# Revision to Connecticut's State Implementation Plan

# Ozone Attainment Demonstration for Areas Classified Serious Nonattainment for the 2008 Ozone Standards

# Technical Support Document

***Connecticut Department of Energy and Environmental Protection***

***June 2022***

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# ACRONYMS and ABBREVIATIONS

| | |
|---|---|
| ACT | Advanced Clean Trucks |
| 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 |
| CONUS | Continental/Contiguous United States |
| CSAPR | Cross-State Air Pollution Rule |
| DEEP | Department of Energy and Environmental Protection (Connecticut) |
| DERA | Diesel Emissions Reduction Act |
| DOT | Department of Transportation (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 |
| 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 |
| NOx | Oxides of Nitrogen |
| NSPS | New Source Performance Standard |
| OBD | On-Board Diagnostics |
| OTC | Ozone Transport Commission |
| OTR | Ozone Transport Region |

| | |
|---|---|
| PFC | Portable Fuel Container |
| PM2.5 | Fine Particulate Matter |
| ppb | parts per billion |
| ppm | parts per million |
| 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 |
| SIP | State Implementation Plan |
| $SO_2$ | Sulfur Dioxide |
| TCM | Transportation Control Measure |
| TSD | Technical Support Document |
| USC | United States Code |
| USEPA | United States Environmental Protection Agency |
| 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

The purpose if this State Implementation Plan (SIP) revision is to address the requirements of the Clean Air Act (CAA) regarding Connecticut's plan to attain the 2008, 75 ppb 8-hour National Ambient Air Quality Standards for ozone.

Connecticut submitted state implementation plans demonstrating attainment of the 2008 ozone standards on January 17, 2017 and August 8, 2017 for the Greater Connecticut and southwest Connecticut nonattainment areas respectively.[1] These submittals were made consistent with CAA section 182 requirements for moderate nonattainment areas. On August 23, 2019, EPA reclassified these formerly moderate nonattainment areas to serious.[2] The reclassifications triggered a requirement for Connecticut to recertify or enhance elements of the 2017 SIP submittals to satisfy requirements commensurate with designations of serious nonattainment.

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. Preliminary data for 2020 indicates that Greater Connecticut continues to attain the 2008 ozone standards. The clean data determination releases Connecticut from these SIP requirements for the Greater Connecticut nonattainment area provided it continues to attain the standards.[3] Therefore, this document primarily addresses requirements for the southwest Connecticut nonattainment area.

Many of Connecticut's existing attainment measures already satisfy requirements for serious nonattainment areas because Connecticut retains the more stringent SIP elements established under CAA section 182 due to prior designations of the state as either serious or severe under the 1-hour ozone standards implemented with the CAA amendments of 1990.

Connecticut currently implements among the most stringent control programs for nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the country. These control programs are incorporated into the Regulations for Connecticut State Agencies (RCSA) Regulations for the Abatement of Air Pollution and include the following:

- Reasonably Available Control Technology (RACT) standards on all major NOx and VOC stationary sources including electric generating units (EGUs) and non-EGUs. RCSA 22a-174-22e, RCSA 22a-174-22f and RCSA 22a-174-38, recently adopted NOx control measures that will continue to reduce emissions from sources throughout the state;
- California's motor vehicle emission standards – most recently the Low Emission Vehicle III standards – which more stringently regulate the amount of NOx emitted from motor vehicles than federal emission standards;
- Statewide vehicle inspection and maintenance requirements that include testing of older, high-emitting vehicles to significantly reduce on-road mobile emissions;
- Measures to reduce VOC emissions from a variety of large source categories that have been recommended by the Ozone Transport Commission including consumer products, architectural and industrial maintenance coatings, portable fuel containers, adhesives and sealants, asphalt paving, and solvent metal cleaning processes; and,

[1] https://www.ct.gov/deep/cwp/view.asp?a=2684&q=585816&deepNav_GID=1619
[2] 84 FR 44238
[3] 40 CFR 51.1118

- Lowest Achievable Emission Rate standards on all new sources in the state with the potential emissions above the major source thresholds for NOx or VOCs, and on all existing minor sources that would undergo modifications with emissions above these thresholds.

