point	6.8	1.4
Stationary Area	10.4	42.4
On-Road Mobile	22.2	15.9
Non-Road Mobile	11.1	15.6
Total Anthropogenic	50.5	75.3

Source: Estimates of 2017 emissions are based on EPA's 2017 inventory except for on-road mobile emissions which are from CTDOT's Air Quality Conformity Determination.

Figure 4-6 and Figure 4-7 graphically depict the 2017 base year emission estimates for NOx and VOC emissions for Connecticut's nonattainment areas. In Southwest Connecticut, the largest contributing sectors to anthropogenic NOx emissions are on-road and non-road sources, contributing 43 percent and 26 percent, respectively. Stationary point (13 percent) and stationary area sources (18 percent) are lesser contributions. Similarly, in Greater Connecticut, the largest contributing sectors to anthropogenic NOx emissions are on-road and non-road sources, contributing 44 percent and 22 percent, respectively. Stationary area sources are also a larger contributor (21 percent), while stationary point sources are a smaller contributor (13 percent).

The largest sources of anthropogenic VOC emissions in Southwest Connecticut are stationary area (53 percent), non-road mobile (23 percent), and on-road mobile sources (22 percent), with stationary area sources only contributing two percent. The largest sources of anthropogenic VOC emissions in Greater Connecticut are stationary area (56 percent), non-road mobile (21 percent), and on-road mobile sources (21 percent), with stationary area sources only contributing two percent.

Figure 4-6. *2017 Base Year Anthropogenic NOx Inventories for Connecticut's Nonattainment Areas.*

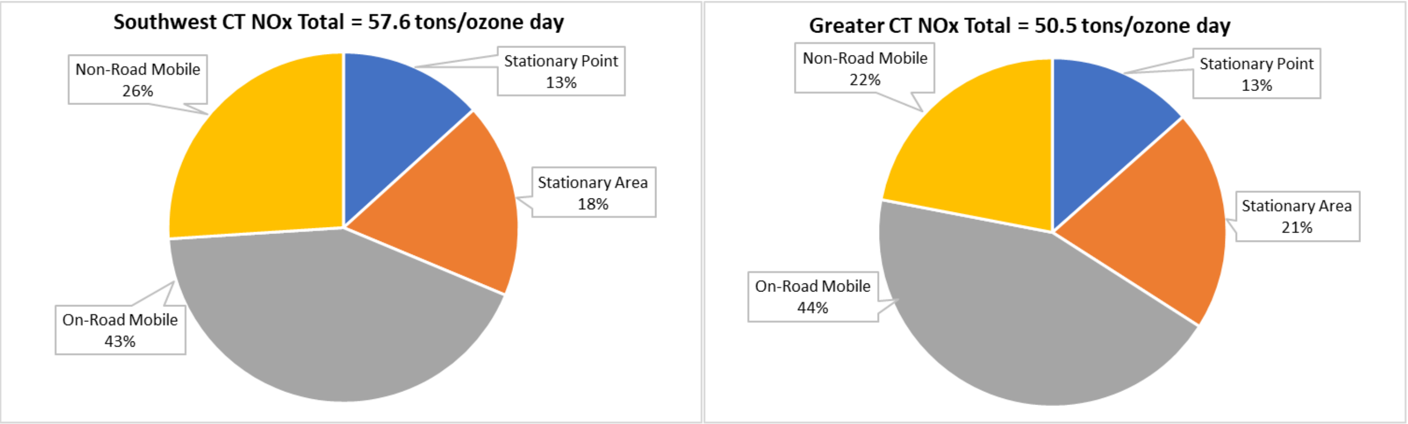
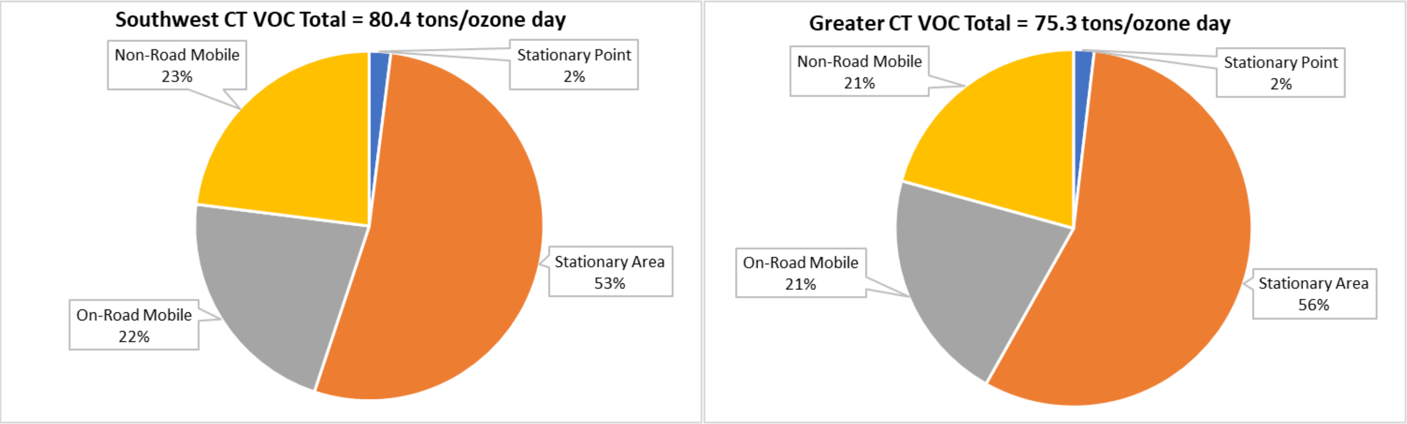


Figure 4-7. *2017 Base Year Anthropogenic VOC Inventory for Connecticut's Nonattainment Areas.*



On-road mobile sources are the largest source category for NOx emissions in both of Connecticut's nonattainment areas. In total, on-road mobile sources contribute 46.8 tons of NOx and 33.5 tons of VOC per ozone season day across Connecticut.

4.2 Control Measures Included in Future Year Projections

DEEP has implemented all emission control programs and measures mandated by the CAA as well as other measures necessary to meet RFP and RACT/RACM requirements in Southwest and Greater Connecticut for the 2015 ozone NAAQS. This section provides an overview of control measures put in place to reduce ozone precursor emissions covering the various sectors of the inventory. Many of these control measures have been in place prior to the existence of the 2015 standard and are required to provide ongoing emissions reductions in support of prior SIP submittals. Other measures, as noted, did not take effect until as recently as 2023. See Section 4.3 for a summary of projected 2023 emission levels that result from the post-2017 control measures.

Mobile Source and Fuels Control Programs

Numerous federal and state control programs have been implemented to reduce ozone precursor emissions from mobile sources. These programs have established increasingly more stringent emission standards for new on-road and non-road engines and equipment, with associated changes required for fuel composition, as well as implementation of inspection programs to ensure continued compliance by registered on-road motor vehicles. The gradual replacement of older on-road vehicles and non-road equipment due to purchases of newer models, when coupled with increasingly stringent emission standards, has resulted in continuing reductions in ozone precursor emissions over time.

Table 4-3 provides a summary of major ozone precursor emission control programs implemented statewide in Connecticut for on-road vehicles that have occurred since the enactment of the 1990 Clean Air Act Amendments. Older programs are included in the table because they continue to contribute to emission reductions in cases where owners replace older vehicles with more recent model year vehicles subject to tighter emission standards.

Federal programs establishing NOx and VOC emission standards for new cars and light/medium-duty trucks include the Tier 1 (phased-in between 1994 and 1996), National Low Emission Vehicle (NLEV, starting in 1998 in Connecticut), Tier 2 (phased-in between 2004 and 2009), and Tier 3 (phased-in between 2017 and 2025) programs. The Tier 3 program, originally approved in 2014 was amended and approved in 2015. Motorcycle emission standards were originally established in 2004 but were included in the amended Tier 3 program update in 2015. EPA also promulgated rules establishing emission standards for heavy-duty trucks in 2000.

Table 4-3. *On-Road Mobile Sources Control Strategies.*

Control Strategy	Pollutant		Federal Program	State Program	Rule Approval Date	Initial Year of Implementation
	VOC	NOx				
Tier 1 Vehicle Standards	•	•	•		6/5/1991	1994-1996
Reformulated Gasoline – Phases I & II	•	•	•		2/16/1994	1995 & 2000
On-board Refueling Vapor Recovery	•		•		4/6/1994	1997-2005
National Low Emission Vehicle (NLEV) Program	•	•	•		1/7/1998	1998-2003 (in CT)
Tier 2 Motor Vehicle Controls/30ppm Sulfur Gasoline	•	•	•		2/10/2000	2004-2009
Heavy-Duty Diesel Vehicle Controls and Fuels	•	•	•		10/6/2000[32]	2004-2005
CT OBD-II Enhanced I/M Program	•	•		•	12/5/2008[33]	2004
2007 Highway Rule/15ppm Sulfur Diesel Fuel	•	•	•		1/18/2001[34]	2006-2010
Highway Motorcycle Exhaust Emission Standards	•	•	•		1/15/2004[35]	2006-2010
CT Low Emission Vehicle Phase 2 (CT LEV2)	•	•	•	•	3/17/2015[36]	2007-2008
CT Low Emission Vehicle Phase 3 (CT LEV3)	•	•		•	8/1/2013[37]	2015-2025

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[32] 65 FR 59896
[33] 73 FR 74019
[34] 66 FR 5002
[35] 66 FR 5002
[36] RCSA 22a-174-36b
[37] RCSA 22a-174-36c

Tier 3 Vehicle Standards/10ppm Sulfur Gasoline	•	•	•		4/28/2014[38]	2017-2025
Amendments to Tier 3 Motor Vehicle Emission and Fuel Standards – including motorcycles	•	•	•		2/19/2015[39]	2017-2025
The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks	•	•	•		4/30/2020[40]	2022-2026
Improvements for Heavy-Duty Engine and Vehicle Test Procedures, and Other Technical Amendments	•	•	•		12/30/2021[41]	2023 and later

Additional federally required fuel programs in place for on-road vehicles include lower volatility reformulated gasoline,[42] low sulfur gasoline,[43] and ultra-low sulfur diesel fuel.[44] The lower sulfur limits were necessary to minimize contamination of catalysts used to achieve greater tailpipe NOx emission reductions. In addition, federal rules required new cars and light/medium duty trucks to be equipped with on-board refueling vapor recovery (ORVR) systems[45] to control refueling emissions. The requirement was phased-in for new vehicles between 1997 and 2006. EPA also established rules[46] in 2000 that require HDVs, up to 10,000 lbs gross vehicle weight rating (GVWR), be equipped with ORVR systems. The ORVR systems for HDVs began to be equipped on model year 2004 vehicles and were fully phased in on HDVs by model year 2006. Most recently, EPA established the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks that increases the affordability of new and more efficient vehicles, reducing the GHG emissions released.

In addition to these federal programs, Connecticut has implemented several in-state programs to control emission from mobile sources. After playing a major role in prompting EPA to promulgate the NLEV program in the late 1990's, Connecticut has continued to require new vehicles sold in the state to meet California's Low Emission Vehicle (LEV) standards, which are more stringent than federal requirements. In December 2004, DEEP adopted Regulations of Connecticut State Agencies (RCSA) section 22a-174-36b, which mirrors California's LEV II regulations and includes zero emission vehicle requirements.[47] The Connecticut LEV II regulation applies to model year 2008 through 2014 passenger car and light-duty trucks and model year 2009 through 2014 medium-duty vehicles. The LEV II standards also include a zero-emission vehicle (ZEV) provision, as well as GHG emission standards for 2009 through 2016 model year passenger cars, light-duty trucks, and medium-duty passenger vehicles. The CT LEV

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[38] 79 FR 23414
[39] 80 FR 9078
[40] 85 FR 24174
[41] 85 FR 24174
[42] 40 CFR Part 80 Subpart D
[43] 40 CFR 1090.205
[44] 40 CFR 1090.305
[45] See https://www.epa.gov/ozone-pollution/fact-sheet-final-rule-determining-widespread-use-onboard-refueling-vapor-recovery. On May 16, 2012, EPA completed a finding (77 FR 28772) that ORVR technology was in widespread use, thereby enabling EPA to waive the requirement for affected states to implement Stage II refueling programs at gasoline stations due to the duplicative nature of the two programs. DEEP subsequently repealed its Stage II program on 7/8/2015.
[46] 65 FR 59896
[47] DEEP also submitted revisions to the LEV II program on 12/22/2005 and 8/4/2009.

II program was approved as a SIP revision by EPA in March 2015.[48] In August 2013, DEEP adopted RCSA section 22a-174-36c, which follows California's LEV III regulations to create increasingly more stringent emission standards for criteria pollutants and GHG for new passenger vehicles, light-duty trucks, and medium-duty passenger vehicles of model year 2015 and newer. The CT LEV III program was proposed for approval as a SIP revision by EPA in January 2018.[49]

Connecticut's LEV III New Vehicle Emission Standards

Sections 209(a) and (b) of the Clean Air Act prohibit states from adopting motor vehicle emission standards for new vehicles, but also provides a waiver provision allowing the State of California to adopt standards more stringent than federal standards under certain conditions. Notwithstanding the section 209(a) prohibition, CAA section 177 allows other states to adopt vehicle standards that are identical to California standards which have received the section 209(b) waiver.

Connecticut has long been committed to reducing motor vehicle emissions beyond federal requirements through the State's LEV program. Connecticut General Statutes (CGS) section 22a-174g requires DEEP to adopt regulations to remain consistent with California LEV standards to ensure consistency with CAA section 177. In August 2012, the California Air Resources Board (CARB) finalized major new revisions to the California program[50] and EPA issued the required CAA section 209(b) waiver in December 2012. The CA LEV III revisions include more stringent exhaust and evaporative emission standards for both criteria pollutants and greenhouse gases for new passenger cars, light duty-trucks, and medium-duty vehicles. CARB estimates the changes will reduce ozone precursor emissions by about 75 percent from 2014 levels when fully implemented in 2025.[51] California, stakeholder states (including Connecticut), and the regulated community worked with EPA during California's rulemaking process to harmonize the standards with federal Tier III requirements and make it easier for the regulated community to meet a national standard.

Following the updates to the California program, DEEP proposed amendments to Connecticut's regulations, officially adopting RCSA 22-174-36c (CT LEV III) on September 1, 2013, to be consistent with the standards specified in the CA LEV III program. RCSA 22-174-36c replaced a temporary emergency regulation that was established in December 2012 to ensure the two-year lead time required by CAA section 177 was satisfied so that the more stringent standards could be in place for 2015 model year vehicles. Connecticut is one of only 14 states, including Washington D.C., that have adopted the California LEV III requirements.

The CT LEV III program establishes more stringent non-methane organic gases (NMOG), NOx, particulate matter (PM), and evaporative emission standards for passenger cars, light-duty

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[48] 80 FR 13768

[49] 83 FR 2097

[50] See the CARB webpage: https://www.arb.ca.gov/regact/2012/leviiighg2012/leviiighg2012.htm.

[51] See the CARB webpage: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/about

trucks, and medium-duty passenger vehicles beginning with model year 2015. The regulation also includes revised ZEV mandates beginning with model year 2018 and revised GHG standards beginning with model year 2017. In addition, through incorporation by reference to the California regulations, RCSA 22-174-36c extends full useful life durability requirements from 120,000 miles to 150,000 miles.

Adoption of the California LEV III standards in Connecticut extends vehicle standards out to 2025. The CT LEV III standards provide additional criteria pollutant reductions beyond EPA's Tier 2 and Tier 3 vehicle standards.

As discussed further in Section 8, infra, Connecticut is pursuing the adoption of both LEV IV and the next iteration of ZEV standards (Advanced Clean Cars II), which were finalized by California in November 2022. If adopted in Connecticut, these standards would further reduce emissions from new light-duty vehicles beginning with the 2027 model year.

Connecticut's Motor Vehicle Inspection and Maintenance (I/M) Program

CAA section 182(b)(4) requires moderate nonattainment areas to provide for a basic motor vehicle inspection and maintenance program. Additionally, because Connecticut is in the OTR, portions of Connecticut's nonattainment areas that are in metropolitan statistical areas with a population of 100,000, or more, are required to implement an enhanced I/M program pursuant to CAA 184(b)(1).[52] Federal I/M program requirements are specified in 40 CFR 51 Subpart S. All elements of the basic program described in 40 CFR 51.352 are included in the enhanced program as described in 40 CFR 51.351.

Connecticut has required in-use vehicles to undergo periodic emission inspection and maintenance since 1983. The program has been modified over the years to meet CAA-required enhancements and to accommodate technological advancements in new vehicles such as on-board diagnostics (OBD).

Due to prior more stringent nonattainment designations, Connecticut implements an enhanced I/M program statewide, thus exceeding the I/M requirements for this SIP. Moreover, whereas EPA's I/M requirements only cover gasoline powered vehicles up to 8,500 pounds (lbs.) gross vehicle weight rating (GVWR), Connecticut's I/M program increases the number of vehicles subject to the enhanced standard by testing both gasoline and diesel motor vehicles through 10,000 lbs. GVWR.

Connecticut's motor vehicle inspection and maintenance (I/M) program currently meets the requirements of an enhanced I/M program based on prior state-wide designations of serious and severe for the 1-hour ozone standards. The I/M SIP, consisting of a program narrative and implementing authority contained in RCSA 22a-174-27 and Connecticut General Statutes (CGS) 14-164c, was approved into Connecticut's SIP on December 5, 2008 [73 FR 74019]. Connecticut recertified this program as satisfying the moderate requirements when it made the submittals in

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[52] Litchfield County is not part of a metropolitan statistical area and does not fall under this requirement.

2017. The program was approved as satisfying moderate nonattainment requirements on March 29, 2019 [84 FR 11884] and the associated notice of proposed rulemaking [February 1, 2019; 84 FR 1015] recognized the program as enhanced.

In 2021, Connecticut entered into a contract with Opus Inspection Incorporated to provide administration of the Connecticut program for the next six years. Included in the contract are program enhancements including customer service improvements such as vehicle identification number verification and most notably conditions for expansion to emissions testing for certain medium and heavy-duty vehicles up to 14,000 lbs. GVWR.[53]

DEEP and the Connecticut Department of Motor Vehicles (DMV) coordinate to evaluate and provide periodic evaluations of its enhanced motor vehicle I/M Program. Reports are written and submitted to EPA in fulfillment of the requirement to provide annual I/M reports pursuant to 40 CFR 51.366 and can be found on DEEP's webpage.[54]

This approved enhanced I/M program will continue to be implemented statewide and remains an important control strategy.

Federal Tier 3 Emission Standards and Gasoline Sulfur Requirements

On April 28, 2014, EPA published the final rule establishing the federal Tier 3 vehicle emission and fuel standards.[55] As with the Tier 2 program, Tier 3 was designed considering the vehicle and its fuel as an integrated system. The vehicle standards will reduce both tailpipe and evaporative emissions from passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles, resulting in significant reductions in pollutants such as ozone, particulate matter, and air toxics across the country. The Tier 3 standards are intended to harmonize with California's LEV program, thus creating a federal vehicle emissions program that will allow automakers to sell the same vehicles in all 50 states. The standards will be implemented over the same timeframe as the federal greenhouse gas/fuel efficiency standards for light-duty vehicles (promulgated by EPA and the National Highway Safety Administration in 2012), as part of a comprehensive approach toward regulating emissions from motor vehicles.

The Tier 3 standards include new light and heavy-duty vehicle emission standards for exhaust emissions of NMOG+NOx, PM, and evaporative emissions, to be phased in between model years 2017 (2018 for heavier vehicles) through 2025. The final standards are in most cases identical to those of California's LEV III program. The rule also required the reduction of gasoline sulfur content from 30 ppm average down to a 10 ppm average beginning in 2017. The reduction in average sulfur content of gasoline will optimize catalyst performance with two beneficial effects: 1) Vehicles designed to the Tier 3 tailpipe exhaust standards will be able to meet those standards in-use for the duration of their useful life, and 2) Immediate emission reductions will

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[53] Connecticut Department of Administrative Services Contract Portal, found at: https://biznet.ct.gov/SCP_Documents/Results/22360/Final%20DMV%20Opus%20Contract%20with%20Exhibit%20A%2022%20January%202021.pdf. Page 8, section 4.9.

[54] https://portal.ct.gov/DEEP/Air/Mobile-Sources/Vehicle-Emission-Testing

[55] 79 FR 23414

be realized from all the gasoline-fueled vehicles on the road at the time the new lower sulfur limits are implemented in 2017.

In the Tier 3 rule, EPA cited research studies that examined the effect of various gasoline sulfur levels on Tier 2 vehicles. The results indicated that reducing sulfur levels in gasoline from 30 ppm to 10 ppm could result in NOx reductions from Tier 2 vehicles of 12-27 percent and hydrocarbon reductions of 11-13 percent. EPA also evaluated the national impact of the Tier 3 program using the MOVES model, finding a 10 percent reduction in national on-road NOx emissions in 2018 due to the program, with a 35 percent reduction in 2030. VOC emission reductions were estimated to be 3 percent in 2018 and 16 percent in 2030 for the national on-road inventory due to the Tier 3 requirements.

The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks

On April 30, 2020, the National Highway Traffic Safety Administration (NHTSA) and EPA published a final rule to amend and establish carbon dioxide (CO_2) standards for MY 2021 and later, as well as establish new fuel economy standards for MY 2022 through 2026.[56] The SAFE Vehicles Rule amends the Congressionally-mandated Corporate Average Fuel Economy (CAFE) and Light-Duty Vehicle Greenhouse Gas Emissions Standards, of which the NHTSA set and enforce, while EPA calculates average fuel economy standards and GHG emissions standards.

The rule applies to companies that manufacture or sell new light-duty trucks and vehicles, and medium-duty passenger vehicles and aims to facilitate the ability of motor vehicle manufacturers to meet the requirements of the program under a single national program. The CAFE and CO_2 emission standards will increase at 1.5 percent each year in stringency from MY 2020 levels to MY 2021 through 2026. Both standards are vehicle-footprint-based standards and become more stringent every year from 2021 to 2026, when compared to MY 2020 standards. Using footprint-based standards assures that the burden of compliance is distributed across all vehicle manufacturers and footprints.

By MY 2030, EPA's standards are projected to require 201 grams per mile (g/mi) of CO_2 and NHTSA's standards are projected to require 40.5 miles per gallon (mpg). The agencies note that the CAFE and CO_2 compliance levels are often lower than the real-world CO_2, and usually higher than real-world fuel economy. A portion of EPA's expected CO_2 decreases will be achieved through improvements in air conditioner leakage and using alternative refrigerants.

Non-Road Compression Ignition (Diesel) Engines

Non-road engines are used in a variety of applications such as construction equipment, outdoor power equipment, farm equipment, lawn and garden equipment, marine vessels, locomotives, and aircraft. Prior to the mid-1990's, emissions from these engines were largely unregulated. EPA has since issued several rules regulating emissions from new and, in some cases,

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[56] 85 FR 24174

remanufactured non-road engines.[57] Major non-road emission control measures and fuel programs are summarized in Table 4-4 and accounted for in the emissions inventories used for this attainment demonstration. Older programs are included in the table because they continue to contribute to emission reductions through fleet turnover as owners replace older equipment with more recent model year equipment subject to tighter emission standards.

EPA rules have established four tiers of emission standards for new non-road diesel engines. EPA's first non-road regulations were finalized in 1994,[58] when Tier 1 emission standards were issued for most large, greater than 50 horsepower (hp), land-based non-road compression-ignition (CI, or diesel) engines used in applications such as agricultural and construction equipment, which were phased in between 1996 and 2000.

In 1998, EPA promulgated Tier 1 standards for smaller (< 50 hp) diesel engines, including marine propulsion and auxiliary engines, which required phase-in between 1999 and 2000.[59] At the same time, EPA issued more stringent Tier 2 emission standards for all non-road diesel engine sizes to be phased in from 2001 to 2006 and Tier 3 standards requiring additional reductions from new diesel engines between 50 and 750 hp to be phased in from 2006 to 2008.

EPA finalized Tier 4 rules for non-road diesel engines in 2004. The rule integrated new diesel engine emission standards with fuel requirements. The emission standards applied to most construction, agricultural, industrial, and airport equipment, and were phased in between 2008 and 2015. The Tier 4 emission standards do not apply to diesel engines used in locomotives and marine vessels.

The rule also established a two-phase reduction in diesel fuel sulfur levels, limiting concentrations to 500 ppm in 2007 and 15 ppm in 2010 (2012 for locomotives and marine vessels). The lower sulfur diesel levels minimize damage to emission-control systems used to meet the Tier 4 engine exhaust standards.

Non-Road Spark Ignition (e.g., Gasoline) Engines

EPA rules regulate small (less than 25 hp) non-road spark-ignition (SI) engines (except marine and recreational engines) in two phases. EPA's Phase 1 standards for new small SI engines were issued in 1995.[60] These engines, which usually burn gasoline, are used primarily in lawn and garden equipment. The standards apply to model year 1997 and newer engines.

EPA subsequently issued more stringent Phase 2 emission standards for both small non-handheld engines (e.g., lawn mowers, generator sets, air compressors) and small handheld

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[57] Tables of emission standards by engine type are posted by EPA at: https://www.epa.gov/regulations-emissions-vehicles- and-engines/regulations-emissions-non-road-vehicles-and-engines and https://www.epa.gov/emission-standards-reference-guide/epa-emission-standards-non-road-engines-and-vehicles.

[58] 59 FR 31306

[59] 63 FR 56968

[60] 60 FR 34582

engines (e.g., leaf blowers, chain saws, augers) in 1999[61] and 2000,[62] respectively. Phase 2 standards were phased-in from 2001 to 2007 for non-handheld engines and from 2002 to 2007 for handheld engines.

EPA finalized emission standards for new gasoline spark-ignition marine engines in 1996[63] to be phased-in between 1998 and 2006. These engines, typically based on simple two-stroke technology, are used for outboard engines, personal watercraft, and jet boats.

EPA's 2002 rulemaking also included exhaust emission standards for non-road recreational spark-ignition engines and vehicles.[64] These recreational land-based engines are found in snowmobiles, off-highway motorcycles, and all-terrain-vehicles (ATVs). The standards were phased-in between 2006 and 2007, except for snowmobiles, which had until 2009 to comply. In addition, snowmobiles were subject to more stringent standards that became effective in 2010 and 2012. Plastic fuel tanks and rubber hoses available on recreational vehicles are also regulated for permeation, to minimize the fuel lost through the component walls. The permeation standards for fuel tanks and fuel hoses on recreational vehicles were effective in 2008.

In 2008, Phase 3 emission standards were issued for new marine SI engines and land-based SI at or below 19 kW, such as those used in lawn and garden equipment.[65] These new standards began in 2010 for new marine SI engines and in 2011 or 2012 for the land-based SI engines. EPA estimates that by 2030, this rule will decrease VOC emissions by 604,000 tons/year, NOx emissions by 132,200 tons/year, and PM2.5 emissions by 5,500 tons/year.

Marine Diesel Engines

Marine diesel engines include small auxiliary and propulsion engines, medium-sized propulsion engines on coastal and harbor vessels, and very large propulsion engines on ocean-going vessels. EPA published a final rule in 2002 that included new engine emission standards for recreational marine diesel engines.[66] These are marine diesel engines rated over 37 kW, or >50 hp, which are used in yachts, cruisers, and other types of pleasure craft. The standards were phased-in, beginning in 2006, depending on the size of the engine. By 2009, emission standards were in effect for all recreational, marine diesel engines.

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[61] 64 FR 15208
[62] 65 FR 24268
[63] 61 FR 52088
[64] 67 FR 68242
[65] 73 FR 59034
[66] 67 FR 68242

Table 4-4. *Non-Road Mobile Sources Control Strategies.*

Non-Road Engine Category	Date of Final Rule	Implementation Phase-In (MY)
Compression Ignition (diesel) Engines		
Tier 1: Land-Based Diesel Engines > 50 hp	06/17/1994 (59 FR 31306)	1996-2000
Tier 1: Small Diesel Engines < 50 hp	10/23/1998 (63 FR 56968)	1999-2000
Tier 2: Diesel Engines (all sizes)		2001-2006
Tier 3: Diesel Engines 50 - 750 hp		2006-2008
Tier 4: All Diesel Engines (Except locomotive and marine vessels)	06/29/2004 (69 FR 38958)	2008-2015
Spark-Ignition (e.g., gasoline) Engines		
Phase 1: SI Engines < 25 hp (except marine & recreational)	07/03/1995 (60 FR 34582)	1997
Phase 2: Non-Handheld SI Engines < 25 hp	03/30/1999 (64 FR 15208)	2001-2007
Phase 2: Handheld SI < 25 hp	04/25/2000 (65 FR 24268)	2002-2007
Phase 3: SI Engines (including marine) < 19kW	10/08/2008 (73 FR 59034)	2010 - 2012
Gasoline SI Marine Engines (outboard & personal watercraft)	10/04/1996 (61 FR 52088)	1998-2006
Large Spark-Ignition Engines >19 kW (or >25 hp)	11/08/2002 (67 FR 68242)	2004 & 2007
Recreational Land-Based Spark-Ignition Engines		2006-2012
Marine Diesel Engines The Act to Prevent Pollution from Ships (APPS) implements the provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI for the United States (33 U.S.C. 1901–1912)	2/19/2015 (80 FR 9078) More info: https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-emissions-marine-vessels	US Emission Control Areas in effect: 2012 After-treatment NOx controls: 2016
Commercial Marine Diesel Engines[1] (US-flagged vessels)	12/29/1999 (64 FR 73300)	2004-2007
Recreational Marine Diesel Engines >37 kW (or >50 hp)	11/08/2002 (67 FR 68242)	2006-2009
Marine Diesel Engines (US-flagged vessels) >30 liters/cylinder	02/28/2003 (68 FR 9746) 04/30/2010 (75 FR 22896)	2004 2011-2016
Locomotive & Marine Diesel Rule (new & remanufactured) Amendments to Locomotive & Marine Diesel Rule	06/30/2008 (73 FR 37096) 10/02/2020 (85 FR 62218)	2009 -2015 2024 -2026
Spark-Ignition Engines/Equipment (marine & land engines)	10/08/2008 (73 FR 59034)	2010-2012
Locomotives New & Remanufactured Locomotives and Locomotive Engines[2]	04/16/1998 (63 FR 18978)	Tier 0: 1973-2001 Tier 1: 2002-2004 Tier 2: 2005 +
Locomotive & Marine Diesel Rule (new & remanufactured)	06/30/2008 (73 FR 37096)	2009-2015
Non-Road Diesel Fuel	06/29/2004 (69 FR 38958)	Phase 1: 2007 Phase 2: 2010 (2012 for Marine & Locomotive)

Aircraft		
Control of Air Pollution From Aircraft and Aircraft Engines 1	05/08/1997 (62 FR 25356)	1997
Control of Air Pollution From Aircraft and Aircraft Engines 2	11/17/2005 (70 FR 69664)	2005
Control of Air Pollution From Aircraft and Aircraft Engines 3	06/08/2012 (77 FR 36342)	2012 & 2014
Control of Air Pollution From Aircraft and Aircraft Engines 4	11/23/2022 (87 FR 72312)	2023 & 2028

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[1] Only applies to commercial marine diesel engines with displacements under 30 liters per cylinder.

[2] EPA has established three sets of locomotive standards, applied based on the date the locomotive was first manufactured (i.e. during the Tier 0, Tier 1, or Tier 2 periods). The applicable standards take effect when the locomotive or locomotive engine is first manufactured and continue to apply at each periodic remanufacture.

On February 28, 2003, EPA finalized emission standards for exhaust emissions from U.S.-flagged vessels with new marine diesel engines rated over 37 kW with displacements over 30 liters per cylinder (also known as Category 3 Marine Diesel Engines).[67] This marks the first time that emissions from very large marine diesel engines have been regulated. These diesel engines are used primarily for propulsion power on ocean-going vessels such as container ships, tankers, bulk carriers, and cruise ships. Most Category 3 marine diesel engines are used for propulsion on vessels engaged in international trade.

Both new and modified marine diesel engines rated above 175 hp must adhere to international standards (i.e., MARPOL convention) if vessel construction or engine modification commences on or after January 1, 2000. U.S.-flagged commercial vessels with new marine diesel engines rated over 37 kW (or >50 hp, with displacements up to 30 liters per cylinder) produced after 2003 (after 2006 for very large engines) were required to comply with EPA standards issued in 1999.[68] In October 2008, the member states of the International Maritime Organization agreed to amend MARPOL Annex VI, adopting new tiers of NOx and fuel sulfur controls. The most stringent of these new emission standards apply to ships operating in designated areas, including the newly-designated North American Emission Control Area, which was officially recognized in 2012. The Tier III standards for NOx, which become effective in 2016 along the US East Coast, are 80 percent lower than Tier I standards.

In 2008, EPA finalized the Marine Diesel Rule creating exhaust emission standards for marine spark-ignition engines (more stringent than those finalized on October 4, 1996[69]) and small land-based non-road spark-ignition engines.[70] The rule also included new evaporative emission standards for equipment and vessels using these engines. The marine spark-ignition engines and vessels affected by these standards, effective starting with the 2010 model year, include outboard engines and personal watercraft, as well as sterndrive and inboard engines. The small non-road spark-ignition engines and equipment affected by these standards, effective starting with the 2011 and 2012 model year, are those rated below 25 hp (19 kW) used in household and commercial applications, including lawn and garden equipment, utility vehicles, generators, and a variety of other construction, farm, and industrial equipment.

Locomotives

States are generally preempted from adopting standards to control emissions from locomotives. As such, Connecticut depends on EPA to establish standards. EPA established emission standards for new and remanufactured locomotives and locomotive engines in 1998.[71] At that time, three sets of standards were adopted, with applicability of the standards tied to the date a locomotive is first manufactured (i.e., 1973 through 2001, 2002 to 2004, and 2005 and later). In June 2008, EPA finalized additional standards to reduce emissions of PM and NOx from

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[67] 68 FR 9746

[68] 61 FR 73300

[69] 61 FR 52088

[70] 73 FR 59034

[71] 63 FR 18978

locomotives and marine vehicles.[72] The 2008 rule established short term Tier 3 standards and longer-term Tier 4 standards for new locomotives as well as established idling restrictions.

The remanufacturing standards do not apply to the existing fleets of locomotives owned by very small railroads, such as those which comprise the bulk of the fleet in Connecticut. The second part established near term engine-out (Tier 3) emission standards for new locomotives and marine diesel engines, phased-in starting in 2009. The third part of the program entailed setting longer-term (Tier 4) emission standards for newly-built locomotives and marine diesel engines that reflect the application of high-efficiency emission control technology. The Tier 4 emission standards began to be phased-in starting in 2014 for marine diesel engines and 2015 for locomotives (these standards are enabled due to the availability of diesel fuel capped at 15 ppm sulfur content in 2012). All new marine diesel engines with displacements less than 30 liters per cylinder (Category 1 and Category 2 engines greater than 50 hp) vessels are covered in this rulemaking.

In order to accelerate the phase-in of cleaner locomotives, CARB recently adopted the *In-Use Locomotive Regulation* aimed at forcing diesel fueled locomotives to cease operation and increasing the use of zero emission locomotives by 2030.[73] If California's In-Use Locomotive Regulation is approved by EPA for implementation, DEEP intends to evaluate the feasibility of such a rule in Connecticut. Connecticut has already electrified much of its commuter rail and CTDOT's Connecticut State Rail Plan (2022-2026) has among its objectives the electrification of all commuter rails. The plan also has goals for improved service to increase rail ridership and freight capacity in order to reduce VMT and the use of less efficient automobiles and trucks.

Aircraft

States are preempted from adopting standards to control emissions from aircraft. As such, Connecticut depends on EPA to establish standards. Control of air pollution from aircraft and aircraft engines was first regulated by EPA in a 1997 rulemaking.[74] That rule adopted the international aircraft emissions standards of the United Nations International Civil Aviation Organization (ICAO), which had been in place since 1986 and amended in 1993. The rule brought U.S. aircraft standards into alignment with international standards and applied to newly manufactured and newly certified commercial aircraft gas turbine engines with rated thrust greater than 26.7 kilonewtons (kN). ICAO adopted revised standards in 1999 for implementation beginning in 2004. In November of 2005, EPA finalized the adoption of the revised ICAO standards, to bring U.S. aircraft standards once again into alignment with international standards.[75]

In June 2012, EPA adopted additional measures to establish Tier 6 and Tier 8 aircraft standards,

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[72] 73 FR 37096

[73] https://theicct.org/publication/californias-in-use-locomotive-regulation-jul23/#:~:text=The%20In%2Duse%20Locomotive%20Regulation,before%20it%20can%20be%20implemented.

[74] 62 FR 25356

[75] 70 FR 69664

both designed to further reduce NOx emissions.[76] The Tier 6 standards applied to engines until December 31, 2013, and the Tier 8 standards apply to engines being manufactures since January 1, 2014.

In November 2022, EPA issued a final rule regulating PM emission standards that mirror the ICAO standards that cover subsonic turbofan and turbojet engines with rated outputs of greater than 26.7 kN.[77]

Stationary and Area Source Control Measures

Several existing and proposed federal and state rules serve to reduce ozone precursor emissions from stationary and area sources in Connecticut (and upwind states) in the post-2017 period. These measures contribute to meeting RFP requirements and achieving attainment of the ozone NAAQS in Connecticut. Table 4-5 summarizes federal stationary and area source measures, along with the effective date of the rules and the initial date when emission reductions are required.

Some of the federal rules, such as the Revised Cross-State Air Pollution Rule (CSAPR) Update and the final Good Neighbor Plan for the 2015 Ozone NAAQS, directly limit emissions of NOx during the ozone season in states located upwind of Connecticut. Other rules, such as the Reciprocating Internal Combustion Engine (RICE) National Emission Standards for Hazardous Air Pollutants (NESHAP) rule, the Industrial/Commercial/Institutional (ICI) Boiler Maximum Achievable Control Technology (MACT) rule, and the Mercury and Air Toxics (MATS) rule, may not specifically require limitations on ozone precursor emissions, but are projected by EPA to indirectly reduce ozone precursor emissions in Connecticut and upwind states.[78] Small, indirect reductions are anticipated to occur as a co-benefit of regulation of another pollutant (e.g., by motivating changes in equipment or fuels used, work practices, or increased use of renewable generating capacity).

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[76] 77 FR 36342

[77] 87 FR 72312

[78] See: "Technical Support Document (TSD) Preparation of Emissions Inventories for the 2016v1 North American Emissions Modeling Platform", EPA OAQPS; March 2021

Table 4-5. *Federal Stationary and Area Source Measures Expected to Provide Ozone Precursor Emission Reductions.*

Federal Control Measures	Affected Ozone Precursor Pollutant(s)	Date of Federal Rule Promulgation	Date when Emission Reductions Begin
Good Neighbor Plan for the 2015 Ozone NAAQS*	NOx	06/05/2023 (88 FR 36654)	2023
RICE NESHAP	NOx, VOC	08/10/2022 (87 FR 48603) 01/30/2013 (78 FR 6674) 8/10/2010 (75 FR 51570)	2013
ICI Boiler & Process Heater MACT & Amendments	VOC	10/06/2022 (87 FR 60816) 11/20/2015 (80 FR 72790) 03/21/2011 (76 FR 15608 and 76 FR 15554)	2023 2013 2014 & 2012+
Mercury & Air Toxics Standards	NOx	04/15/2020 (85 FR 20838) 04/14/2016 (81 FR 24420) 12/16/2011 (77 FR 9304)	2020 2015
Portable Fuel Container Rule (part of Mobile Source Air Toxics rule)	VOC	EPA 02/26/2007 rule (72 FR 8428) enabled CT to revoke equivalent 2007 state rule (RCSA 22a-174-43)	2007-2017 (turnover period)

* The Good Neighbor Rule for the 2015 Ozone NAAQS became final in June 2023 to ensure that the 26 states included in the CAA "Good Neighbor" requirements reduce pollution that contributes significantly to downwind states. For the first time, the rulemaking included reductions from EGU and non-EGU sources. Connecticut was not cited by EPA as a significantly contributing state and is therefore not included in the program; however, emission reductions required in upwind states were projected by EPA to provide small ozone air quality improvements (0.5 ppb or less) at Connecticut monitors.

On an ongoing basis, DEEP evaluates and adopts control measures that reduce NOx and VOC emissions from Connecticut sources to reduce in-state impacts and to minimize impacts on downwind areas in other states. EPA has issued a large number of Control Techniques Guidelines (CTGs) and Alternate Control Technique (ACT) documents with recommendations on how to control VOC emissions from a variety of source categories. The CTG/ACTs are intended to assist states with the development of RACT regulations. Many control measures described in the tables below were identified as satisfying requirements for Connecticut's multiple RACT reviews for the 2008 and 2015 ozone NAAQS as required by CAA sections 182(b) and 184(b).[79]

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[79] See DEEP's webpage for update to CT's RACT program: https://portal.ct.gov/DEEP/Air/Planning/SIP/Air-SIP-Revisions--Other-State-Plans-for-Control-of-Air-Pollution

Table 4-6. *Connecticut's CTG/ACT-Based VOC Control Measures Enacted Since 2011.*

Control Measure	Pollutant	Section of the Regulations of Connecticut State Agencies	Status of Regulation Adoption	Date Applies to Create Emissions Reductions	CTG or ACT issued for the source category regulated by the control measure
Metal furniture coating	VOC	22a-174-20(p)	4/6/2010	1/1/2011	CTG for Metal Furniture Coatings (2007)
Paper, film and foil coating	VOC	22a-174-20(q)	4/6/2010	1/1/2011	CTG for Paper, Film and Foil Coatings (2007)
Flexible package printing	VOC	22a-174-20(ff)	4/6/2010	1/1/2011	CTG for Flexible Package Printing (2006)
Offset lithographic and letter press printing	VOC	22a-174-20(gg)	4/6/2010	1/1/2011	CTG for Offset Lithographic Printing and Letterpress Printing (2006)
Large appliance coatings	VOC	22a-174-20(hh)	4/6/2010	1/1/2011	CTG for Large Appliance Coatings (2007)
Industrial solvent cleaning	VOC	22a-174-20(ii)	4/6/2010	1/1/2011	CTG for Industrial Cleaning Solvents (2006)
Spray application equipment cleaning	VOC	22a-174-20(jj)	4/6/2010	1/1/2011	State-specific requirements. In the absence of RCSA section 22a-174- 20(jj), spray gun cleaning would be addressed via the industrial solvent cleaning requirements (RCSA section 22a-174-20(ii)) adopted pursuant to the CTG for Industrial Cleaning Solvents (2006).
VOC emissions from miscellaneous metal and plastic parts coating	VOC	22a-174-20(s)	10/31/2012	1/1/2013	CTG for Miscellaneous Metal and Plastic Parts Coatings (2008)
VOC emissions from pleasure craft coating	VOC	22a-174-20(kk)	10/31/2012	1/1/2013	CTG for Miscellaneous Metal and Plastic Parts Coatings (2008)
Control of VOC emissions from above- ground storage tanks	VOC	22a-174-20(a)	3/7/2014	6/1/2014	Alternative Control Techniques Document – Volatile Organic Liquid Storage in Floating and Fixed Roof Tanks (1994) Control of Volatile Organic Emissions from Petroleum Liquid Storage in External Floating Roof Tanks (1978) Control of Volatile Organic Emissions from Storage of Petroleum Liquids in Fixed Roof Tanks (1977)

VOC emissions from transfer and dispensing of gasoline	VOC	22a-174-20(a), 22a-174-30a	7/8/2015	7/1/2015 -- CARB-approved P/V vent valves 7/8/2015 -- Annual pressure decay test	Design Criteria for Stage I Vapor Control Systems – Gasoline Service Stations (1975)
Oil and Natural Gas Industry	VOC	Not applicable – CT certifies that no sources meeting the description of this CTG category are operating within the state	Not applicable	Not applicable	CTG for the Oil and Natural Gas Industry (2016)

Table 4-6 lists CTG/ACTs which have been adopted into Connecticut's SIP, along with the date on which the requirement was adopted in Connecticut and the date on which compliance was required so that the control measure began to reduce VOC emissions. The CTG or ACT upon which each control measure is based (or that applies to the same source category as is regulated by the control measure) is also identified.