While mobile sources are largely regulated at the federal level, Connecticut is aggressively improving the emissions profile of its vehicle fleet despite the prior administration's rollback of light-duty vehicle emission standards that had frustrated Connecticut's progress in reducing ozone levels. On September 27, 2019, EPA finalized its "One National Program" Rule which revoked California's ability to set its own mobile source standards and took away the ability of other states to adopt California standards to improve their own air quality issues. On March 21, 2020, EPA and the National Highway Traffic Safety Administration (NHTSA) finalized fuel economy and carbon dioxide emission standards for model year 2021 through 2026 light-duty vehicles, which greatly weakened previously-established standards. DEEP is encouraged that in May 2022, NHTSA has proceeded to restore and strengthen those standards and restore the waiver of preemption that allows Connecticut to enforce the stronger California standards for model year 2024 through 2026 light-duty vehicles.[4]

Connecticut is working diligently to reduce emissions from the existing heavy-duty vehicle fleet. Connecticut is leveraging funding from the Volkswagen settlement for a wide variety of mitigation projects that will result in significant NOx reductions while accelerating the transformation to a zero-tailpipe emission transportation system. The proposed mitigation actions generally include replacing or repowering older, dirtier diesel-powered vehicles with newer, cleaner vehicles including a strong preference for all-electric vehicles, where feasible.

The seven programs and actions listed below will support the deployment of more electric and lower emissions vehicles in Connecticut. While some of these programs are aimed at achieving the state's greenhouse gas reduction goals, the programs will yield reductions in NOx and/or VOC emissions and thus will assist in attaining the ozone standards as expeditiously as possible.

- VW Settlement. Through three partial settlements, EPA resolved a civil enforcement case against Volkswagen (VW) for installing defeat devices. As a result of these partial settlements, Connecticut was allocated over $55 million for use in projects to reduce NOx emissions from mobile sources. Since 2018, 28 projects have been funded. These projects together achieve a lifetime NOx reduction of 243.6 tons and a lifetime VOC reduction of 15.9 tons.
- DERA Grants. The DERA program is designed to achieve reductions in diesel emissions. Awards made under the DERA program between 2008 and 2020 created NOx emissions reductions of an estimated 1,799 tons and VOC reductions of 131 tons. Awards of 2021 funds were made in March 2022. NOx reductions of about 138 tons and VOC reductions of about 2 tons are available from these awards if implemented as planned.
- EV Connecticut. Widescale EV deployment is a primary solution for achieving the state's statutorily required economy-wide greenhouse gas (GHG) reduction targets. 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

[4] See NHTSA Final Rule entitled *"Corporate Average Fuel Economy Standards for Model Years 2024-26 Passenger Cars and Light Trucks"* 87 Fed. Reg. 25710 (May 2, 2022)

Connecticut. The program also has funded charging stations. The state presently has 336 outlets and 214 level 2 charging stations. In addition, as of March 31, 2022, there are 417 level 2 outlets and 65 DC fast charging outlets (non-Tesla). Tesla has installed 36 level 2 and 151 DC fast chargers in Connecticut.[5]

- Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) 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 Connecticut automobile dealership. The program began providing incentives in May 2015. An expanded version of the CHEAPR program began January 1, 2020. From May 2015 through April 2022, CHEAPR issued 3,812 and 4,343 rebates for battery electric and plug-in hybrid electric vehicles respectively, for a combined total of 8,155 highway capable electric vehicles. Public Act 22-25, An Act Concerning the Connecticut Clean Air Act, will dramatically increase funding for the CHEAPR program to further support Connecticut's vehicle electrification efforts.
- On July 14, 2021, the Public Utilities Regulatory Authority issued a decision in Docket No. 17-12-03RE04, which establishes a nine-year statewide electric vehicle charging program that launched on January 1, 2022. 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.
- In March 2022, DEEP released "An Assessment of Connecticut's Need to Adopt California's Medium and Heavy-Duty Vehicle Emission Standards"[6] which explained that reducing emissions from medium and heavy-duty (MHD) vehicles in the transportation sector is essential to meeting to Connecticut's air quality and greenhouse gas (GHG) reduction targets. Despite only being 6% of Connecticut's vehicle fleet, MHD vehicles account for 45% of particulate matter, 53% of NOx emissions, and 25% of GHG emissions. On May 10, 2022, Governor Lamont signed Public Act 22-25, An Act Concerning the Connecticut Clean Air Act,[7] which authorizes DEEP to adopt California's low NOx Omnibus and Advanced Clean Truck rules. The implementation of both the low NOx Omnibus and ACT rules in Connecticut 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. DEEP is working towards the adoption of these vehicle emission standards in 2022-2023.