In addition to the CTG/ACT measures just described, DEEP recently adopted six additional control measures to further reduce NOx or VOC emissions from Connecticut stationary and area sources. Table 4-7 identifies these measures, the relevant statute or regulation, the adoption status, and the anticipated effective and compliance dates.

As part of regional haze planning obligations, Connecticut and other northeast states revised state statutes and regulations to reduce the level of sulfur allowed in distillate and residual fuel oil to help reduce regional sulfate levels. Studies found that lower levels of sulfur in distillate oil also result in reductions in NOx emissions from stationary combustion sources. As part of a MARAMA inventory effort, states examined the available literature and conservatively estimated that reducing distillate sulfur content from 3000 ppm to 500 ppm (Connecticut's Phase 1 limit, which began in July 2014) reduced NOx emissions from boilers and process heaters by seven percent.[80] Connecticut's Phase 2 limit of 15 ppm began in July 2018 and improves air quality over the baseline year and beyond.

Revisions to Connecticut's municipal waste combustor (MWC) regulation were finalized in August 2016 and became effective in August 2017. Statewide NOx emission reductions of 658 tons per year (tpy) result from the revised MWC rule. Those reductions will help to further improve ozone air quality in 2018 and beyond.

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[80] "Technical Support Document: Emission Inventory Development for 2011, 2018, and 2028 for the Northeastern U.S. Beta2 Version"; MARAMA; July 12, 2017. See page 63 for a discussion of NOx emission reductions associated with low-sulfur fuel oil. The MARAMA TSD refers to a Technical Memorandum prepared by NYDEC dated April 15, 2016 for documentation on the level of NOx reductions.

In 2016, DEEP finalized adoption of two measures targeted at major (RCSA 22a-174-22e) and non-major (RCSA 22a-174-22f) NOx sources. Phase 1 NOx standards of RCSA 22a-174-22e were implemented on June 1, 2018. More stringent Phase 2 standards began on June 1, 2023. Any alternative compliance options expire as of May 1, 2028, requiring all equipment operating under a compliance option to meet the applicable Phase 2 standard or shutdown. The standards in RCSA section 22a-174-22e compare favorably with the NOx emission limits required in other states for all categories of fuel-burning equipment.

The final two VOC measures identified in Table 4-7 are updates to Connecticut's regulations to further reduce emissions from consumer products (RCSA 22a-174-40) and architectural and industrial maintenance (AIM) coatings (RCSA 22-174-41).

Many of the control measures mentioned above are further described in the RACT SIP that DEEP submitted to EPA in 2020 for the 2008 ozone NAAQS. Background information concerning the amendment of RCSA section 22a-174-38 for MWCs and the adoption of RCSA sections 22a-174-22e and 22a-174-22f is available on DEEP's RACT webpage.

Table 4-7. *Connecticut's Non-CTG Controls for Ozone Precursor Emissions from Stationary and Area Sources.*

Control Measure	Pollutant	Section of the Regulations of Connecticut State Agencies or Connecticut General Statutes	Status of Regulation Adoption	Date Requirements Apply to Create Emissions Reductions
Fuel oil sulfur limits for #2 distillate/heating oil and #4/#6 residual oil that indirectly reduce NOx emissions	NOx	22a-174-19, 22a-174-19a, 22a-174-19b, CGS 16a-21a	RCSA 22a-174-19, 19a & 19b: Revised 04/15/2014 and approved by EPA on 05/06/2016 (81 FR 33134), with subsequent revisions submitted 06/08/2015 & 09/28/2015. CGS 16a-21a: Revised July 2015.	Phase 1: 7/1/2014 Phase 2: 7/1/2018
Reduction in emission limit for mass burn waterwall municipal waste combustors	NOx	22a-174-38	Adoption complete: 08/02/2016. SIP Revision submitted 09/16/2016. EPA SIP approval 07/31/2017. (80 FR 13768)	Revised emission limits become effective 8/2/2017.
Control of NOx emissions from fuel-burning equipment at major stationary sources of NOx	NOx	22a-174-22e (one of two regulations to replace 22a-174-22)	Adoption complete: 12/22/2016. SIP Revision submitted 01/24/2017. EPA SIP approval 07/31/2017. (82 FR 35454) Amended 10/08/2019 EPA SIP approval 07/14/2021 (86 FR 37053)	Phase 1 emission limits: June 1, 2018. Phase 2 emission limits: June 1, 2023. Unless otherwise specified in permit or order, end of compliance options and case-by-case RACT limits: May 1, 2028.
High daily NOx emitting units at non-major sources of NOx	NOx	22a-174-22f (one of two regulations to replace 22a-174-22)	Adoption complete: 12/22/2016. SIP Revision submitted 01/24/2017. EPA SIP approval 07/31/2017. (82 FR 35454).	May 1, 2018.
Reduction in VOC content limits for consumer products	VOC	22a-174-40	Adoption complete: 10/05/2017 EPA SIP Approval 11/19/2018 (83 FR 28188)	May 1, 2018
Reduction in VOC content limits for architectural and industrial maintenance coatings	VOC	22a-174-41, 22a-174-41a	Adoption complete: 10/05/2017 EPA SIP Approval 11/19/2018 (83 FR 28188)	May 1, 2018

4.3 Future Year Emission Projections

EPA's Implementation Rule for the 2015 ozone NAAQS requires moderate nonattainment areas to demonstrate RFP towards attainment by achieving at least a 15 percent reduction in ozone precursor emissions between 2017 and 2023. The rule requires that ozone season day emissions be used for the RFP demonstration and should represent the conditions that led to a nonattainment designation. DEEP has prepared a projected future year ozone season day inventory for 2023 to assess whether the 15 percent RFP requirement has been satisfied and to also meet the requirement to submit an inventory for the required attainment year. Emissions projections were developed from the 2017 Base Year Inventory (see Section 4.1) by using appropriate methods to account for expected changes in activity (i.e., growth) and emission controls during the 2017 through 2023 period for each source category.

The following subsections describe the selection of growth factors for each source category, estimated reductions from the controls described in Section 4.2, and the resulting future year emission projections for 2023.

Growth and Control Methodologies Used to Project 2023 Emissions

As described in Section 4.1, the 2017 Base Year Inventory to be used for the RFP demonstration was developed from the 2017 NEI for the point source, area source, and non-road source categories. On-road emissions estimates for 2017 were consistent with the motor vehicle emissions budgets (MVEBs) approved by EPA with Connecticut's SIP submittal for the 2008 ozone NAAQS in 2018 (83 FR 49297). See Section 4.1 for a more complete explanation of modifications made to the 2017 NEI.

Emissions projections for 2023 were developed from the 2017 Base Year Inventory by accounting for changes in activity (i.e., growth) and post-2017 controls for the various anthropogenic source categories. Table 4-8 below, which was taken from Section 4 of EPA's *Technical Support Document (TSD): Preparation of Emissions Inventories for the 2016v3 North American Emissions Modeling Platform,*[81] summarizes methodologies used for projecting each source sector.

In general, projections relied on various datasets collected from state, local, or tribal agencies, sources such as the Annual Energy Outlook (AEO) 2022, EPA reports, or Environmental Impact Assessments (EIA) and include data from different rules or regulations such as the Revised CSAPR Update.

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[81] https://www.epa.gov/system/files/documents/2023-03/2016v3_EmisMod_TSD_January2023_1.pdf

Table 4-8. *Overview of Projection Methods for the Future Year Cases.*

Platform Sector: ***abbreviation***	**Description of Projection Methods for Analytic Year Inventories**
EGU units: *ptegu*	The Integrated Planning Model (IPM) outputs from the Updated Summer 2021 version of the IPM platform were used. For 2023, the 2023 IPM output year was used and for 2026 the 2025 output year was used. Emission inventory Flat Files for input to SMOKE were generated using post-processed IPM output data. **A list of included rules is provided in Section 4.1**.
Point source oil and gas: *pt_oilgas*	First, known closures were applied to the 2016 pt_oilgas sources. Production-related sources were then grown from 2016 to 2021 using historic production data. The production-related sources were then grown to 2023 and 2026 based on growth factors derived from the Annual Energy Outlook (AEO) 2022 data for oil, natural gas, or a combination thereof. The grown emissions were then controlled to account for the impacts of New Source Performance Standards (NSPS) for oil and gas sources, process heaters, natural gas turbines, and reciprocating internal combustion engines (RICE). Some sources were held at 2018 or 2019 levels. WRAP future year inventories are used in all of the WRAP states except for New Mexico (CO, MT, ND, SD, UT and WY). The future year WRAP inventories are the same for all analytic years. New Mexico emissions are projected from 2016 along with the non-WRAP states.
Airports: *airports*	Point source airport emissions were grown from 2016 to each analytic year using factors derived from the 2021 Terminal Area Forecast (TAF) released in June 2022 (see https://www.faa.gov/data_research/aviation/taf/). Corrections to emissions for ATL from the state of Georgia are included, as well as some corrections for specific airports in the state of Texas.
Remaining non-EGU point: *ptnonipm*	2019 NEI data (EPA, 2022) were used for 2023 for most sources. Known closures were applied to ptnonipm sources. Closures were obtained from the Emission Inventory System (EIS) and also submitted by the states of Alabama, North Carolina, Ohio, Pennsylvania, and Virginia. Industrial emissions were grown according to factors derived from AEO2022 to reflect growth from 2023 onward. Rail yard emissions were grown using the same factors as line haul locomotives in the rail sector. Controls were applied to account for relevant NSPS for RICE, gas turbines, refineries (subpart Ja), and process heaters. The Boiler MACT is assumed to be fully implemented in 2016 except for North Carolina. Controls are reflected for the regional haze program in Arizona. Changes to ethanol plants and biorefineries are included. In 2016v3, additional closures were implemented, new sources were added based on 2019 NEI, and growth in MARAMA states was updated using MARAMA spreadsheets after incorporating AEO 2022 data. Railyards in California were updated with CARB data for 2023 and 2026. Point source solvents are based on 2019 NEI and projected to 2023 and 2026.
Category 1, 2 CMV: *cmv_c1c2*	Category 1 and category 2 (C1C2) CMV emissions sources outside of California were projected to 2023 and 2026 based on factors from the Regulatory Impact Analysis (RIA) Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters per Cylinder. California emissions were projected based on factors provided by the state. Projection factors for Canada for 2026 were based on ECCC-provided 2023 and 2028 data interpolated to 2026. The 2023 and 2026 emissions are unchanged from 2016v2 except for the improved spatial allocation to counties.

Category 3 CMV: *cmv_c3*	Category 3 (C3) CMV emissions were projected to 2023 and 2026 using an EPA report on projected bunker fuel demand that projects fuel consumption by region out to the year 2026. Bunker fuel usage was used as a surrogate for marine vessel activity. Factors based on the report were used for all pollutants except NOx. The NOx growth rates from the EPA C3 Regulatory Impact Assessment (RIA) were refactored to use the new bunker fuel usage growth rates. Assumptions of changes in fleet composition and emissions rates from the C3 RIA were preserved and applied to bunker fuel demand growth rates for 2023 and 2026 to arrive at the final growth rates. Projection factors for Canada for 2026 were based on ECCC-provided 2023 and 2028 data interpolated to 2026. The 2023 and 2026 emissions are unchanged from 2016v2 except for the improved spatial allocation to counties.
Locomotives: *rail*	Passenger and freight locomotives were projected using separate factors. Freight emissions were computed for analytic years based on fuel use values for 2023 and 2026. Specifically, they were based on AEO2019 and 2020 freight rail energy use growth rate projections along with emission factors based on historic emissions trends that reflect the rate of market penetration of new locomotive engines.
Area fugitive dust: *afdust, afdust_ak*	Paved road dust was grown to 2023 and 2026 levels based on the growth in VMT from 2016. The remainder of the sector including building construction, road construction, agricultural dust, and unpaved road dust was held constant at 2016 levels, except in the MARAMA region and NC where some factors were provided for categories other than paved roads. The projected emissions were reduced during modeling (as they are for the base year) according to a transport fraction computed using a new method for the 2016 beta platform and a meteorology-based zero-out that accounts for precipitation and snow/ice cover.
Livestock: *livestock*	Livestock were projected to 2023 and 2026 based on factors created from USDA National livestock inventory projections published in 2022(https://www.ers.usda.gov/publications/pub-details/?pubid=92599). NC and NJ projections were state provided.
Nonpoint source oil and gas: *np_oilgas*	Exploration-related sources were based on an average of 2017 through 2019 exploration data with NSPS controls applied, where applicable. Production-related emissions were initially projected to 2021 using historical data and then grown to 2023 and 2026 based on factors generated from AEO2022 reference case. Based on the SCC, factors related to oil, gas, or combined growth were used. Coalbed methane SCCs were projected independently. Controls were then applied to account for NSPS for oil and gas and RICE. WRAP future year inventories are used in seven WRAP states for 2023 and 2026 (except for NM, which is projected based on AEO).
Residential Wood Combustion: *rwc*	The 2016v3 emissions are the same as 2016v2, with the exception of Idaho, which uses the 2017 NEI for the base year emissions. RWC emissions were projected from 2016 to 2023 and 2026 based on growth and control assumptions compatible with EPA's 2011v6.3 platform, which accounts for growth, retirements, and NSPS, although implemented in the Mid-Atlantic Regional Air Management Association (MARAMA)'s growth tool. Factors provided by North Carolina were used for that state. RWC emissions in California, Oregon, and Washington were held constant at 2017 levels.
Solvents: *solvents*	Solvents are based on an updated method for 2016v3. The same projection and control factors were applied to solvent emissions as if these SCCs were in nonpt. Additional SCCs in the new inventory that correlate with human population were also projected. Solvent emissions associated with oil and gas activity were projected using the same projection factors as the oil and gas sectors. The 2016v1 NC and NJ nonpoint packets were used for 2023 and interpolated to 2026, and updated to apply to more SCCs. OTC controls for solvents were applied – both DE and NY provided new controls.

Remaining nonpoint: *nonpt*	Industrial emissions were grown according to factors derived from AEO2022 to reflect growth from 2021 onward. Data from earlier AEOs were used to derive factors for 2016 through 2021. Portions of the nonpt sector were grown using factors based on expected growth in human population. The MARAMA projection tool was used to project emissions to 2023 and 2026 after the AEO-based factors were updated to AEO2022. Factors provided by North Carolina and New Jersey were preserved. Controls were applied to reflect relevant NSPS rules (i.e., reciprocating internal combustion engines (RICE), natural gas turbines, and process heaters). Emissions were also reduced in 2016v2 and v3 to account for fuel sulfur rules in the mid-Atlantic and northeast not fully implemented by 2017. OTC controls for PFCs are included.
Nonroad: *nonroad*	Outside California and Texas and Texas, the MOVES3 model was run to create nonroad emissions for 2023 and 2026. The fuels used are specific to the analytic year, but the meteorological data represented the year 2016. EPA received new CARB data for analytic years for 2016v3. Texas nonroad emissions were provided by TCEQ for 2023 and 2028, and interpolated to 2026.
Onroad: *onroad, onroad_nonconus*	Activity data for 2016 were backcast from the 2017 NEI then projected from 2016 to 2019 based on trends in FHWA VM-2 trends. Activity data were held flat from 2019 to 2021, and then projected from 2021 to 2023 and 2026 using factors derived from AEO2022. Where S/Ls provided activity data for 2023, those data were used. To create the emission factors, MOVES3 was run for the years 2023 and 2026 using 2016 meteorological data and fuels, but with age distributions projected to represent the analytic years and the remaining inputs consistent with those used in 2017. The analytic year activity data and emission factors were then combined using SMOKE-MOVES to produce the 2023 and 2026 emissions. Inspection and maintenance updates were included for NC and TN (this changed the representative county groupings for analytic years). Section 4.3.2 describes the applicable rules that were considered when projecting onroad emissions.
Onroad California: *onroad_ca_adj*	CARB-provided emissions were used for California, but temporally allocated using MOVES3-based data. The 2016v3 platform uses new onroad emissions data provided by CARB for 2023 and 2026.
Other Area Fugitive dust sources not from the NEI: *othafdust*	Othafdust emissions for the analytic years were provided by ECCC in 2016v1. Projection factors were derived from those 2023 and 2028 inventories and applied to the 2016v2 inventory. 2026 projection factors were interpolated from 2023 and 2028. No changes were made to 2023 or 2026 othafdust emissions in 2016v3. Mexico emissions are not included in this sector.
Other Point Fugitive dust sources not from the NEI: *othptdust*	Wind erosion emissions were removed from the point fugitive dust inventories. Base year 2016 inventories with the rotated grid pattern removed were held flat for the analytic years, including the same transport fraction as the base year and the meteorology-based (precipitation and snow/ice cover) zero-out. No changes were made to 2023 or 2026 othptdust emissions between 2016v2 and 2016v3.
Other point sources not from the NEI: *othpt*	Canada emissions for analytic years were provided by ECCC for use in 2016v1. Projection factors were derived from those 2023 and 2028 inventories and applied to the 2016v2 inventory. 2026 projection factors were interpolated from 2023 and 2028. No changes were made to othpt emissions between 2016v2 and 2016v3. Canada projections were applied by province-subclass where possible (i.e., where subclasses did not change from between platforms). For inventories where that was not possible, including airports and most stationary point sources except for oil and gas, projections were applied by province. For Mexico sources, Mexico's 2016 inventory was grown using to the analytic years 2023 and 2026, using state+pollutant factors based on the 2016v1 platform inventories.

Mobile Sources

The majority of anthropogenic NOx and VOC emissions from Connecticut sources are emitted by on-road and non-road mobile sources. Non-road and on-road emissions were calculated using the MOVES3 model. As was previously described in Section 4.1, DEEP used data from CTDOT's most recent Ozone Air Quality Conformity Determination to estimate ozone season day emissions for on-road motor vehicles for both 2017 and 2023.

CTDOT provided county-level projections of various traffic data required by the MOVES3 model for 2023. Vehicle miles traveled (VMT) were estimated using CTDOT's Cube Series 2, which is a statewide network-based travel demand model. The MOVES runs for 2023 include appropriate inputs to reflect Connecticut's LEV III program and EPA's federal Tier 3 vehicle and fuel standards, in addition to all the control programs modeled to estimate 2017 emissions. See Section 4.2 (and Table 4-3) for a full description of modeled emission control programs for on-road vehicles.

Area and non-EGU Point Sources

The Control Strategy Tool (CoST) was used to produce future year area and non-EGU point source inventories. CoST creates future year inventories for each emissions modeling sector through applying control strategy, growth factor, and closure information developed into packets applicable sectors in the 2016 base year inventory.

For area and non-EGU point sources, CoST uses facility, unit, and stack-level closure information derived from a report from the Emissions Inventory System (EIS). Information from states regarding additional closures or closures that did not happen was also included in the data package.

Growth factors used for the area and non-EGU point sectors were based on a variety of indicators as surrogates for future sector activity including economic, energy, vehicle miles traveled, and demographic parameters. While recognizing that these surrogates may not track exactly with emissions, they are considered to be the "best available" data for projecting emissions for area and non-EGU point sources. Growth indicators were mapped to specific source classification codes.

The 2016v3 modeling platform relied on spreadsheets provided by the Mid-Atlantic Regional Air Management Association (MARAMA) of projection factors that included data from Annual Energy Outlook (AEO) 2022 and other similar surrogate data. Additional nonpoint sources such as fugitive dust growth, solvents, non-IPM point sources, and nonpoint sources also used data from MARAMA spreadsheets. MARAMA also provided EPA with data regarding reductions from fuel sulfur rules.

EGU Point Sources

The 2023 EGU point source emissions inventory was developed using the updated Summer 2021 Reference Case run of the Integrated Planning Model (IPM). IPM is a linear programming model that uses information such as energy demand, planned unit retirements, and planned rules to model unit-level energy production.

Large EGUs are associated with base year hourly NOx and SO2 Continuous Emissions Monitoring System (CEMS) data. Operational data was obtained from the National Electric Energy Data System (NEEDS). These base year values are then projected to match total seasonal emissions values in future years. EPA's 2016v3 inventory projects the EGU sector in Connecticut to have total NOx emissions of 2,772 tons in 2023.

Emission Projections for 2023

The resulting 2023 inventory, projected from 2016v3, is summarized at EPA's website for the 2023gf inventory. Ozone season day emissions were determined using the same method applied to the base year emissions as described in section 4.1. The 2023 projections include the effects of the control measures described in Section 4.2 and are summarized in Table 4-3 through Table 4-7. Emission estimates for 2023 are summarized in Table 4-9 for Southwest Connecticut and in Table 4-10 for Greater Connecticut.

Table 4-9. *Summary of Southwest Connecticut Anthropogenic NOx and VOC Emissions for 2023 Ozone Season Day.*

Source Category	Ozone Season Day NOx (tons/ozone season day)	Ozone Season Day VOC (tons/ozone season day)
Stationary Point	6.5	1.7
Stationary Area	10.0	37.4
On-Road Mobile	18.6	15.3
Non-Road Mobile	11.8	15.1
Total Anthropogenic	46.9	69.6

Source: Estimates of 2023 emissions are based on EPA's 2023 inventory except for on-road mobile emissions which are from CTDOT's Air Quality Conformity Determination.

Table 4-10. *Summary of Greater Connecticut Anthropogenic NOx and VOC Emissions for 2023 Ozone Season Day.*

Source Category	Ozone Season Day NOx (tons/ozone season day)	Ozone Season Day VOC (tons/ozone season day)
Stationary Point	7.0	1.8
Stationary Area	9.6	37.5
On-Road Mobile	16.3	13.6
Non-Road Mobile	8.5	12.2
Total Anthropogenic	41.3	65.0

Source: Estimates of 2023 emissions are based on EPA's 2023 inventory except for on-road mobile emissions which are from CTDOT's Air Quality Conformity Determination.

Figure 4-8 provides a comparison of the base and future year emissions for the Southwest Connecticut area. Both VOC and NOx emissions are projected to decrease in Southwest Connecticut over the six-year period from 2017 to 2023. Anthropogenic VOC emissions are projected to decrease by 14 percent, after accounting for growth. Anthropogenic NOx emission reductions are projected to be even greater, with estimated reductions of 23 percent between 2017 and 2023, after accounting for growth. Large reductions are expected in the non-road (18 percent for VOC and 21 percent for NOx) and on-road (13 percent for VOC and 24 percent for NOx) sectors, as older vehicles and equipment are replaced by newer models. Large reductions are also projected for stationary area sources, with a 12 percent reduction of VOC and a 4 percent reduction in NOx. Stationary point sources are the only source category with projected VOC emissions that increase slightly in 2023 (6 percent increase).

Figure 4-8. *Comparison of 2017 and 2023 VOC and NOx Emissions for Southwest Connecticut.*

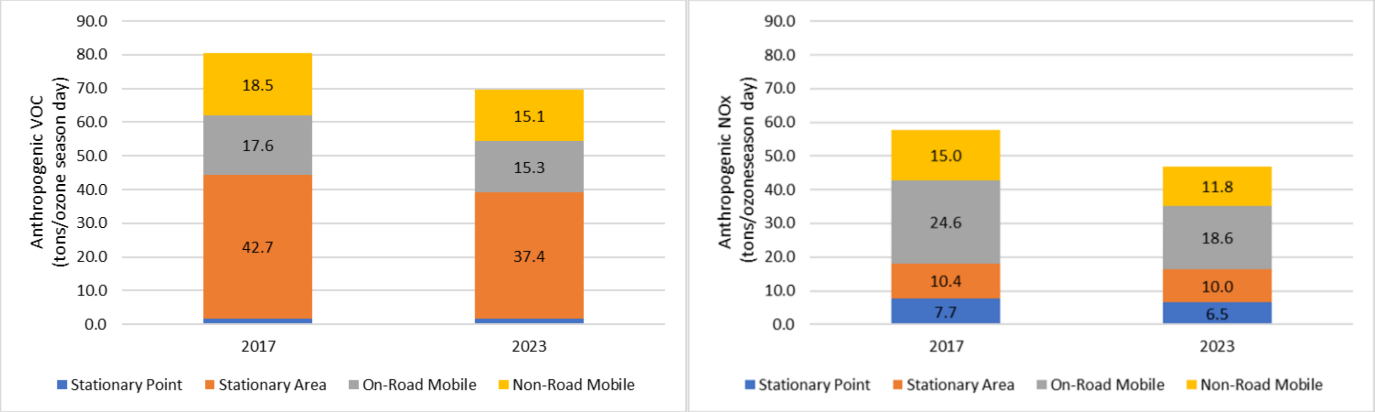
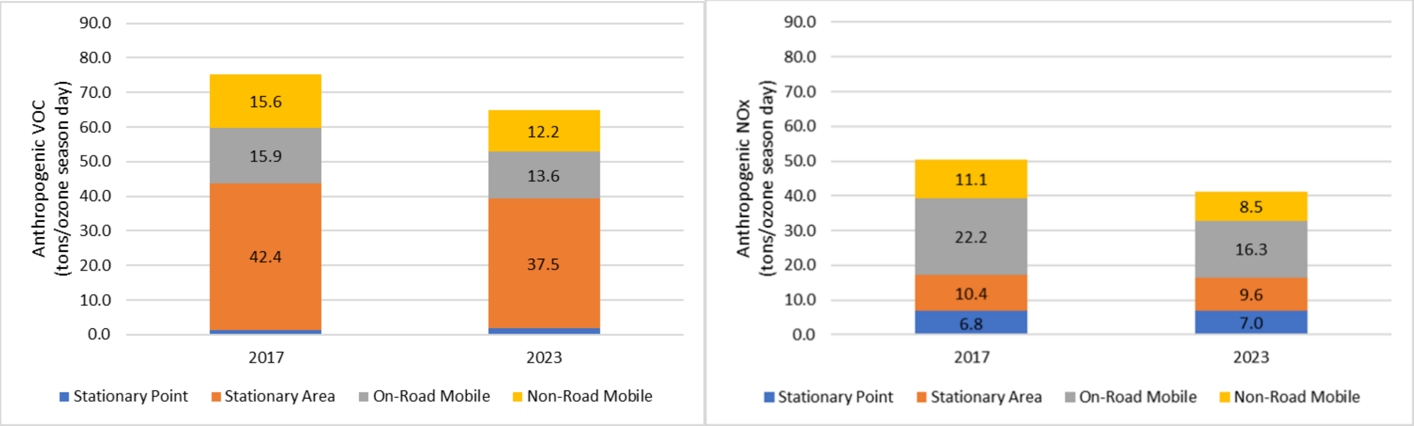


Figure 4-9 provides a comparison of base year and future year emissions for the Greater Connecticut area. Both VOC and NOx emissions are projected to decrease in Greater Connecticut over the six-year period from 2017 and 2023. Anthropogenic VOC emissions are projected to decrease by approximately 14 percent, after accounting for growth, while anthropogenic NOx emissions are projected to decrease by 18 percent. The largest reductions are expected in the on-road (14 percent for VOC and 27 percent for NOx) and non-road (22 percent for VOC and 23 percent for NOx) sectors. Stationary point sources are the only source category with projected VOC and NOx emissions that increase in 2023 (7 percent increase for VOC and 3 percent increase for NOx).

Figure 4-9. *Comparison of 2017 and 2023 VOC and NOx Emissions for Greater Connecticut.*



5 Reasonable Further Progress

Sections 172(c)(2) and 182(b)(1) of the CAA require nonattainment areas to include a demonstration of reasonable further progress (RFP). The Implementation Rule for the 2015 ozone standards describes the RFP requirements applicable to Connecticut's nonattainment areas. Specifically, as moderate nonattainment areas, the Greater Connecticut and Southwest Connecticut nonattainment areas are required to secure at least a 15 percent reduction in ozone precursor emissions within six years after the 2017 baseline year. The RFP mandate will be satisfied for the multi-state nonattainment area if each state demonstrates at least a 15 percent reduction in its portion of the area between 2017 and 2023.

To demonstrate RFP, projected emissions of NOx and VOC will be less than or equal to calculated target levels set for the end of the RFP period. This section describes the methodology and calculations used to establish the 2023 target emission levels for the Greater Connecticut and Southwest Connecticut nonattainment areas. It also demonstrates that the areas will meet RFP requirements because projected NOx and VOC emissions will be less than the calculated target levels.

5.1 Base Year Inventory

The base year inventory for RFP is comprised of all anthropogenic sources of VOC and NOx for a typical high ozone day in 2017. This is identical to the 2017 base year summer day inventory presented in Section 4, which excludes biogenic emissions sources. The tables below present the ozone season day emissions for the anthropogenic portion of the Greater Connecticut and Southwest Connecticut inventories. This is the starting point for calculation of required target level emissions to show reasonable further progress.

Table 5-1. *Base Year RFP Inventory for Southwest Connecticut.*

Ozone Precursor Pollutant	2017 Base RFP Inventory (TPD)				
	Stationary Point	Stationary Area	On-road Mobile	Non-road Mobile	Total
NOx	7.7	10.4	24.6	15.0	57.7
VOC	1.6	42.7	17.6	18.5	80.4

Table 5-2. *Base Year RFP Inventory for Greater Connecticut.*

Ozone Precursor Pollutant	2017 Base RFP Inventory (TPD)				
	Stationary Point	Stationary Area	On-road Mobile	Non-road Mobile	Total
NOx	6.8	10.4	22.2	11.1	50.5
VOC	1.4	42.4	15.9	15.6	75.3

5.2 Calculation of Target Levels

EPA's RFP methodology specifies that the required 15 percent RFP emission reductions can come from any combination of VOC and NOx reductions occurring between the base year (2017) and six years later (2023) for moderate areas. Consistent with past practice, DEEP has elected to establish 2023 target levels comprised of 10 percent NOx reductions and 5 percent VOC reductions. While both pollutants contribute to ozone formation, the preference for NOx reductions recognizes that Connecticut's ozone problem is generally NOx limited. The tables below show the calculation of the Target Levels for each of Connecticut's nonattainment areas' 2023 ozone season day inventory.

Table 5-3. *Determination of 2023 Target Level Emissions to Demonstrate RFP for Southwest Connecticut.*

Southwest Connecticut Target Level Emission Calculations	NOx (tons/ozone season day)	VOC (tons/ozone season day)
1. Base Year (2017)	57.7	80.4
2. RFP Reductions needed (Base*0.1) for NOx and (Base *0.05) for VOC	5.8	4.0
3. 2023 Target Level (Base-RFP Reductions Needed)	51.9	76.4

Table 5-4. *Determination of 2023 Target Level Emissions to Demonstrate RFP for Greater Connecticut.*

Greater Connecticut Target Level Emission Calculations	NOx (tons/ozone season day)	VOC (tons/ozone season day)
1. Base Year (2017)	50.5	75.3
2. RFP Reductions needed (Base*0.1) for NOx and (Base *0.05) for VOC	5.1	3.8
3. 2023 Target Level (Base-RFP Reductions Needed)	45.4	71.5

5.3 Compliance with RFP Requirements

Compliance with the RFP requirements is met provided that projected 2023 ozone season day emissions in Southwest and Greater Connecticut are less than or equal to the calculated RFP Target Levels.

Projected 2023 emissions were developed as described in Section 4.

Table 5-5 and Table 5-6 compare projected 2023 ozone season day emissions for Southwest Connecticut and Greater Connecticut to the required RFP target levels. Both NOx and VOC emission levels in 2023 are projected to be well below the target levels, thus meeting the RFP requirement.

Table 5-5. *Comparison of 2023 Projected Emissions to the Required RFP Target Levels for Southwest Connecticut.*

Description	NOx (tons/ozone season day)	VOC (tons/ozone season day)
2023 RFP Emission Target Levels (portion of required 15% precursor reduction)	51.9 (10%)	76.4 (5%)
2023 Projected Emissions (% reduction projected from 2017-2023)	46.9 (18%)	69.6 (13%)

Table 5-6. *Comparison of 2023 Projected Emissions to the Required RFP Target Levels for Greater Connecticut.*

Description	NOx (tons/ozone season day)	VOC (tons/ozone season day)
2023 RFP Emission Target Levels (portion of required 15% precursor reduction)	45.4 (10%)	71.5 (5%)
2023 Projected Emissions (% reduction projected from 2017-2023)	41.3 (18%)	65.0 (13%)

6 Transportation Conformity Process and Motor Vehicle Emission Budgets

Transportation conformity serves as a bridge to connect air quality and transportation planning activities. Transportation conformity is required under section 176(c) of the CAA to ensure that highway and transit project activities receiving federal funds are consistent with ("conform to") the purpose and goals of the SIP. Conformity to a SIP is achieved if transportation programs or transit project activities do not cause or contribute to any new air quality violations, do not increase the frequency or severity of violations, and do not delay timely attainment of the relevant NAAQS or any required interim milestone.

Transportation conformity applies to areas that are designated nonattainment or "maintenance" (former nonattainment areas) for the following transportation-related criteria pollutants: ozone (O_3), particulate matter ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), and nitrogen dioxide (NO_2). Transportation conformity also requires addressing ozone precursor pollutants, which includes NOx and VOCs.

Transportation conformity addresses air pollution from on-road mobile sources such as cars, trucks, motorcycles, and buses. For this reason, transportation conformity budgets are often referred to as motor vehicle emission budgets (MVEB). There are also significant emissions from non-road mobile sources, area sources, and stationary sources that are not addressed by transportation conformity.

The CTDOT and the metropolitan planning organizations (MPOs) in Connecticut must demonstrate conformity for any transportation plans, transportation improvement programs (TIPs), or any federally supported highway and transit projects.

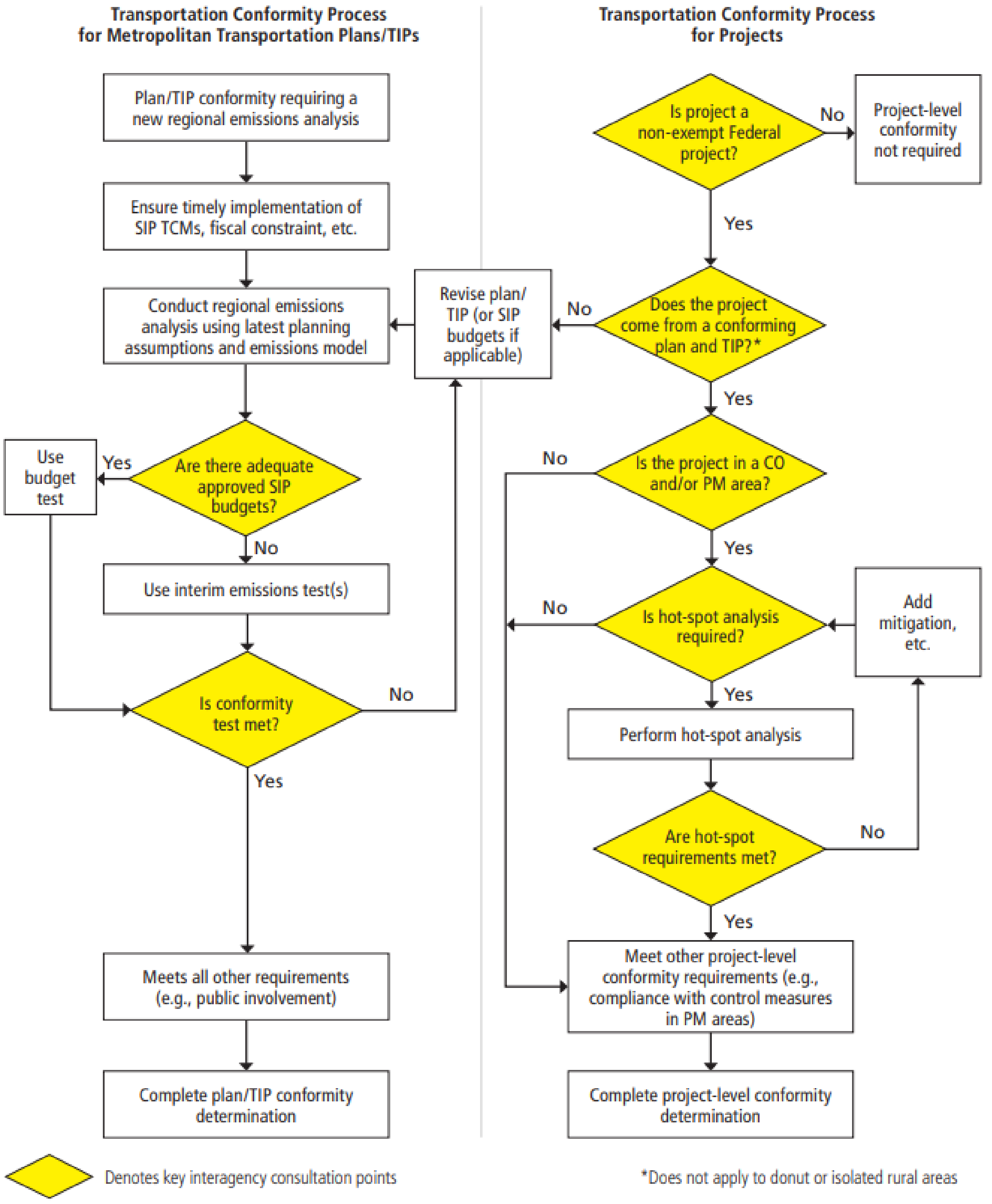
Conformity determinations are developed by CTDOT in consultation with DEEP and EPA. The Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA), agencies of the United States Department of Transportation (USDOT), review the submittals from CTDOT and the Connecticut MPOs and make a conformity determination.

Conformity determinations consist of the following components:
- Regional emissions analysis;
- Transportation modeling requirements;
- Latest planning assumptions and emissions model;
- Timely implementation of transportation control measures (TCMs);
- Interagency consultation;
- Public participation (consistent with USDOT regulations); and
- Fiscal constraint (consistent with USDOT regulations).

The regional emissions analysis is the primary component, which incorporates either a "budget" test for areas or states with approved SIP budgets, or an interim emissions test for areas with no adequate or approved SIP budgets. Budgets are developed using various transportation and emissions models. Local modeling inputs are cooperatively developed by CTDOT and DEEP, using EPA recommended methods where applicable. Generally, CTDOT's estimated air emissions from transportation plans and TIPs must not exceed an emissions limit, or budget, established by DEEP as part of an attainment or maintenance SIP.

A general flowchart depicting the transportation conformity process is set forth in Figure 6-1 below. A more detailed explanation of transportation conformity and how the elements of a conformity determination interact can be found in EPA's *Transportation Conformity Guidance for 2015 Ozone NAAQS Nonattainment Areas [EPA-420-B-18-023, June 2018]*.

Figure 6-1. *General Flowchart of the Transportation Conformity Process.*



Source: Transportation Conformity: A Basic Guide for State and Local Officials, Federal Highway Administration

6.1 Transportation Conformity Regulatory History

The federal CAA and federal transportation reauthorization legislation passed in the 1990s established an interrelationship of clean air and transportation planning. To receive federal transportation funds, CTDOT and the MPOs in Connecticut must cooperatively work to develop and endorse an Air Quality Conformity Statement, which certifies to the federal government that the Statewide Transportation Improvement Program (STIP), which incorporates all TIPs, conforms to the requirements of the CAA amendments.

On August 15, 1997, the EPA published a major revision to the Transportation Conformity Rule.[82] The full text of the rule, which has been updated multiple times since 1997 as various transportation funding bills have been passed, is contained in 40 CFR Part 93 – Determining Conformity of Federal Actions to State or Federal Implementation Plans.[83]

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) revised the CAA conformity SIP requirements in 2005 to use state and local resources more efficiently.[84] SAFETEA-LU guided surface transportation policy and funding up until it was due to expire in 2009. Congress extended the provisions nine times until it finally expired on June 30, 2012.

On July 6, 2012, Moving Ahead for Progress in the 21st Century (MAP-21) was signed into law.[85] MAP-21 reauthorized the transportation programs that were previously authorized by SAFETEA-LU. The programs under MAP-21 continued through September 30, 2014, and finally expired, after five short-term extensions, on December 4, 2015.

On December 4, 2015, the Fixing America’s Surface Transportation (FAST) Act was signed into law as the first long-term transportation funding bill since SAFETEA-LU.[86] The FAST Act authorizes federal highway, transit, safety and rail programs and funding certainty for five years - through September 30, 2020.

On September 30, 2020, the FAST Act was extended for one year until September 20, 2021, as a part of the Continuing Appropriations Act, 2021, and other Extensions Act.[87] The extension continued coverage for federal-aid highways and federal public transportation programs.

On November 15, 2021, the Infrastructure, Investment and Jobs Act (IIJA) was signed into law, providing transportation and infrastructure funding for five years.[88] This law intends to modernize roads, public transit, airports, and other infrastructure in efforts to reduce congestion and harmful emissions.

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[82] 62 FR 43780
[83] 40 CFR Part 93
[84] Public Law 109-59
[85] Public Law 112-141
[86] Public Law 114-94
[87] Public Law 116-159
[88] Public Law 117-58

CTDOT regularly updates the STIP in accordance with the terms and provisions of the CAA relevant funding and authorization acts, and all regulations issued pursuant thereto. As part of STIP development, CTDOT conducts air quality assessments and prepares conformity reports. DEEP and EPA review the STIP and conformity reports.

6.2 Previous Motor Vehicle Emission Budgets (MVEBs) for the 2008 Ozone Standards

The transportation conformity rules at 40 CFR 93.10(c)(2) states that a nonattainment area with approved or adequate MVEBs in an applicable implementation plan or implementation plan submission for another NAAQS for the same pollutant, must use those existing MVEBs in transportation conformity determinations until MVEBs for the current NAAQS are submitted by the state and found adequate or are approved by the EPA.

The most recent previous MVEBs, the 2020 MVEBs as shown in Table 6-1 below, were submitted to EPA in 2022 with a SIP revision for the 2008 ozone standards.[89] However, as of this writing, these budgets have not been approved.

Table 6-1. *2020 Motor Vehicle Emission Budgets.*

2020 Motor Vehicle Emission Budgets	VOC (tons/day)	NOx (tons/day)
Greater Connecticut	15.6	20.5
Southwest Connecticut	17.6	23.3

The MVEBs for 2017 were submitted to EPA for Connecticut's nonattainment areas while designated moderate nonattainment for the 2008 ozone NAAQS. The 2017 MVEBs were federally approved into the SIP effective October 31, 2018 [83 FR 49297] and appear in Table 6-2.[90]

Table 6-2. *2017 Baseline Motor Vehicle Emission Budgets.*

2017 Motor Vehicle Emission Budgets	VOC (tons/day)	NOx (tons/day)
Greater Connecticut	15.9	22.2
Southwest Connecticut	17.6	24.6

As the most recently approved MVEBs, the 2017 MVEBs are currently used for conformity tests under both the 2008 and 2015 ozone standards. Additionally, for nonattainment areas for the 2015 ozone NAAQS, 2017 is the baseline year for transportation conformity purposes.[91]

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[89] "Revision to Connecticut's State Implementation Plan: Ozone Attainment Demonstration for Areas Classified Serious Nonattainment for the 2008 Ozone Standards"; DEEP; June 2022.

[90] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-52/subpart-H/section-52.377 40 CFR 52.377(t).

[91] 2015 Ozone NAAQS Implementation Rule: https://www.govinfo.gov/content/pkg/FR-2018-12-06/pdf/2018-25424.pdf page 63005.