Connecticut also anticipates recent federal actions, including the American Rescue Plan and the Infrastructure Investment and Jobs Act, will provide additional support for the state's ongoing vehicle electrification efforts.

As a national leader in developing clean energy and proceeding toward a low emissions economy, Governor Ned Lamont signed the following executive orders to reduce or eliminate emissions from fossil fuels:

[5] EERE: Alternative Fuels Data Center Home Page (energy.gov)
[6] MHD_Whitepaper_030822.pdf (ct.gov)
[7] AN ACT CONCERNING THE CONNECTICUT CLEAN AIR ACT.

- On April 24, 2019, Governor Ned Lamont signed Executive Order No. 1 establishing goals for sustainability, efficient use of energy and the reduction of pollution at State facilities.
- On September 3, 2019, Governor Ned Lamont signed Executive Order No. 3 with the goal of eliminating carbon emissions from the electric sector by 2040 and ensuring emission reductions in the transportation and building sectors.
- On July 10, 2020, Governor Ned Lamont signed the Multi-State Zero Emission Medium- and Heavy-Duty Vehicle Memorandum of Understanding, joining 14 other states and the District of Columbia in an agreement to develop an action plan to ramp up electrification of buses and trucks. Connecticut committed to work collaboratively to accelerate the market for electric medium- and heavy-duty vehicles, with the goal of ensuring that all new medium- and heavy-duty vehicle sales be zero emission vehicles by 2050 with an interim target of 30 percent zero-emission vehicle sales in these categories of vehicles by 2030.
- On June 28, 2021, Governor Ned Lamont announced new electric vehicle incentives for Connecticut residents under CHEAPR. New incentives include used EVs, increased rebates, and additional incentives for income-eligible consumers.

Nevertheless, and in-spite of Connecticut's leadership efforts, the state continues to be significantly impacted by interstate transport and upwind mobile source emissions to such a degree that controlling emissions solely in Connecticut, which is the jurisdictional limit of this plan, is critical but will not be sufficient to reach attainment. DEEP has repeatedly urged EPA to develop a reasonable and workable program under the Clean Air Act's (CAA) good neighbor provisions. Instead, EPA has developed rules such as the Cross State Air Pollution Rule Update, that are not sufficiently stringent or timely to address transport for the 2008 ozone NAAQS. Recently, on April 6, 2022, EPA published the proposed Federal Implementation Plan Addressing Regional Ozone Transport for the 2015 Ozone National Ambient Air Quality Standard again failing to fully address transport for the 2015 NAAQS. Until such time that EPA and upwind states satisfactorily address transport and EPA takes additional steps to regulate mobile source emissions, Connecticut and its most vulnerable communities will continue to suffer from the resulting environmental, public health and economic disparities as it struggles to attain the ozone standards.

The following SIP elements have been previously submitted to EPA in January 2017 and August 2017 for the Greater Connecticut and southwest Connecticut nonattainment areas, respectively, to satisfy requirements for Connecticut's moderate nonattainment areas for the 2008 ozone standards:

- Enhanced Monitoring;
- Inventory and Emission Statements;
- Nonattainment New Source Review (NNSR);
- Reasonably Available Control Measures and Reasonably Available Control Technology;
- Enhanced Motor Vehicle Inspection and Maintenance;[8]
- Transportation Conformity and Motor Vehicle Emission Budgets (MVEBs);
- Clean Fuels/Substitute Program;
- Reasonable Further Progress (RFP) and Contingency Measures; and

[8] DEEP is updating its I/M performance modeling per a request by EPA. The modeling will be submitted separately.