6.3 Final Motor Vehicle Emissions Budgets for the 2015 Ozone Standard

As was described in Sections 4 and 5, this attainment plan includes numerous emission control programs designed to sufficiently reduce ozone precursor emissions in Connecticut. Emission control strategies are targeted at all types of emission sources, including on-road sources such as cars and diesel trucks. Projected 2023 emission levels are consistent with achieving RFP requirements in the Greater Connecticut and Southwest Connecticut areas; therefore, the associated 2023 on-road emission projections qualify for use as MVEBs for RFP purposes.

DEEP believes that projected 2023 emission levels in Connecticut would be sufficient to provide for attainment of the 2015 ozone NAAQS by the moderate attainment date of August 3, 2024, if an equitable level of emission reductions was provided in a timely manner by EPA and upwind states, consistent with CAA requirements. DEEP will continue to pursue available options under the CAA to secure the necessary upwind reductions to achieve and maintain attainment as expeditiously as possible.

The on-road portion of the 2023 emission estimates will, after being deemed adequate or approved by EPA, become the sole governing MVEBs for Greater Connecticut and Southwest Connecticut. Table 6-3 displays the 2023 emission budgets for both Greater Connecticut and Southwest Connecticut. Note that, as with previous attainment and maintenance SIPs approved by EPA for Connecticut, the on-road vehicle emission estimates for 2023 include a 2 percent contingency factor to account for uncertainties in future transportation planning, such as changes to modeling procedures that could affect future year emission estimates that must be compared to budgets established with previous model versions. The resulting final budgets are much more stringent than the current budgets for Connecticut's nonattainment areas and will help fulfill the requirements to attain the ozone NAAQS and satisfy the 15 percent RFP requirement for the 2015 ozone NAAQS.

Table 6-3. *2023 Motor Vehicle Emission Budgets.*

2023 Motor Vehicle Emission Budgets	VOC (tons/day)	NOx (tons/day)
Greater Connecticut	13.6	15.5
Southwest Connecticut	15.2	17.6

7 Attainment Demonstration

The objective of the photochemical modeling study is to enable DEEP to analyze the efficacy of various control strategies, and to assess whether the measures adopted as part of the implementation plan are sufficient to provide for attainment of the 8-hour ozone standard by the end of the 2023 ozone season. EPA recommends the use of photochemical grid models for evaluating ozone control strategies.

These models are complex and require significant time and resources to develop the regional scale inventories and meteorological data that are necessary for the selected episodes and scenarios modeled. Varying inputs such as growth factors, chemistry, and predicted changes in energy dispatch can result in differing conclusions. Therefore, DEEP has reviewed both the OTC SIP quality modeling as well as EPA's modeling used in support of the final Good Neighbor Federal Implementation Plan for the 2015 Ozone NAAQS to provide greater perspective on model results with respect attainment projections for Connecticut.

7.1 Description of OTC and EPA Modeling Platforms

Following recommendations outlined in EPA's *Modeling Guidance for Demonstrating Air Quality Goals for Ozone, PM$_{2.5}$, and Regional Haze [November, 2018]*, the model platform and configuration for regional modeling studies conducted by OTC and EPA are described briefly below.

Details of the OTC modeling are documented in the *Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2016 Based Modeling Platform Support Document [January, 2023]* (OTC TSD1) and the *Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2016 Based Modeling Platform Technical Support Document: OTC V2/V3 Modeling Platform Update [July, 2023]* (OTC TSD2).

The details of the EPA study are found in the *Air Quality Modeling Final Rule Technical Support Document 2015 Ozone NAAQS Good Neighbor Plan [March, 2023] (EPA TSD),* while additional supporting documents are posted at EPA's webpage for the Good Neighbor Plan for the 2015 Ozone NAAQS.

Air Quality Model Selection

The selected photochemical grid models capable of simulating ozone production and transport on a regional or national scale consistent with EPA's modeling guidance. The OTC used the Community Multi-scale Air Quality Model version 5.3.1 (CMAQ) as well as the Comprehensive Air Quality Model with Extensions version 7.10 (CAMx) for modeling described in OTC TSD1. Updated modeling with CMAQ version 5.3.3 and CAMx version 7.20 is described in OTC TSD2. EPA used CAMx version 7.10 for their model runs as documented in the EPA TSD.

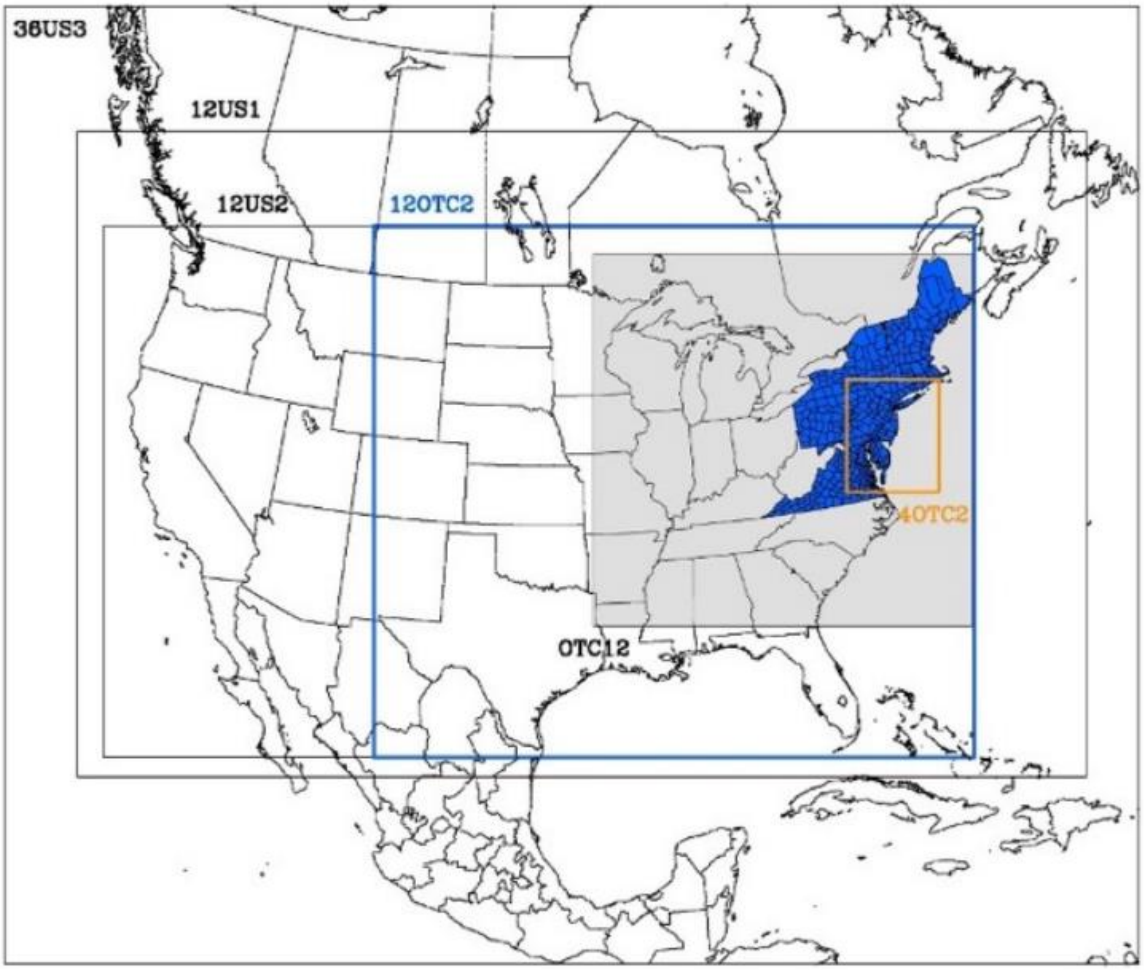
Episode/Period Selection

DEEP participated in a federal and state collaborative workgroup that was formed to determine the most suitable base year for ozone modeling. The workgroup considered the meteorological and air quality patterns conducive to ozone formation, the occurrence of exceptional events, availability of inventories, and time constraints. The assessment concluded that the 2016 ozone season was the best candidate base year for these modeling exercises.[92] The OTC and EPA used 2016 for base year modeling as recommended by the workgroup.

Modeling Domain and Grid Resolution

EPA's CAMx modeling domain started with a rectangular region covering the 48 contiguous states and including portions of Canada and Mexico with a horizontal resolution of 36 x 36 kilometers (km) (36US3 in Figure 7-1). The 36 km domain was then used to provide initial and boundary conditions for the 12 x 12 km domain (12US2) used for EPA's modeling for the Good Neighbor Plan.

Figure 7-1. *Modeling domains used by EPA and OTC.*



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[92] Base Year Selection Workgroup Final Report, 2017.

For its main modeling exercises, the OTC used the 12 x12 km 12OTC2 domain. This is the area outlined in blue in Figure 7-1. Other domains shown in the figure have been used for purposes such as screening modeling with preliminary inventories and are critical to the results discussed here. For example, the OTC also conducted modeling with a nested 4 x 4 km grid (4OTC2). The nested grid allowed greater resolution in the areas of concern. However, the nested grid results did not significantly differ from those of the 12x12 grid. Discussion and results of these additional modeling studies can be found in OTC TSD1.

All domains for both the EPA and OTC modeling reported here used 35 vertical layers to a height of approximately 17.5 km, or 50 millibars in atmospheric pressure.

Connecticut is located well downwind from the domain boundaries in both the OTC and EPA modeling platforms, enabling a more complete account of transport of ozone and precursors from upwind states.

Initial and Boundary Conditions

The objective of a photochemical grid model is to estimate the air quality given a set of meteorological and emissions conditions. The winds move pollutants into, out of, and within the domain. The models handle the movement of pollutants within the domain and out of the domain. An estimate of the quantity of pollutants moving into the domain is needed. These are called boundary conditions. Similarly, each grid cell throughout the domain needs initial concentration fields.

Initial and boundary conditions for OTC modeling were developed by New York State Department of Environmental Conservation (NYSDEC) using CMAQ v5.3.1 run on the 36US3 domain with 2016fh emissions from the Intermountain West Data Warehouse.[93] Initial and boundary conditions for the CAMx model runs were converted from the CMAQ data.

Initial and Boundary conditions for EPA's CAMx modeling were provided from 36 km grid modeling simulations using the GEOS-Chem global model and Hemispheric version of CMAQ (H-CMAQ).

A ramp up period of 15 days was used to minimize the effects of initial conditions for both the EPA and OTC runs and Connecticut's location within the domains mitigates the effects of boundary conditions.

Meteorological Model Selection and Configuration

The meteorological data for air quality modeling was based on 2016 meteorological simulations from version 3.8 of the Weather Research Forecasting Model (WRF). WRF outputs meteorology including hourly wind fields, temperature, humidity, vertical diffusion rates and rainfall for each grid cell. This output was processed to be CMAQ or CAMx ready for the full 35 vertical layers for each of the applicable grid domains.

Emissions Inventory

Base and future year inventories were developed through a collaboration with state and regional air agencies, federal land managers and EPA.[94] The starting point for inventory development was the 2014 National Emissions Inventory (NEI). Inventory sectors were updated to represent the year 2016 by incorporating 2016-specific data and nationally-applied adjustments. Updates resulted in various versions of the inventory. The OTC modeling reported on here relied on Version 1 of the inventory (OTC TSD1) and a hybrid Version 2 / Version 3 inventory (OTC TSD2). Version 2 of the inventory included updated MOVES3 mobile source emissions, area source emissions from the 2017 NEI, improved oil and gas inventory and updated emissions from Canada and Mexico. Updates to the commercial marine vessel and solvent sector emissions, later incorporated into Version 3, were used in a hybrid Version 2 / Version 3 inventory platform by

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[93] https://views.cira.colostate.edu/iwdw/RequestData/Default.aspx

[94] 2016 Base Year Inventory Documentation

OTC as documented in OTC TSD2. EPA used the Version 3 inventory for its assessment of the Good Neighbor transport FIP.

Future year inventories, including for 2023, were developed for each of the versions using projections for growth and expected control strategies. The models require detailed emissions inventories containing temporally allocated (i.e., hourly) emissions for each grid-cell in the modeling domain for a large number of chemical species that act as primary pollutants and precursors to secondary pollutants. Base and future year annual emission inventories were processed into model-ready hourly gridded emission inputs using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system.

The OTC modeling platforms used the ERTAC option for projecting future year EGU emissions while EPA uses IPM. All modeling platforms reported here use the BEIS option, rather than MEGAN, for generating biogenic emissions.

7.2 Model Performance

The ability of a model to predict the efficacy of future year control strategies can be assessed by considering its performance in replicating base year ozone concentrations.

Statistics are presented in

Table *7-1* for base year predicted ozone for the OTC and EPA platforms relative to observed maximum daily 8-hour ozone values greater than 60 ppb. Performance at the higher concentrations is more relevant to the critical high ozone values which are targeted for reduction. The mean bias is the average difference in predicted to observed values and a negative number indicates a tendency for under prediction. The mean error is the average absolute difference in predicted to observed values and smaller numbers indicate a more accurate model. The normalized mean bias and normalized mean error are the sum of the signed and absolute differences in predicted to observed values, respectively, divided by the sum of observed values and indicate percentage differences.

Table 7-1. *Model Performance Statistics for Maximum Daily 8-Hour Observations > 60 ppb Ozone.*

Modeling Scenario	Region	Mean Bias (ppb)	Mean Error (ppb)	Normalized Mean Bias (%)	Normalized Mean Error (%)
OTC1 CMAQ	Greater CT	-7.6	12.0	-11.3	17.8
	NY-NJ-CT	-5.2	9.0	-7.7	13.2
OTC2 CMAQ	Greater CT	-10.1	12.2	-15.0	18.0
	NY-NJ-CT	-7.3	9.9	-10.7	14.6
OTC1 CAMx	Greater CT	-4.6	8.4	-2.3	11.1
	NY-NJ-CT	-1.6	7.5	-0.6	9.2
OTC2 CAMx	Greater CT	-7.5	9.7	-11.1	14.4
	NY-NJ-CT	-4.9	7.9	-7.2	11.6
EPA CAMx	Northeast	1.7	7.0	2.5	10.4

Notes:
OTC statistics are for April through October 2016; EPA statistics are for May through September 2016.
EPA performance statistics for the Northeast include monitor sites from New England, New York, New Jersey, Pennsylvania, Maryland and Delaware.

Statistics in the table indicate that the model upgrades from OTC1 to OTC2 resulted in poorer performance in the regions of interest for both CMAQ and CAMx. While a direct comparison cannot be made due to the difference in geographical scope for the reported values, the EPA CAMx platform statistics more nearly approach the OTC1 CAMx platform statistics for the NY-NJ-CT region. This similarity may result from the use of the same model version (7.10) and sufficient number of high monitored observations in the smaller region and indicate changes in platform performance are more related to model upgrades than inventory upgrades.

Monthly variation in the observed and predicted ozone concentrations for the OTC model scenarios are shown in

Figure *7-2* for the Northeast region which is generally similar to the EPA Northeast region described in

Table *7-1* with the addition of eastern parts of Virginia, West Virginia and Ohio. The data show the models under-predict the overall average ozone levels early in the season and begin to over-predict later in the season. When the data is restricted to the higher (over 60 ppb) ozone, it is apparent that CMAQ under-predicts the majority of data while CAMx tends to over-predict during the mid-season. However, excess over-prediction is more likely to occur with the CMAQ model.

Figure 7-2 (a-b). *Monthly boxplot distributions for (a) all days and (b) days with maximum daily average 8-hour ozone concentrations greater than 60 ppb. Observations (gray) OTC1 CMAQ (red), OTC1 CAMx (blue), OTC2 CMAQ (orange) and OTC2 CAMx (green) for April to October 2016.*

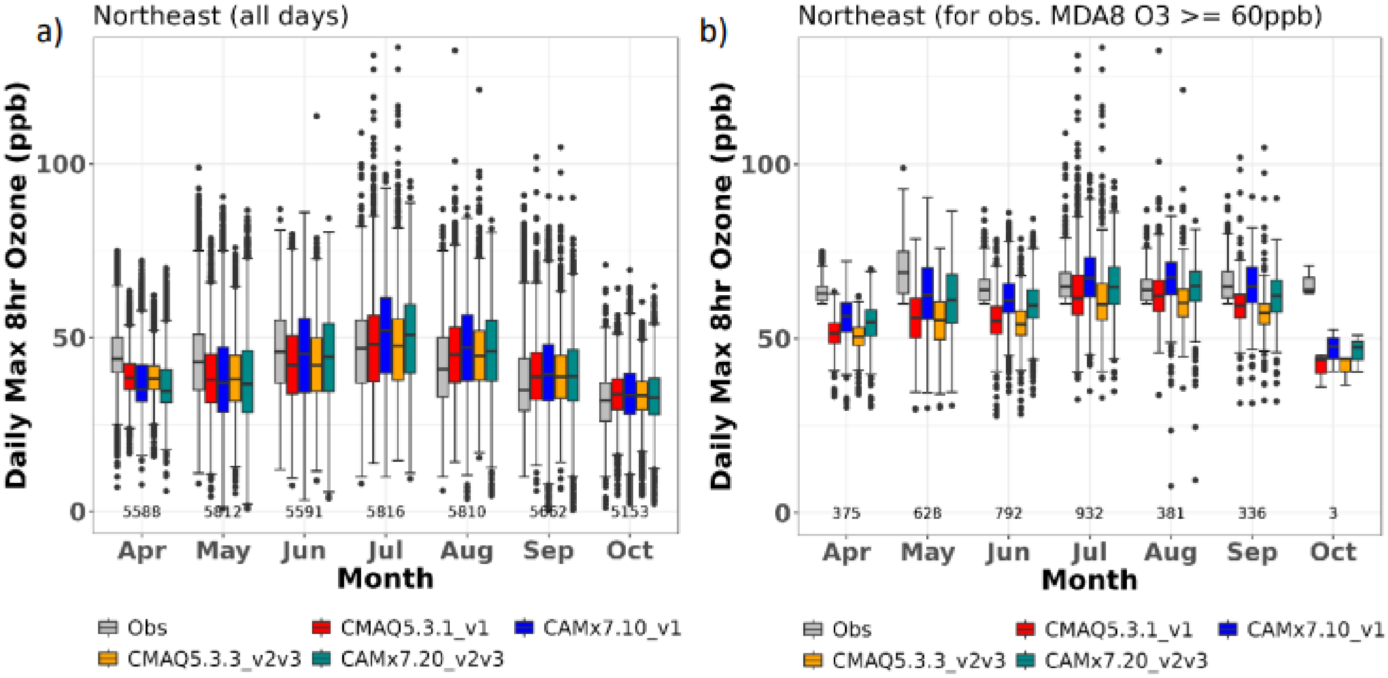
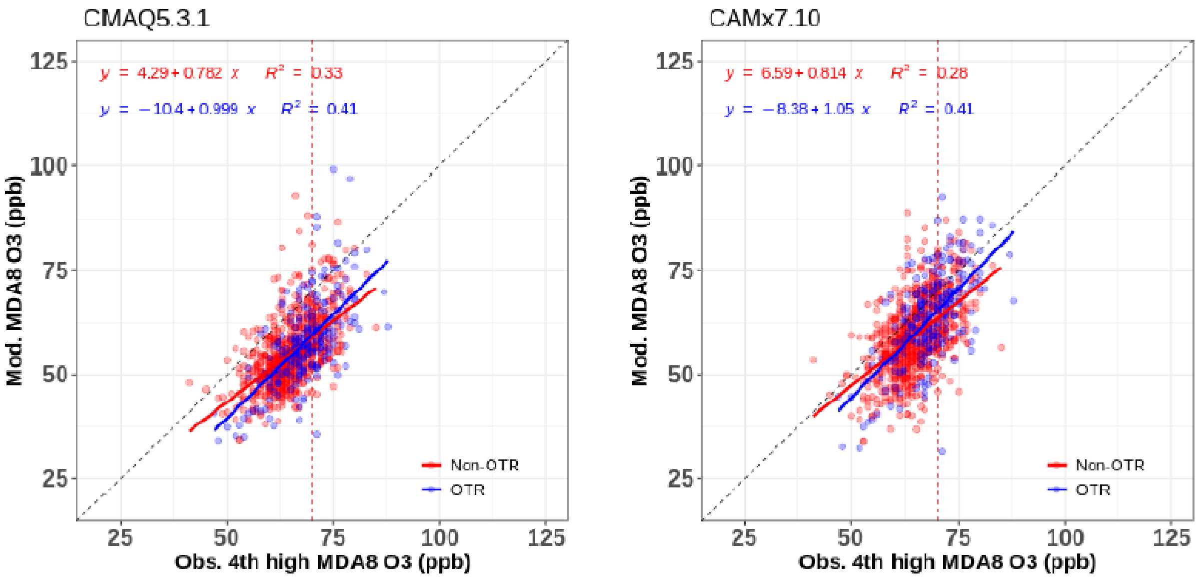


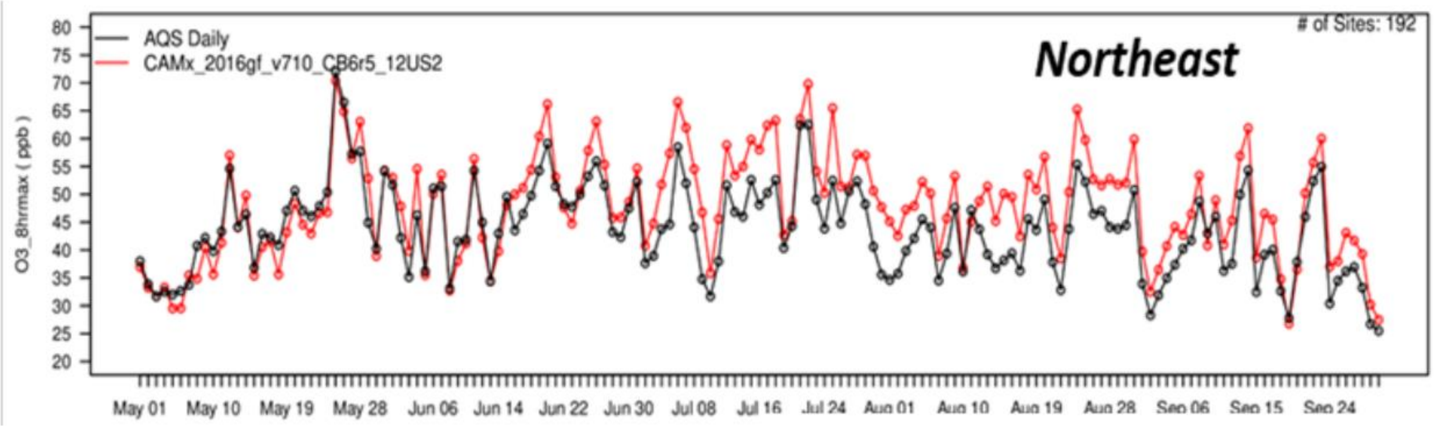
Figure 7-3 shows the results of predicted versus observed fourth high MDA8 ozone concentrations from the OTC1 CMAQ and CAMx modeling of the monitoring sites located within and outside of the OTR. The plot shows that both models performed better for OTR sites, as supported by a greater R^2 value for those sites. The CMAQ model tended to under-predict fourth high daily ozone values at many of the sites, particularly ozone values over 70 ppb. For the sites that CMAQ over-predicted ozone values, six out of the seven highest over-predictions were at coastal Connecticut sites when the monitors were characterized as water cells. This underlines the difficulty in modeling along the land/water interface. The CAMx model results were similar to CMAQ, and while the over-predictions were more numerous, they were not as extreme as those over-predictions from CMAQ.

Figure 7-3. *Density Scatter Plot of Modeled vs. Observed MDA8 Ozone Concentrations for Monitoring Sites in the OTR and outside of OTR in the OTC1 CMAQ (left) and CAMx (right) Modeling Domains.*



EPA evaluated model performance by comparing the observed 2016 8-hour maximum daily ozone monitored data with the model predictions. EPA concluded that overall CAMx model predictions closely reflect the observed ozone concentrations at the 12 km resolution. Data for the northeast indicate a slight under-prediction in MDA8 ozone during the beginning of the ozone season (May and June) but over-prediction in the rest of the season (see Figure 7-4).

Figure 7-4. *Regional average observed and predicted Maximum Daily 8-Hour ozone for May through September in the Northeast using EPA modeling.*



Below are time series charts to observe how EPA's CAMx modeling replicates daily changes in observed ozone concentrations during the ozone season for two of Connecticut's nonattainment monitors for the 2016 base year. At both sites, the model tended to over-predict mid-season, but overall, closely replicated the daily fluctuations in ozone.

Figure 7-5. *Time series of observed and predicted MDA8 ozone concentrations for May through September 2016 at the Stratford, CT monitor.*

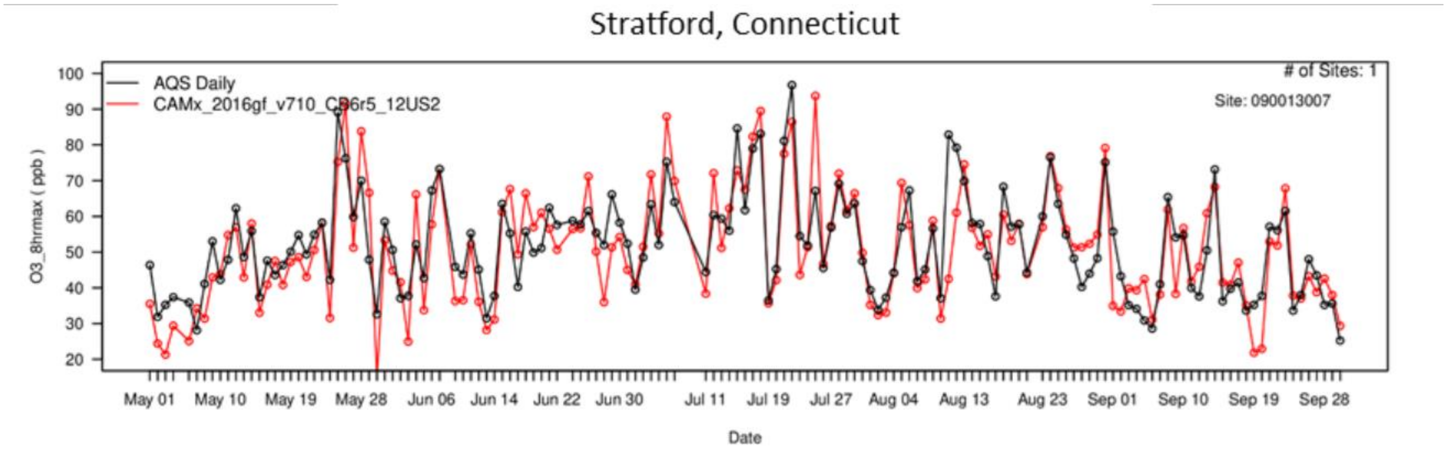
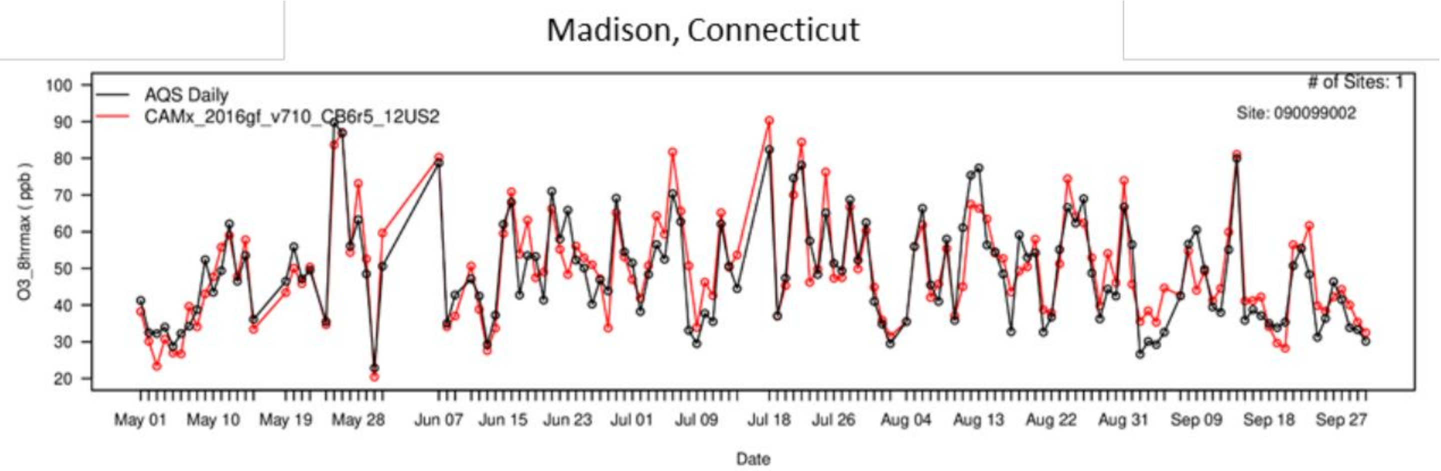


Figure 7-6. *Time series of observed and predicted MDA8 ozone concentrations for May through September 2016 at the Madison, CT monitor.*



Overall, the modeling systems reasonably estimate 8-hour average surface ozone during the base year.

7.3 Modeled Attainment Test (MAT)

Consistent with EPA's guidance,[95] modeled results were applied in a relative sense, assuming that measured values from the baseline period would decrease in proportion to modeled improvements between the baseline and future projection years. EPA and OTC applied the "modeled attainment test" (MAT) to each monitor using the following equation:

$(DV_F)_i = (RRF)_i \, (DV_B)_i$ (MAT Equation)

Where:

$(DV_F)_i$ = the estimated future design value for the year of interest, in ppb
$(DV_B)_i$ = the baseline measured concentration at site i, in ppb
$(RRF)_i$ = the relative response factor determined as the ratio of the, preferably, ten highest modeled days between the future year and the baseline year, calculated from grids in and near site i.

The baseline measured concentration (DV_B) is a five-year weighted average design value centered about the base year. The design value for a site is the average of the fourth highest daily maximum 8-hour average ozone concentrations for each of the three most years. The 2016 five-year weighted base year design value is obtained from averaging the design values for the years 2016, 2017 and 2018 (i.e., fourth highest daily maximums from 2014-2016, 2015-2017, and 2016-2018, respectively).

The RRF is the fractional change in air quality that occurs from base to future year using the most relevant improvement expected in air quality for a given location. Use of this relative attainment test has been shown to slightly improve model projections over the modeled projected design values obtained by simply averaging the future year modeled values in the nine grids including and surrounding the monitor. EPA and OTC modelers use software to make these calculations for each monitoring site.

The 2023 design value (DV_F) is obtained by applying the appropriate RRF to the five-year weighted design value.

7.4 Modeled Projections

OTC and EPA modeling results are presented using the nine (3x3)-grid cell method recommended for the model attainment test, as well as an alternate method that excludes adjacent grid cells located over water (i.e., Long Island Sound), where modeled values are often significantly higher than for grid cells over land.[96] This alternate method does not exclude the grid cell where the monitor is located regardless of the land use characterization. Both the

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[95] "Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze," EPA, 2018

[96] For a discussion of land-water interface issues, see Section 8 of OTC's modeling TSD, Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union 2016 Based Modeling Platform Support Document.

Groton and Greenwich sites are located in grids that are characterized as water. Because the modeled attainment test is based on a ratio of future-to-base year results from the selected grids, the method does not necessarily result in lower predicted future year design values.

Table 7-2 summarizes 2023 projected average design values determined from CMAQ and CAMx modeling conducted by OTC and CAMx modeling conducted by EPA. The OTC runs are labeled consistent with the platforms described above in OTC TSD1 and OTC TSD2 as OTC1 and OTC2, respectively. Results are also presented graphically in Figure 7-7 and Figure 7-8 for monitor locations in Greater Connecticut and Southwest Connecticut.

Maximum projected design values, typically evaluated only for determining maintenance status, are not presented. However, all maximum projected design values for monitors in Greater Connecticut, with the exception of the OTC1 and OTC2 CMAQ "No Water" results, were below the 2015 standard. As the only average projected design values above the standard were from this same model and method, modeling generally indicates the Greater Connecticut area is likely to attain and maintain compliance with the standard.

Shoreline monitors in Southwest Connecticut, with the exception of New Haven, are projected to exceed the 2015 NAAQS in 2023 for nearly all scenarios. The inland monitors attain under all scenarios.

The OTC CMAQ model design value projections are generally lower than the OTC CAMx projections. The exceptions are the CMAQ No Water runs for Greenwich and Groton and the Westport CMAQ runs using the standard 3x3 method which produced the overall highest predicted ozone values of 80 ppb and 77 ppb respectively under the OTC1 and OTC2 scenarios.

EPA's design value projections are all lower than OTC's projections with exceptions for Greenwich and Madison. EPA's Greenwich runs are lower than the OTC Greenwich runs with the exception of the OTC1 CMAQ standard 3x3 scenario. EPA's standard 3x3 run reaches the same level as several of the OTC scenarios at Madison.

Modeling indicates that the coastal sites in Southwest Connecticut do not attain the 2015 ozone NAAQS in 2023. It is important to note, however, that EPA modeling shows Southwest Connecticut does attain the older 2008 ozone NAAQS.

Table 7-2. *Comparison of OTC CMAQ and EPA CAMx Average Design Value Projections for 2023.*

				OTC1 CAMx		OTC1 CMAQ		OTC2 CAMx		OTC2 CMAQ		EPA CAMx	
	Monitor	**Monitor ID**	**DVB 2014-2018 Design Values (ppb)**	**2023 Projected Design Value (3x3) (ppb)**	**2023 Projected Design Value (No Water1) (ppb)**	**2023 Projected Design Value (3x3) (ppb)**	**2023 Projected Design Value (No Water1) (ppb)**	**2023 Projected Design Value (3x3) (ppb)**	**2023 Projected Design Value (No Water1) (ppb)**	**2023 Projected Design Value (3x3) (ppb)**	**2023 Projected Design Value (No Water1) (ppb)**	**2023 Projected Design Value (3x3) (ppb)**	**2023 Projected Design Value (No Water) (ppb)**
Greater CT	Groton	09-011-0124	74.3	67	68	67	71	67	67	68	71	65	65
	Cornwall	09-005-0005	71.3	63	63	62	62	63	63	63	63	61	61
	East Hartford	09-003-1003	71.7	63	63	62	62	63	63	62	62	61	61
	Stafford	09-013-1001	71.7	63	63	62	62	63	63	62	62	61	61
	Abington	09-015-9991	69.7	61	61	60	60	61	61	60	60	59	59
Southwest CT	Greenwich	09-001-0017	79.3	74	74	71	78	76	73	75	74	72	71
	Danbury	09-001-1123	77.0	69	69	69	69	69	69	69	69	67	67
	Stratford	09-001-3007	82.0	75	75	74	75	75	75	74	74	73	72
	Westport	09-001-9003	82.7	78	76	80	75	76	75	77	76	74	73
	Middletown	09-007-9007	78.7	70	70	69	69	70	70	69	69	68	68
	New Haven	09-009-0027	75.7	69	68	69	68	69	68	69	68	67	66
	Madison	09-009-9002	79.7	71	72	71	71	72	72	72	71	71	70

Figure 7-7. *Comparison of Modeled Projections of 2023 Design Values in Greater Connecticut.*

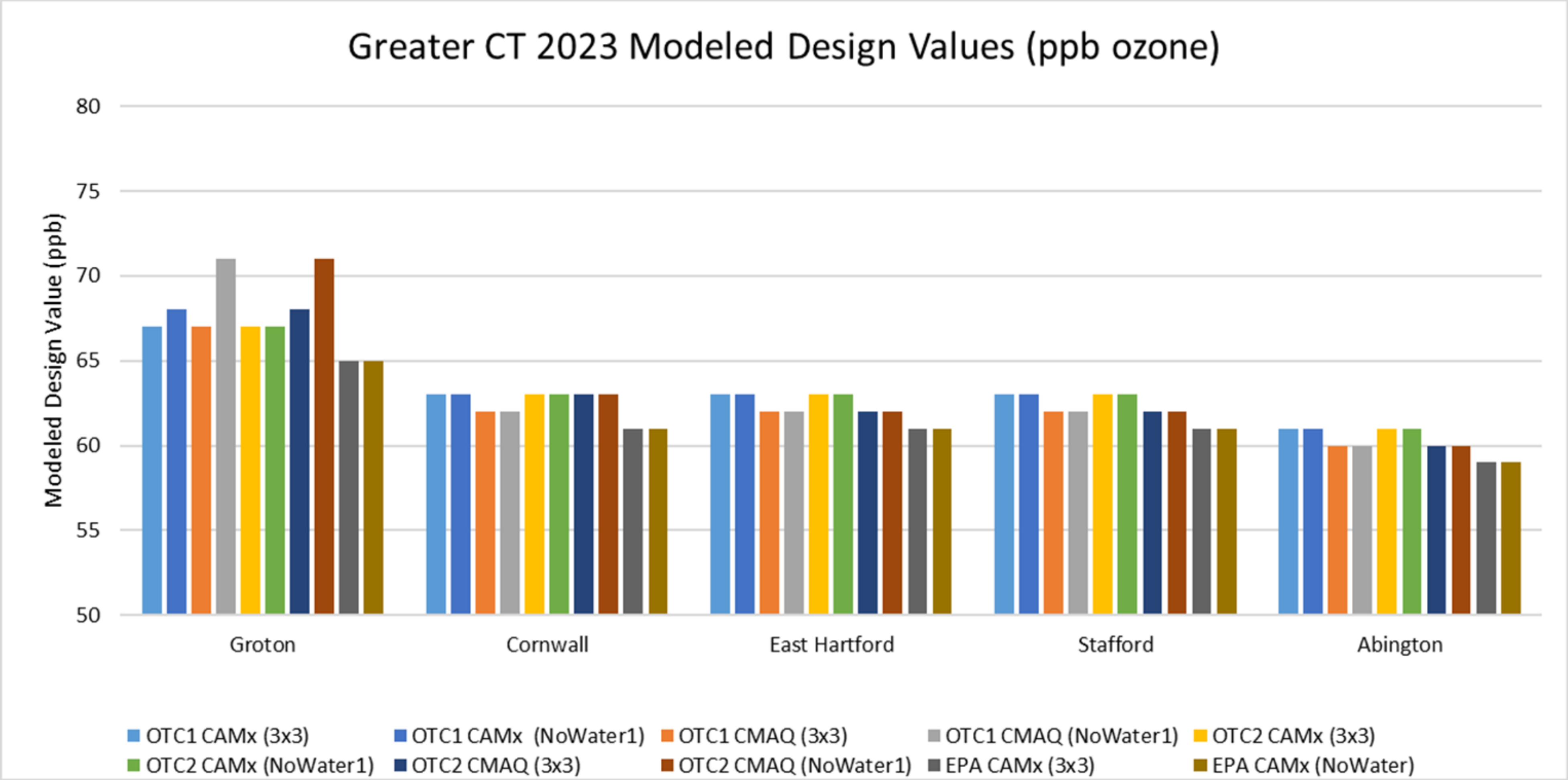
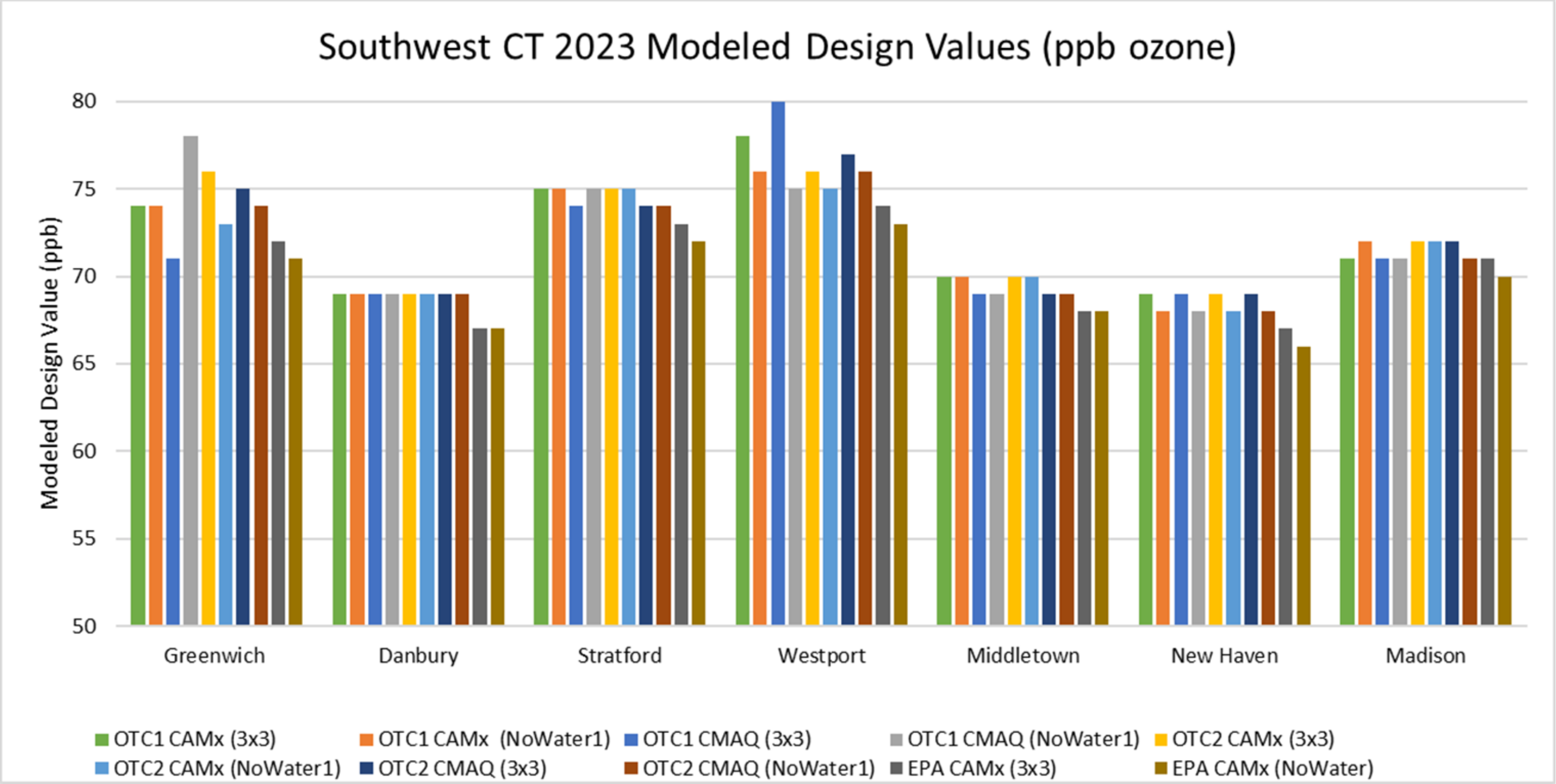


Figure 7-8. *Comparison of Modeled Projections of 2023 Design Values in Southwest Connecticut.*



8 Weight of Evidence

This section considers factors affecting the likelihood of attainment in each of Connecticut's nonattainment areas.

8.1 Greater Connecticut

Modeling indicates that Greater Connecticut is likely to attain the 2015 ozone NAAQS in 2023. More importantly, monitoring data to date supports this conclusion when days which were heavily impacted from enhanced ozone transport due to wildfires are excluded from consideration in accordance with the exceptional events rule.[97]

DEEP is evaluating exceptional events which occurred in 2023 on April 13-14, June 1-2, June 30 and July 1 and July 12 due to US and Canadian fires. Although smoke from Quebec wildfires enhanced ozone in Connecticut throughout the early summer of 2023, these seven dates are most critical from a regulatory perspective and provide the opportunity for a one year extension of the attainment date in accordance with CAA section 181(a)(5) and the 40 CFR 51.1307 of the implementation rule.