- An Attainment Demonstration.

With the recertifications or enhancements referred to in this submittal, the southwest Connecticut nonattainment area satisfies the implementation plan requirements for serious nonattainment areas under the 2008 ozone standards.  Requirements for Greater Connecticut, other than the additional RFP measures and MVEBs that would apply to a serious nonattainment area should the Clean Data Determination be rescinded, are also satisfied.

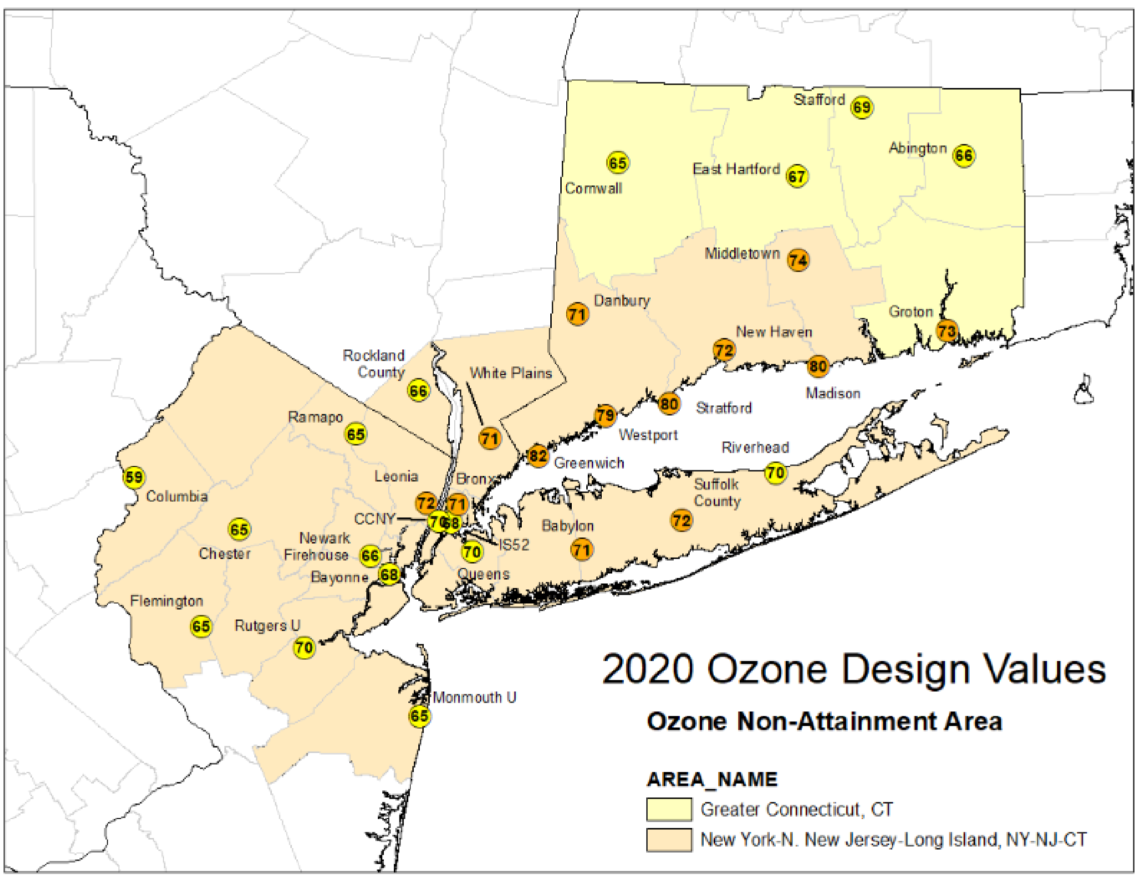
## 2. Ozone Related Air Quality Levels in Connecticut

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 is implementing an enhanced ozone monitoring plan, which includes monitoring of nitrogen oxides and other parameters so as to better understand ozone levels and characterize ozone exceedances in Connecticut.