8.2 Southwest Connecticut

EPA modeling shows that Southwest Connecticut attains the 2008 ozone NAAQS in 2023. Monitoring data – with the exclusion of data from exceptional events – indicate that attainment of the 2008 NAAQS plausibly begins in 2023. It is evident however that attainment with the 2015 standard will not occur by the attainment date in Southwest Connecticut.

EPA conducted modeling[98] to evaluate ozone contributions to downwind states in assessing the efficacy of its federal implementation plan under CAA section 110(a)(2)(D) – the "good neighbor" provision of the Act – for the 2015 ozone standard. The results of that modeling are optimistic, predicting a 2023 maximum design value of 73 ppb ozone in southwestern Connecticut at the Westport monitor. However, a 2022 design value of 80 ppb at that site, and a preliminary 2023 design value of 82 ppb[99]), raise concern for the modeling on which the rule was based. Deepening the concern is the magnitude of the contributions from nearby upwind states that are expected to remain even after the rule becomes effective as shown in Figure 8-1.

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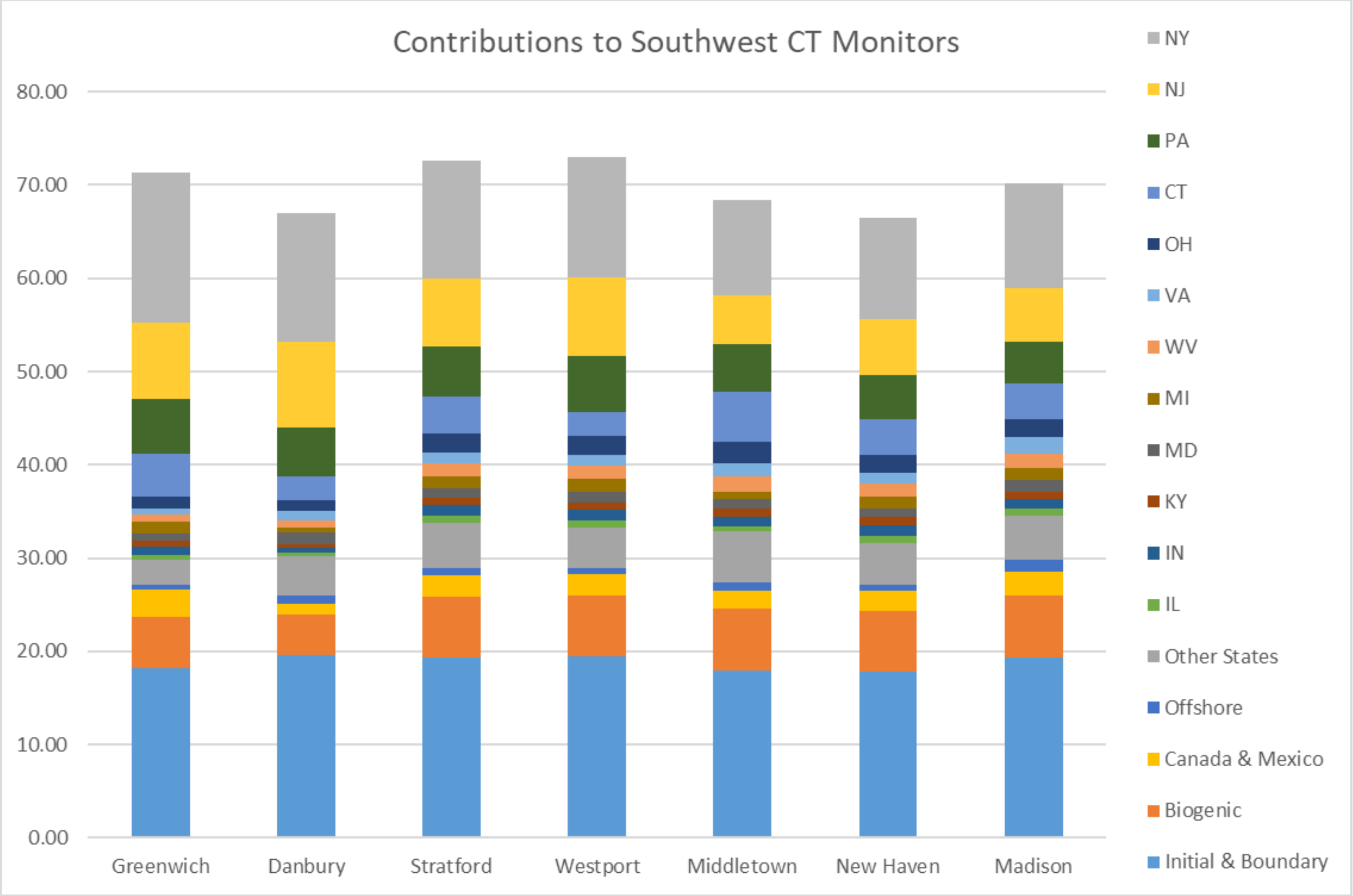
[97] 40 CFR 50.14

[98] EPA's modeling results are available at https://www.epa.gov/csapr/good-neighbor-plan-2015-ozone-naaqs under the heading "Data File with Ozone Design Values and Ozone Contributions." The file list the contribution by each state to the modeled projected average 2023 ozone design value for each monitor.

[99] This does not exclude data which may be influenced by exceptional events.

Figure 8-1. *Contributions to 2023 Design Values for Southwest Connecticut Monitors according to the EPA's Final Good Neighbor FIP modeling.*



Despite of the relatively small contribution Connecticut makes to its own monitors, and that it is impossible for Connecticut to attain without the actions by upwind states and the EPA to reduce out-of-state emissions, Connecticut has taken and continues to seek every opportunity to obtain emissions reductions from in-state sources.

8.3 Exceptional Event Requests

DEEP is evaluating the option to submit a request to exclude ozone data that has been affected by smoke from US and Canadian fires during 2023. Table *8-1* and Table 8-2 provide the current ten highest ranking daily ozone values at each monitoring site in the Greater Connecticut and Southwest Connecticut nonattainment areas, respectively. Candidate days for exclusion are highlighted in red in the tables, but not all monitors for each day will be subject to the request as there may be no regulatory significance to making such requests. For example, the fourth highest ozone level at the Abington monitor is currently well below the NAAQS and no regulatory significance results from excluding the ozone data impacted by smoke at that site.

Each table shows associated particulate values from collocated or nearby monitors as an indicator of smoke presence. PM2.5 levels for the June 30-July 1 event are well above levels ordinarily monitored in Connecticut and clearly indicate the presence of smoke. While the particulate levels were not as high for the April 13-14 event, Figure 8-2 shows back trajectories for April 13th traversing areas with high smoke and fire activity. Figure *8-3* shows a satellite image of smoke across the northeast during the July 12 event. DEEP will submit in-depth analyses of each exceptional event in a separate demonstration to EPA using similar data and techniques.

The exclusion of the events would result in sufficiently lower values for the fourth highest maximum 8-hour ozone concentrations as indicated by the values highlighted in yellow in Table 8-1 and Table 8-2. These values would be consistent with EPA modeling reported in section 7 which showed Greater Connecticut attaining the 2015 ozone NAAQS, and Southwest Connecticut attaining the 2008 ozone NAAQS, in 2023.

Table 8-1. *Highest Ozone Days in Greater Connecticut for 2023.*

Greater CT 10 Highest Ozone Values with Accompanied PM2.5 Values per Monitor																				
Cornwall	**4/14/2023**		**7/1/2023**		**6/30/2023**		**6/1/2023**		**4/13/2023**		**7/26/2023**		**5/12/2023**		**6/11/2023**		**4/12/2023**		**7/13/2023**	
	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5
	82	12.5	79	50	78	73.7	76	14.6	67	9.8	67	17.2	65	6.8	65	24.5	62	7.6	62	13.7
East Hartford	**4/14/2023**		**7/1/2023**		**6/30/2023**		**6/1/2023**		**5/28/2023**		**7/6/2023**		**6/2/2023**		**4/13/2023**		**7/12/2023**		**7/26/2023**	
	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5
	84	14.7	82	46.4	73	46.1	73	15.8	70	10.1	69	13.3	69	13.5	67	10.9	64	14.7	64	15.9
Groton	**7/12/2023**		**7/1/2023**		**4/13/2023**		**4/14/2023**		**7/29/2023**		**6/30/2023**		**5/12/2023**		**7/28/2023**		**9/7/2023**		**7/6/2023**	
	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5
	81	15.3	76	32.7	76	13.2	73	14.8	71	11.3	70	38.9	70	12.2	69	9.5	64	15	62	10.8
Stafford	**4/14/2023**		**7/1/2023**		**4/13/2023**		**5/28/2023**		**6/30/2023**		**6/1/2023**		**5/12/2023**		**6/12/2023**		**9/2/2023**		**4/4/2023**	
	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5
	88	14.7	76	46.4	71	10.9	70	10.1	68	46.1	65	15.8	64	10.2	63	24.4	62	5.3	61	8.1
Abington	**4/14/2023**		**7/1/2023**		**4/13/2023**		**5/12/2023**		**5/16/2023**		**5/28/2023**		**6/1/2023**		**6/12/2023**		**7/13/2023**		**4/12/2023**	
	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5	O3	PM2.5
	74	14.7	71	46.4	69	10.9	63	10.2	63	6.7	62	10.1	61	15.8	61	24.4	59	13.1	58	8

Table 8-2. *Highest Ozone Days in Southwest Connecticut for 2023.*

Southwest CT 10 Highest Ozone Values with Accompanied PM2.5 Values per Monitor																				
Danbury	**4/14/2023**		**6/30/2023**		**7/1/2023**		**7/26/2023**		**6/1/2023**		**6/11/2023**		**9/7/2023**		**4/13/2023**		**7/6/2023**		**7/17/2023**	
	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5
	85	17.5	85	47.9	83	45.1	75	13.8	73	15.8	72	24.2	70	11.9	68	12.4	68	11.7	65	19.3
Greenwich	**7/12/2023**		**9/7/2023**		**7/1/2023**		**7/26/2023**		**6/30/2023**		**6/2/2023**		**7/6/2023**		**4/14/2023**		**7/28/2023**		**6/1/2023**	
	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5
	89	17.2	87	12.2	82	48.1	82	16.8	81	60.2	81	16.3	77	13.3	76	18.1	75	12.1	73	24.5
Madison	**4/13/2023**		**7/12/2023**		**7/29/2023**		**6/30/2023**		**7/1/2023**		**4/14/2023**		**5/12/2023**		**8/21/2023**		**9/3/2023**		**9/7/2023**	
	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5
	82	16	81	13.4	81	9	78	51.4	77	39.8	75	18.8	75	14.6	74	15.3	71	8.4	69	13
Middletown	**4/14/2023**		**7/29/2023**		**7/1/2023**		**4/13/2023**		**7/12/2023**		**6/30/2023**		**6/2/2023**		**6/1/2023**		**5/28/2023**		**9/2/2023**	
	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5
	82	16.5	80	9.2	80	51.4	75	13.7	70	14.2	69	49.7	68	13.7	68	16.8	66	7.7	66	5.6
New Haven	**7/29/2023**		**6/30/2023**		**7/1/2023**		**7/6/2023**		**4/14/2023**		**7/12/2023**		**6/11/2023**		**6/2/2023**		**5/12/2023**		**7/4/2023**	
	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5
	82	9	80	51.4	72	39.8	69	10.5	66	18.8	66	13.4	66	24.2	65	11.9	64	14.6	64	14.6
Stratford	**7/12/2023**		**7/1/2023**		**7/29/2023**		**6/30/2023**		**4/13/2023**		**9/7/2023**		**7/6/2023**		**6/2/2023**		**8/21/2023**		**7/19/2023**	
	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5
	89	17.2	86	48.1	86	11.6	81	60.2	77	14.9	77	12.2	76	13.3	75	16.3	74	14.4	73	28
Westport	**7/12/2023**		**7/1/2023**		**6/2/2023**		**7/29/2023**		**6/30/2023**		**4/13/2023**		**4/14/2023**		**9/7/2023**		**7/26/2023**		**7/19/2023**	
	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5	O_3	PM2.5
	89	17.2	82	48.1	80	16.3	79	11.6	79	60.2	79	14.9	78	18.1	76	12.2	75	16.8	74	28

Figure 8-2. *Back trajectories for April 13 showing winds traversing through smoke and fire.*

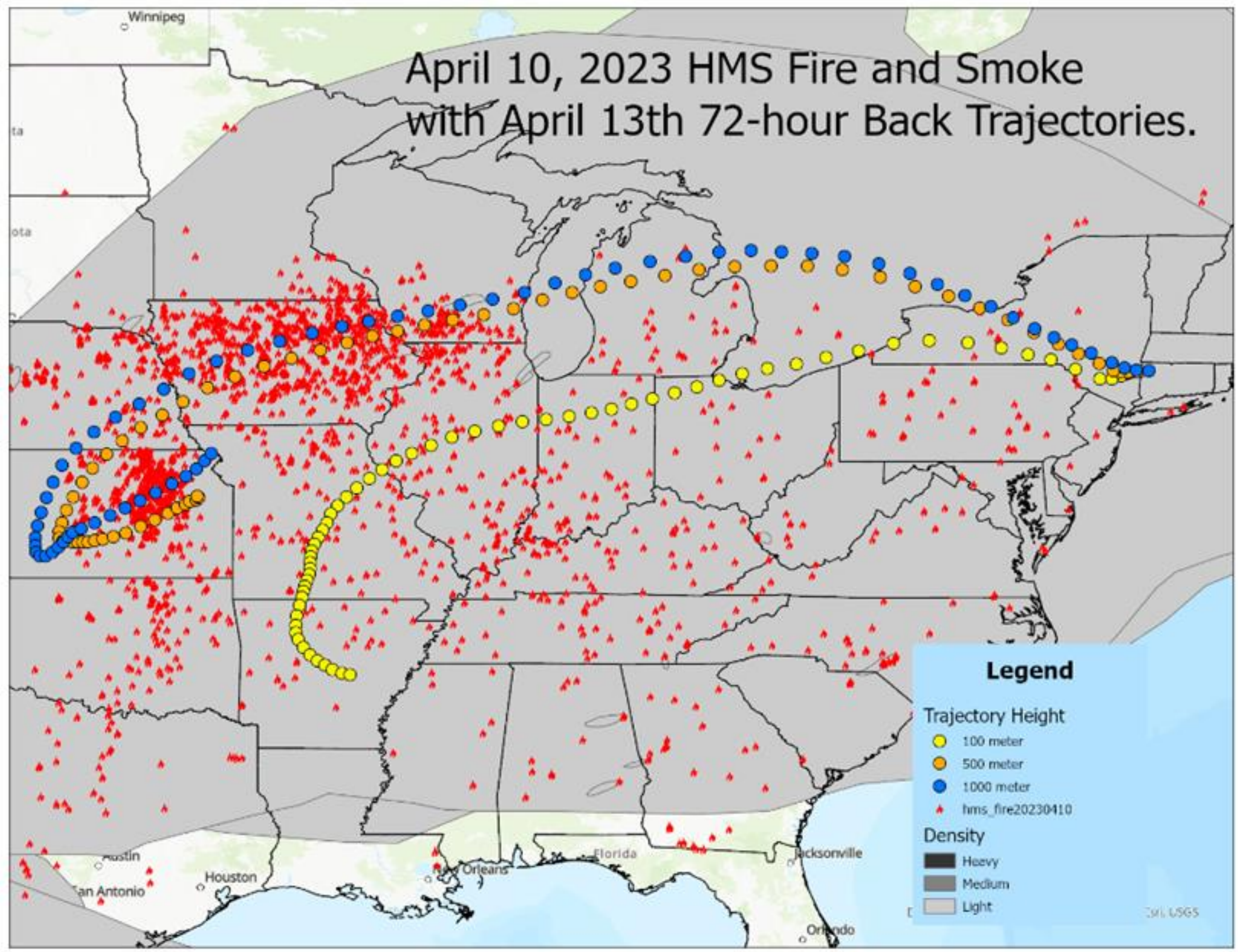
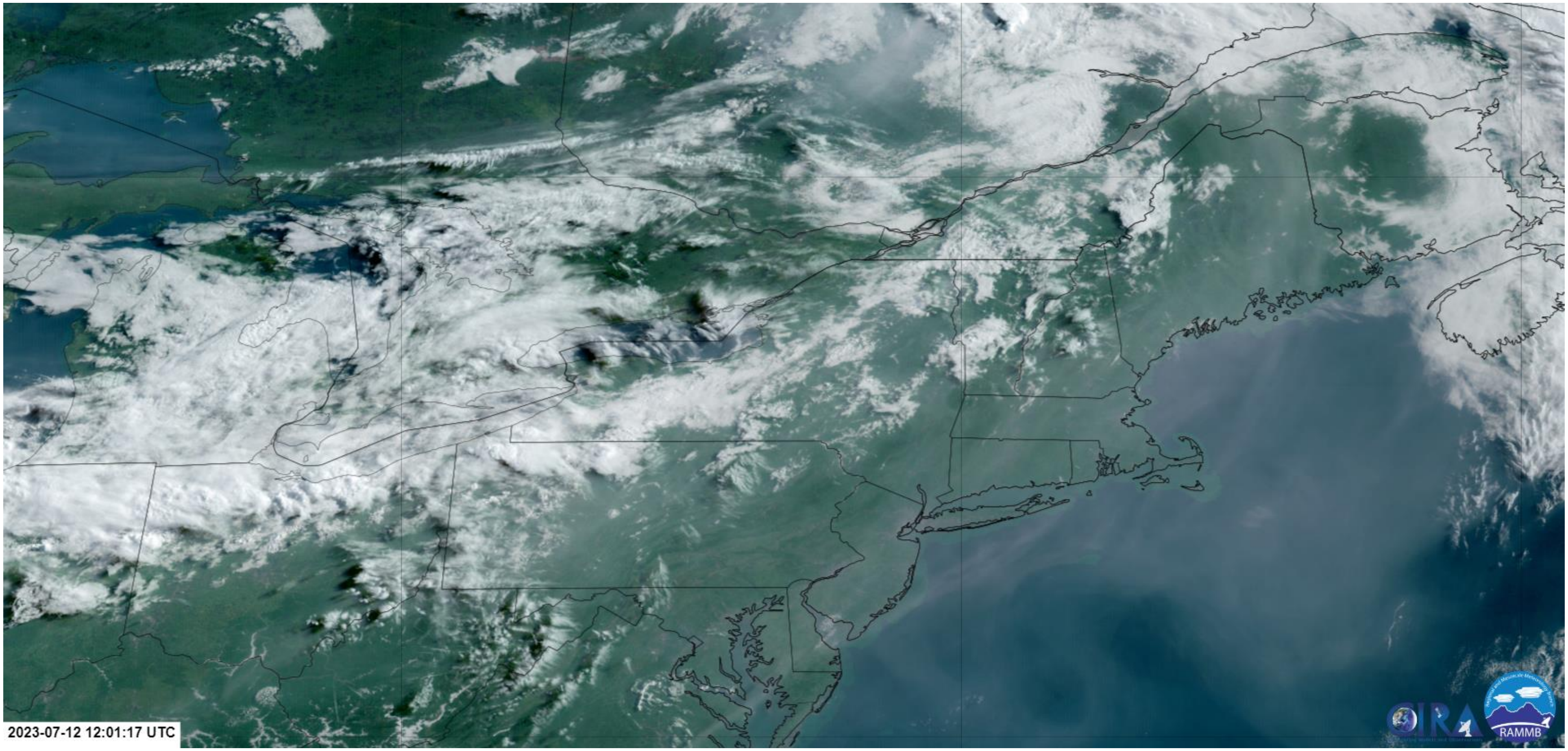


Figure 8-3. *Satellite image showing smoke (gray shading) over the Northeastern US, Canada and off-shore on July 12, 2023*



8.4 Additional Control Measures for Mobile Sources

The Clean Air Act was designed with the recognition that ozone is transported from areas outside of a state's authority to control and provides various remedies for relief from interstate transport of ozone. CAA 110(a)(1) requires that implementation plans providing adequate provisions to prohibit interstate transport as described in CAA 110(a)(2)(D) be submitted to EPA within not more than three years of promulgation of a standard (i.e., 2018 for the 2015 ozone NAAQS). While EPA's federal implementation plan for states that failed to adequately prohibit interstate transport is still not fully effective in 2023, it does not address the larger portion of emissions in contributing states that can only be regulated by the federal government. These emissions, from the on-road and nonroad mobile source sectors, are in need of further reductions and will help contributing states that remain large contributors to nonattainment in Connecticut reduce those contributions while reducing above average nitrogen oxides concentrations that unequally affect the populations within their states.

As in Connecticut, a large portion of contributing states' inventories are from the mobile source sector. EPA has authority over most of the emissions control options for mobile sources and regional reductions from the mobile source sector must continue for Connecticut to attain and maintain compliance with the ozone NAAQS .

EPA's Clean Trucks Plan consists of three regulatory actions to occur over the next few years, with the first being the *Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards* issued in 2023. The rule finalizes stronger NOx and GHG standards to reduce pollution from heavy-duty vehicles (HDV) and engines starting in MY 2027. The new standards will significantly reduce NOx emissions from heavy-duty gas and diesel engines, as well as set stronger GHG standards for certain heavy-duty vehicle categories. The provisions in this final rule apply to all heavy-duty engine (HDE) classes: Spark-ignition (SI) HDE, compression-ignition (CI) Light HDE, CI Medium HDE, and CI Heavy HDE. Over time, as newer, cleaner vehicles enter the fleet, emissions reductions will continue. These updated standards ensure cleaner HDVs and engines, while jump-starting the transition to zero-emission HDVs. EPA estimates that by 2040, the final rule will reduce NOx emissions by more than 40 percent and by 2045, NOx emissions will be down 50 percent. The next two stages of the Clean Trucks Plan will follow in the coming years.