Exceedances of the ozone standards generally occur when ozone and precursor emissions are transported into the State from emissions rich areas to the south and west on warm sunny days when the meteorology is favorable to ozone formation. The meteorology of Long Island Sound also serves to enhance concentrations of ozone along Connecticut's southwest shore. Thus, southwest Connecticut (Fairfield, New Haven and Middlesex counties), which is part of the New York-New Jersey-Connecticut (NY-NJ-CT) nonattainment area, measures ozone well in excess of the 2008 standards. However, the Greater Connecticut portion of the State (the remaining five counties) has more recently been monitoring levels below the 2008 NAAQS and was granted a Clean Data Determination in 2020.

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 2008 ozone standards is achieved when all design values in a nonattainment area are less than 0.076 parts per million (76 parts per billion). Figure 2-1 shows 2020 ozone design values and nonattainment area boundaries in Connecticut, New York, and New Jersey.

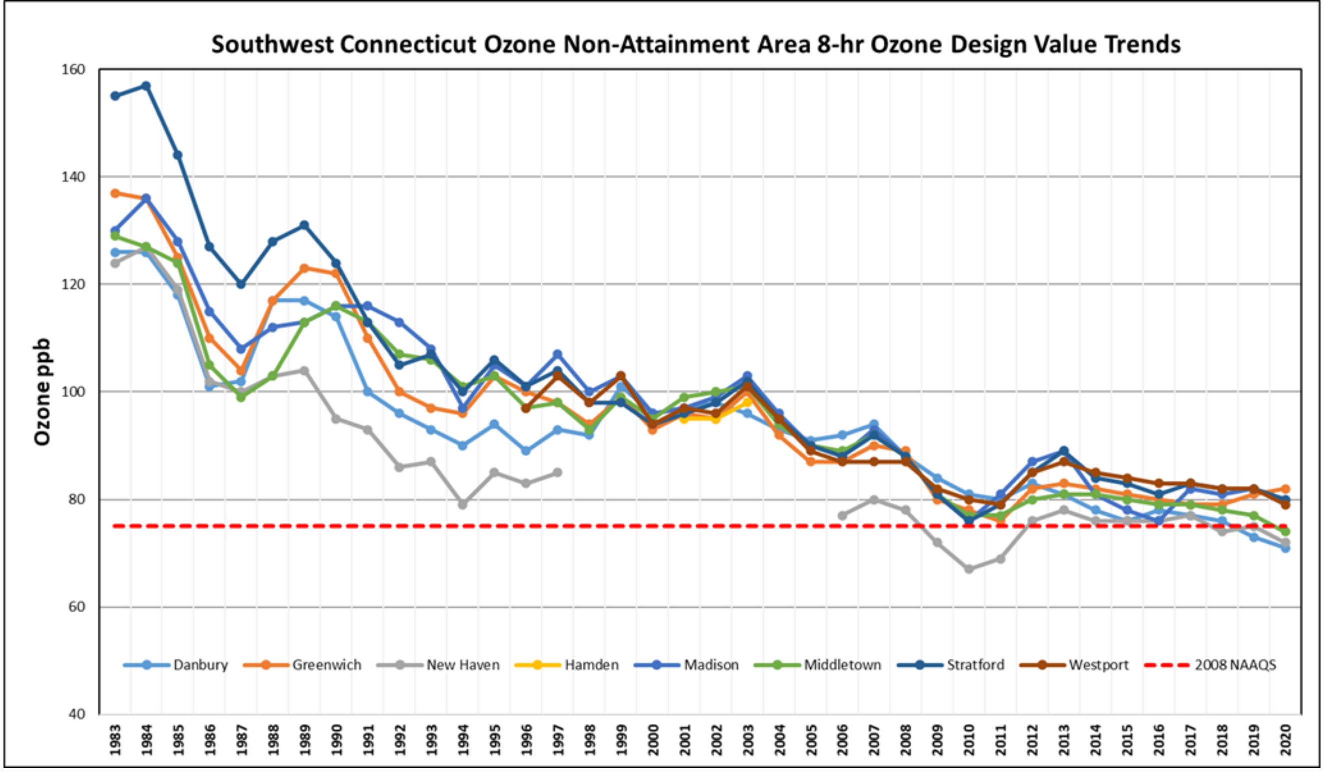
**Figure 2-1.** *8-hour Ozone Nonattainment Areas in Connecticut, New York, and New Jersey with Associated 2020 Preliminary Design Values*.



## 2.1 Trends in Ozone Design Values

Trends in design values for each monitoring site in the southwest Connecticut nonattainment area are plotted in Figure 2-2. Design values in the southwest Connecticut portion of the NY-NJ-CT area have decreased by nearly 50% since the mid-1980s, from nearly 160 ppb at Stratford to below 83 ppb in 2020 at all sites. Three sites, Middletown, New Haven and Danbury, show a recent downward trend dropping below the 75 ppb standards. Four coastal sites, Greenwich, Westport, Stratford and Madison, continue to exceed the standard with Greenwich overtaking Westport as the worst-case monitor. This trend may indicate that the highest concentrations of the regional ozone plume is receding closer to the New York metropolitan area.[9]

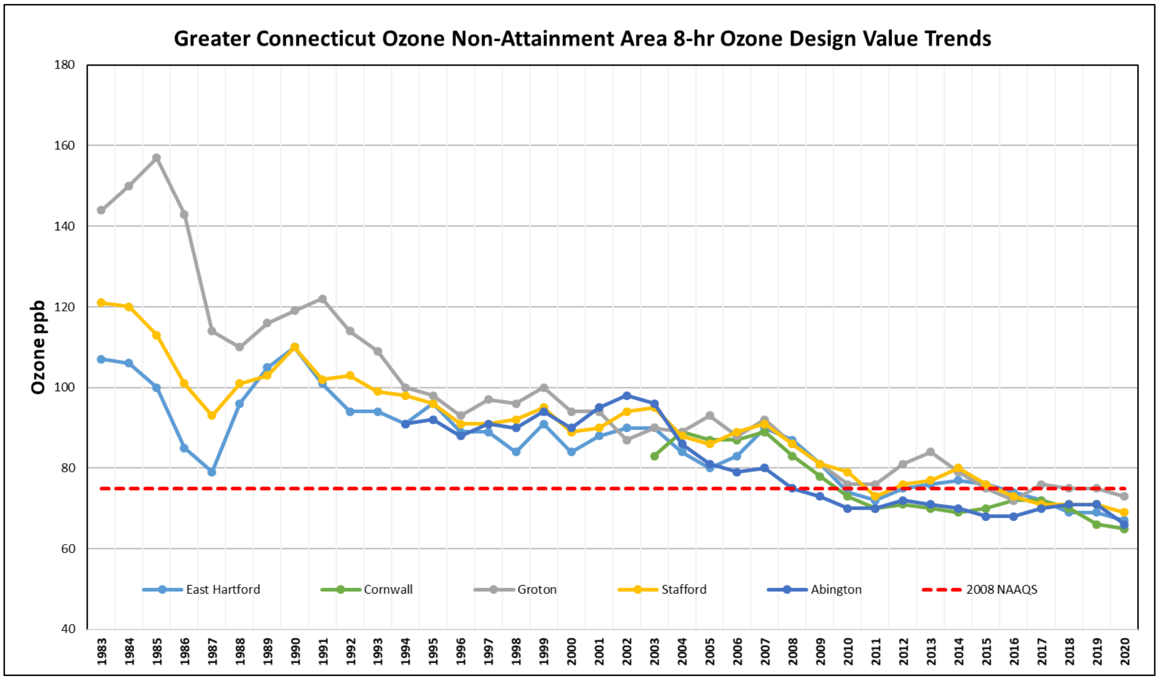
**Figure 2-2.** *Southwest Connecticut 8-hour Ozone Design Value Trends.*