Taking separate action, in July 2020, Connecticut signed a *Multi-State Medium and Heavy-duty Zero Emission Vehicle Memorandum of Understanding (MOU)* to work collaboratively with 14 other states to advance and accelerate the market for electric medium and heavy-duty vehicles.[100] Under the MOU, states will work towards 100 percent of all new medium and heavy-duty vehicles sales be zero emission vehicles by 2050. In December 2021, Governor Lamont issued Executive Order 21-3 (E.O. 21-3), which directed state agencies to take actions to reduce carbon emissions and assess Connecticut's need to adopt the California Air Resources Board

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[100] Multi-State Medium- and Heavy-duty Zero Emission Vehicle Memorandum of Understanding, July 2020

(CARB) standards for medium and heavy-duty vehicles. In 2022, DEEP published a report finding that adopting these standards would reduce both criteria pollutant and GHG emissions.[101] DEEP is currently finalizing regulatory proposals for both the Medium and Heavy-Duty Vehicle Emission Standards and Light-Duty Vehicle Emission Standards for model years 2027-2035.[102] DEEP will submit these control strategies to EPA by way of a SIP revision upon adoption by the Legislative Regulations Review Committee.

As a number of states within the OTR are adopting these same emissions standards, DEEP expects these rules upon implementation will continue to reduce pollution from the mobile source sector throughout the region and will contribute to ozone attainment in Connecticut.

8.5 Additional Connecticut Emission Reduction Programs

In addition to control measures described above and in Sections 4.2 to 4.4, Connecticut continues to implement a variety of other initiatives that provide supplemental emission reductions. These initiatives include on-road and non-road measures, as well as energy efficiency and renewable energy programs. The associated emission reductions will serve to further reduce Connecticut's contributions to in-state ozone levels in both the Southwest Connecticut and Greater Connecticut portions of the state beyond those documented elsewhere in this document.

Mobile Source Initiatives

Connecticut's supplemental mobile source initiatives, some of which are being implemented in collaboration with EPA and other states, include Diesel Emissions Reduction Act (DERA) projects, the Volkswagen (VW) Diesel Emissions Mitigation Program, and the Electric Vehicle (EV) Connecticut Program. These initiatives collectively reduce ozone precursor emissions through accelerated replacement of older, dirtier vehicles and equipment with new, cleaner alternatives.

Connecticut has made use of available DERA grant and VW Settlement allocations to reduce diesel emissions and improve air quality. A list of projects funded is provided on DEEP's webpage: https://portal.ct.gov/DEEP/Air/Mobile-Sources/DERA-Grants.

EV Connecticut is the State of Connecticut's market development program striving to electrify transportation. EV Connecticut has helped build the infrastructure for electric vehicles and partnerships to enhance the technology, markets, and choices for electric vehicles. While EV deployment is considered primarily a GHG measure, it will also achieve ancillary reductions in ozone precursor emissions.

EV Connecticut makes information available to Connecticut residents, businesses, and government to encourage the introduction of more electric vehicles in Connecticut. The

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[101] An Assessment of Connecticut's Need to Adopt California's Medium and Heavy-Duty Vehicle Emission Standards

[102] https://eregulations.ct.gov/eRegsPortal/Search/RMRView/PR2023-020 and https://eregulations.ct.gov/eRegsPortal/Search/RMRView/PR2023-023.

program also has funded charging stations. As of August 29, 2023, the state has 636 total public charging locations consisting of 1,760 electric vehicle supply equipment (EVSE) ports. Of the 1,760 total EVSE ports, 9 are Level 1 charging ports, 1,360 are Level 2 charging ports, 390 are DC fast charging (DCFC) ports.[103]

Connecticut also has the Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) program, which is a statutory incentive program that provides a payment to a Connecticut resident who purchases or leases a new eligible battery electric, plug-in hybrid electric, or fuel cell electric vehicle from a licensed automobile dealership. The program began providing incentives May 2015. An expanded version of the CHEAPR program began January 1, 2020. From May 2015 through July 2023, CHEAPR issued 4,976 and 5,764 rebates for battery electric and plug-in hybrid electric vehicles respectively for a combined total of 10,740 EVs.

On January 1, 2022, a nine-year statewide electric grid distribution planning program launched as described by the Public Utilities Regulatory Authority (PURA) in Docket No. 17-12-03RE04 to consider the effects of electric vehicles. The program goals include enabling a self-sustaining zero emission vehicle market on a scale necessary to meet the State's environmental and energy goals through incentivizing the deployment of residential single-family level 2 charging, residential multi-unit dwelling level 2 charging, direct current fast charging, destination level 2 charging and workplace and light-duty fleet level 2 charging.

On July 1, 2022, Public Act 22-25, *An Act Concerning the Connecticut Clean Air Act*, became effective in Connecticut. The purpose of Public Act 22-25 is to reduce GHG emissions from different types of mobile sources to improve the air quality in the state and the health of Connecticut's residents. The law aims to increase the number the zero-emissions school buses, authorizes DEEP to adopt California's low NOx Omnibus and Advanced Clean Truck rules, establishes a medium and heavy-duty vehicle incentive program, and establishes the Connecticut Electric Bicycle Incentive Program. Public Act 22-25 also expands the CHEAPR program through increased funding, an increased maximum manufacturer suggested retail price (MSRP) cap and expanded eligibility for the program. The implementation of California motor vehicle standards, described in the section above, is expected to result in emission reductions of 912 tons of NOx, 355,767 tons of CO2, and 4.7 tons of PM2.5 by 2050.

Since June 2018, CTDOT has operated *The Hartford Line*, a rail line providing an alternative transportation option for travelers along the Interstate-91 corridor, with connections to the existing Metro- North and Shoreline East commuter rail lines to New York City and New London, respectively, and to the Amtrak Acela high-speed rail service that serves the Northeast Corridor. In 2019, the full first year of operation, *The Hartford Line* carried 730,000 passengers. In 2020, due to pandemic measures and closures, only 78,000 people used the transit line. But by 2021, ridership increased to 357,000 passengers.[104] As ridership continues to increase, on-road vehicle emissions will continue to be offset.

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[103] https://afdc.energy.gov/stations/states.

[104] CTrail's Hartford Line to Springfield recovered in 2021, but reaching pre-pandemic business will be a challenge - masslive.com

Energy Efficiency and Renewable Energy

Connecticut continues to be one of the nation's leaders in promoting energy efficiency. In 2022, Connecticut was ranked 9th in the nation by the American Council for an Energy Efficient Economy (ACEEE) for its policies supporting energy efficiency.[105]

DEEP's Energy Efficiency webpage offers a variety of information on different state initiatives and resources for an energy efficient home, business, or community. Additionally, Energize Connecticut is a state initiative dedicated to providing consumers, businesses, and communities with the resources and information needed to make smart energy choices. The Energize CT website has information exploring different energy solutions for appliances, electric vehicles, the construction of new buildings, and more. The initiative also provides rebates and incentives to those individuals or businesses that wish to purchase energy efficient equipment or appliances.

EPA and DEEP are also collaborating on a Global Change Analysis Model Long-term Interactive Multi-pollutant Scenario Evaluator (GLIMPSE) modeling project to explore different scenarios regarding Connecticut's future in energy efficiency and how these changes may benefit air quality in the state. EPA's GLIMPSE is a tool to assist states with energy and environmental planning through 2050. The model was developed for users to explore the impacts of different energy technologies and policies on the environment. More specifically, GLIMPSE can explore different energy efficiency measures to estimate its effect on variables such as energy savings or emissions and air quality. GLIMPSE users can also specify air quality goals and use the scenario model to identify cost-effective strategies for meeting those goals.

The collaboration between DEEP and EPA includes the completion of different reference scenarios and hypothetical scenarios. The reference case acts as a control for the hypothetical case, which explores how trends for GHG and air pollutant emissions change with the introduction of different energy efficiency measures and practices, such as high efficiency home appliances and vehicle electrification. Scenarios were also run to explore air pollution impacts of state CO_2 reduction targets. In this scenario, the reference case included different emissions reduction efforts such as offshore wind projects, the Regional Greenhouse Gas Initiative (RGGI), and certain state ZEV targets. The hypothetical scenario (StCO2) adds Connecticut's GHG reduction goals, which aims for a 72 percent reduction from 2020 levels by 2050.

Error! Reference source not found.(a and b) show that Connecticut's NOx co-benefits from CO_2 reductions begin small, but after 2030 start growing. Regional NOx co-benefits show a similar trend, but with a greater increase in NOx co-benefits.

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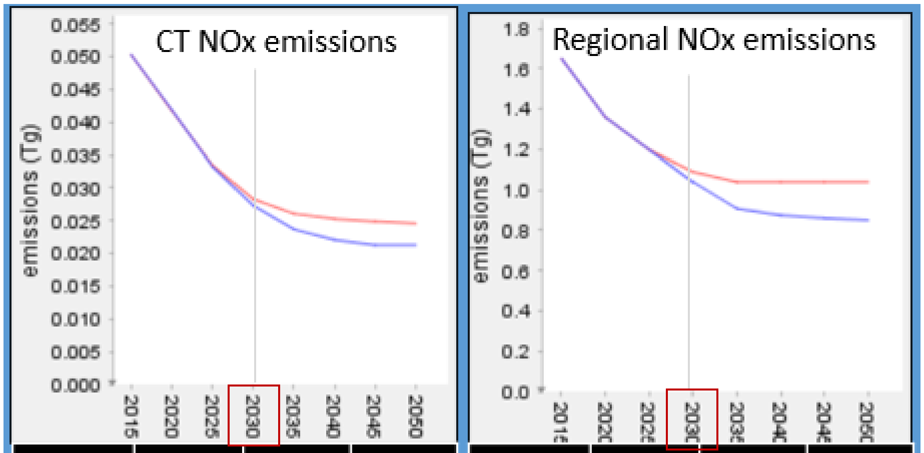
[105] https://database.aceee.org/state/connecticut

Figure 8-4. *GLIMPSE Model Projections for NOx Emissions.*



vs 2015	2025	2030	2050
Ref	-33%	-44%	-51%
StCO2	-34%	-46%	-58%

vs 2015	2025	2030	2050
Ref	-27%	-34%	-37%
StCO2	-27%	-37%	-48%

Blue – Reference Scenario

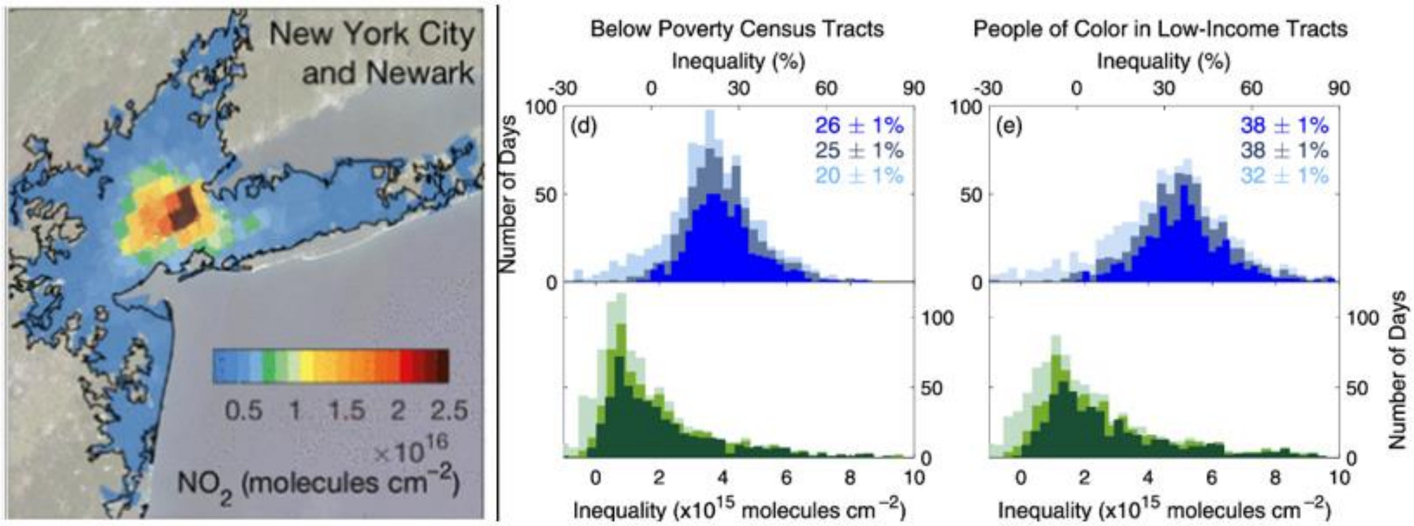
Red – StCO2 Scenario

8.6 EPA's need to Address Federally Regulated Sources in Pursuit of Environmental Justice

EPA's commitment to Environmental Justice[106] and Environmental Equity[107] recognize the need to address the disproportionate pollution burden that populations suffer as a result of failures to address the full context of cumulative impacts, including exposures through multiple pathways and from multiple pollutant sources.

Satellite images of NO2 plumes, similar to those shown in section 2 of this document, show persistently high levels of NO2 in the New York metropolitan area. Study of these plumes indicate that areas of New York City and Northern New Jersey are subject of environmental inequality, as much as 38 percent above baseline levels, with respect to NO2 exposure.[108]

Figure 8-5. *Images from Dressel et al showing elevated NO2 concentrations and neighborhood inequalities reaching 38% above baseline in the New York City and Newark New Jersey area.*



As states and EPA work to remedy this inequity, it will have the benefit of improving ozone in the NY-NJ-CT ozone nonattainment area and in Greater Connecticut by reducing emissions of this critical ozone precursor.

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[106] https://www.epa.gov/environmentaljustice

[107] https://www.epa.gov/system/files/documents/2022-04/epa_equityactionplan_april2022_508.pdf

[108] Dressel IM, Demetillo MAG, Judd LM, Janz SJ, Fields KP, Sun K, Fiore AM, McDonald BC, Pusede SE. Daily Satellite Observations of Nitrogen Dioxide Air Pollution Inequality in New York City, New York and Newark, New Jersey: Evaluation and Application. Environ Sci Technol. 2022 Nov 15;56(22):15298-15311. doi: 10.1021/acs.est.2c02828. Epub 2022 Oct 12. PMID: 36224708; PMCID: PMC9670852.

9 Contingency Measures

Section 172(c)(9) of the CAA requires ozone attainment plans to include control requirements, referred to as contingency measures, to be implemented automatically should an area fail to achieve the required reductions for Reasonable Further Progress (RFP) or fail to attain the NAAQS by the deadline. These measures must be submitted for approval into the SIP as adopted measures that would take effect without further rulemaking action upon a determination by EPA that an area failed to meet the applicable RFP milestone or failed to attain by the required deadline. Under previous SIP submittals, EPA allowed the use of federal measures that provided ongoing reductions into the future (e.g., motor vehicle and non-road engine standards) to be used meet contingency measure requirements. However, recent court rulings have constrained EPA's ability to approve as contingency any measure that is already in place and achieving emission reductions.[109]

In March of 2023, EPA proposed *"Draft Guidance on the Preparation of State Implementation Plan Provisions That Address the Nonattainment Area Contingency Measure Requirements for Ozone and Particulate Matter,"* to address issues raised by the court rulings.[110] The draft guidance recognizes that it may be infeasible to obtain any emissions reductions, particularly for areas such as Connecticut which have been achieving a minimum 3 percent reductions in emissions annually since designation as nonattainment under the 1990 CAA amendments. EPA recognizes the difficulty in achieving these reductions particularly when a greater portion of existing nonattainment area inventories are not within the authority of States to control. For Connecticut, in particular, the majority of emissions in and affecting its nonattainment areas are under the authority of other States or EPA to control.

While the guidance may change as a result of comments received, EPA noted in the draft guidance that certain aspects of the contingency measures guidance were not open to comment as a result of the recent court rulings.[111] These non-negotiable aspects include the requirement that contingency measures must be conditional and prospective; cannot be already implemented or otherwise required by state or federal rules and cannot be control measures that states are required to adopt to implement other legal requirements.

Additionally, EPA guidance provides that contingency measures be implemented within 60 days of notification of failure to attain or reach the RFP milestone. Reductions are expected to occur within one year of the triggering event.

9.1 RFP Contingency Measures

The RFP contingency plan must identify control measures sufficient to secure an additional 3 percent reduction in ozone precursor emissions beyond the 15 percent RFP reduction required to be achieved by 2023 in moderate 8-hour ozone nonattainment areas.

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[109] US Court of Appeals for the District of Columbia, Sierra Club, et al. v. EPA, No. 15-1465, January 29, 2021.

[110] 88 FR 17571, March 23, 2023.

[111] See Sierra Club v. EPA (21 F.4th 815 (D.C. Cir. 2021)

Page 21 of the draft guidance states, "This CM [contingency measure] guidance should not be read as defining or changing existing underlying RFP interpretations or regulatory requirements for RFP in any way." Similar statements are made throughout the draft guidance document.

As DEEP has identified emissions reductions well above the required 15 percent RFP requirement for both its nonattainment areas, it is already clear that RFP is met and contingency measures for failure to meet RFP will not be triggered. Therefore, RFP contingency measures are unnecessary as a practical matter.

9.2 One Year's Worth of Progress

The draft guidance provides that One Year's Worth (OYW) of progress toward attainment is now considered more appropriate than OYW of RFP as was required under prior guidance. EPA states that it now believes that obtaining OYW of RFP (i.e., 3 percent of the base year NOx and/or VOC inventory) is overly conservative.[112] Nevertheless, the guidance now requires one year's worth of progress toward attainment of both the VOC and NOx inventories separately.

The table below shows values for the calculation for One Year's Worth (OYW) of progress based on EPA's formula for calculating progress using the base year and attainment year inventory. EPA recommends using the inventory for the nonattainment area, however we have used only the Connecticut portion of the NY-NJ-CT (Southwest CT) nonattainment area for the values shown in the table below because Connecticut has no authority to control emissions from nearby upwind contributing states.

Table 9-1. *Table showing values used to calculate OYW of Progress for Connecticut's nonattainment areas with results.*

	Base Year Emissions (tons per day)	Attainment Year Emissions (tons per day)	OYW of Progress (tons per day)	OYW of Progress (Percent of Base Year)
Greater CT				
NOx	50.5	41.3	1.3	2.5%
VOC	75.3	65.0	1.5	2.0%
Southwest CT				
NOx	57.7	46.9	1.5	2.5%
VOC	80.4	69.6	1.6	1.9%

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[112] Page 22 of the Draft Contingency Measures Guidance: *"After decades of implementing the CAA, EPA now believes that its OYW of RFP approach to calculating the amount of reductions for CMs was unnecessarily conservative for estimating the amount of emissions reductions needed for CM purposes because a given percentage of the base year inventory tends to represent a much more significant portion of the attainment projected inventory."*

The draft guidance results in the requirement to obtain more reductions than would be required under previous guidance in both of Connecticut's nonattainment areas.[113]

9.3 Failure to Attain Contingency

The failure-to-attain contingency plan must identify self-implementing control measures sufficient to obtain OYW of progress towards attainment in ozone precursor emissions should a nonattainment area fail to attain the 8-hour ozone NAAQS by the required deadline. The deadline in this case is the attainment date of August 3, 2024. EPA is required to make a determination of failure to attain within six months of the attainment date (i.e., not later than February 3, 2025). DEEP will then be expected to implement the contingency measures within 60 days.[114]

Air agencies may provide reasoned justification for less than OYW of progress for contingency by demonstrating that implementation of further controls is technologically or economically infeasible. Specifically, the guidance states that, "…air agencies may be justified in adopting and submitting CMs [*contingency measures*] that would result in less than OYW of progress, if they have identified and evaluated all potentially applicable measures, have adopted the feasible measures necessary to expeditiously attain the relevant NAAQS, have determined that the remaining feasible measures are insufficient to achieve OYW of progress, and have adequately demonstrated these points in their submission to EPA."

As demonstrated throughout this SIP, particularly in section 4.2, DEEP has implemented all control measures to attain the NAAQS as expeditiously as practicable as required by CAA section 181(a). Regardless of the CAA section 181(a) requirement, DEEP is incentivized to expeditiously implement all measures leading to attainment that are within its authority to control for the health of its citizens and in order to avoid penalties under the CAA such as increased NSR permitting offsets, withholding of highway funds and imposition of section 185 fees. While some control measures are currently in process of being adopted, such as rulemakings for the Adoption of LEV IV and the Advanced Clean Cars II Rules, RCSA section 22a-174-36d, and amendment of RCSA section 22a-174-37, the Medium and Heavy-Duty Low NOx "Omnibus" and Advanced Clean Trucks Rules, DEEP cannot reasonably delay or withhold these rules for contingency to satisfy EPA's draft guidance. Nor is it likely that these rules could satisfy the strict timing requirements for implementation and achievement of reductions consistent with the guidance.

While no feasible regulatory contingency measures exist, DEEP has considered the potential for non-regulatory measures. Currently, DEEP encourages voluntary emissions reductions through

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[113] For example, in the Greater Connecticut area, under the draft guidance reductions of 1.3 tons of NOx and 1.5 tons of VOC are expected. Under the old guidance, the area would have obtained 2% of base year NOx (0.02x50.5=1 ton) and 1% of base year VOC (0.01x75.3=0.8 tons) consistent with the approach to RFP. The draft guidance therefore requires 2.8 tons pollutants for contingency where the prior guidance required only 1.8 tons in the Greater Connecticut area.

[114] DEEP notes that the rule would need to implement between approximately October 3, 2024 and April 3, 2025, less than 2 years from this writing. Recent rules have taken between approximately 8 to 16 months to go through the regulatory review process (i.e., OPM/OTG review through posting on eReg system as final rule). Additional time is necessary to internally draft and vet the rule.

its ozone forecasting webpages and press releases.[115] Emission reductions from these measures would by their nature be difficult to quantify and therefore are not feasible enforceable elements for an implementation plan.

Therefore, DEEP has satisfied contingency measure guidance by demonstrating that no technologically or economically feasible measures are available for such purpose. Moreover, DEEP is implementing all control measures within its authority to control in order to expedite attainment of the ozone standards in Connecticut.

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[115] https://portal.ct.gov/DEEP/Air/Monitoring/Ozone-Action-Day