[9] A broader geographical representation of this trend is available at https://portal.ct.gov/DEEP/Air/Monitoring/Trends/Ozone-Trends and coincides with trends in ozone precursor emissions of NOx available at https://airquality.gsfc.nasa.gov/video/changes-nitrogen-dioxide-usa-2005-2019

Trends in design values for each site in the Greater Connecticut attainment area are plotted in Figure 2-3. Like the southwest Connecticut sites, these monitors have followed a decreasing trend since the late 1980s. The shoreline monitor at Groton has lagged Abington, Cornwall, and Stafford which have been in attainment since at least 2016. Currently, however, all monitors in the Greater Connecticut area show attainment of the 2008 standards of 75 ppb.

**Figure 2-3.** *Greater Connecticut 8-hour Ozone Design Value Trends*.

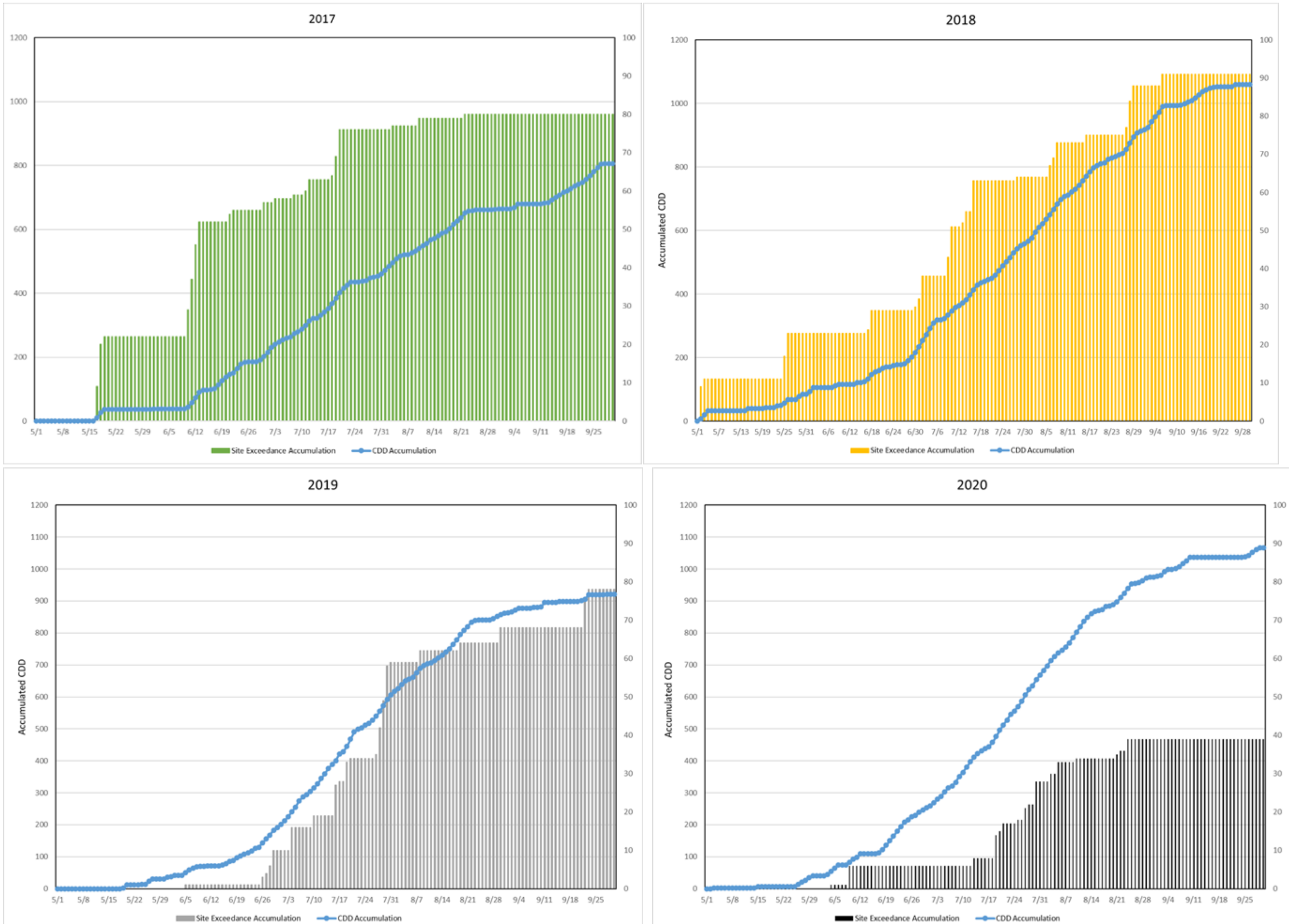



## 2.2 Trends in Cooling Degree Days and Site Exceedances

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 2018 to 2020 with the number of site exceedances within the state.

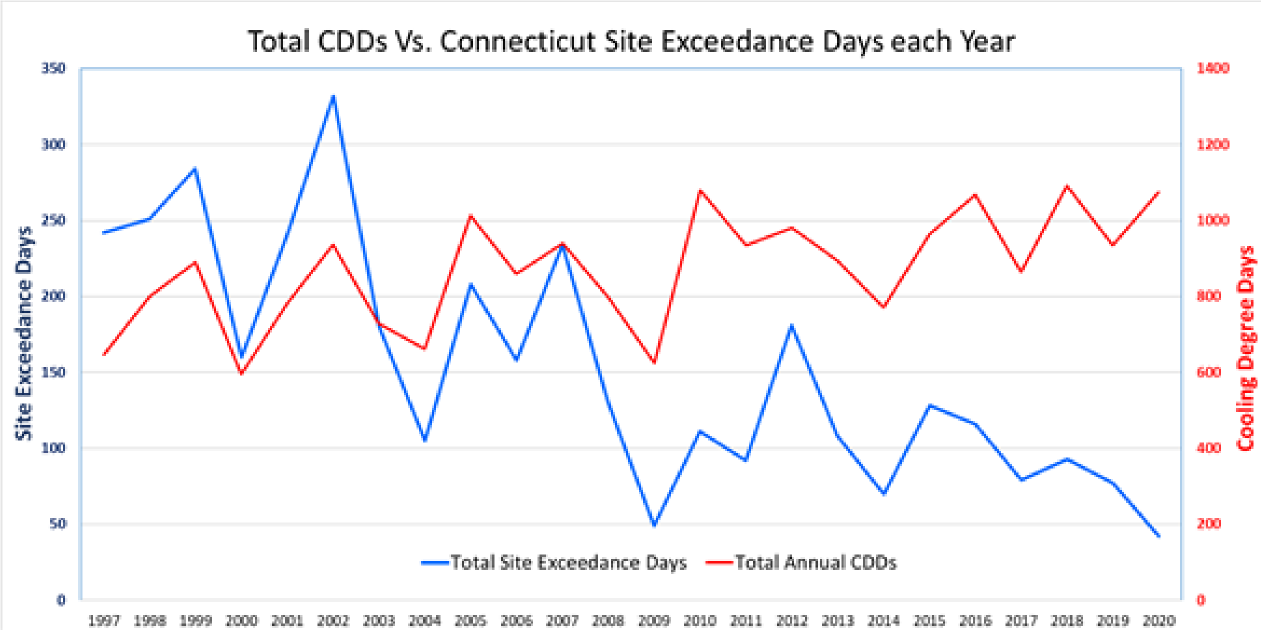
Figure 2-4 compares ozone site exceedances with cooling degree days as the ozone season progresses for the years 2017 through 2020. The charts show site exceedances occurring later in the year and trending downward as the years progress while CDD vary with 2017 the coolest year and 2018 and 2020 comparably warmer.

**Figure 2-4.** *Accumulated Cooling Degree Days vs. Accumulated Site Exceedances 2017 through 2020.*



A longer-term trend of site exceedances vs. CDD is shown in Figure 2-5. This chart used annual CDD rather than ozone season CDD, but generally shows coincident peaks and valleys in trends of CDD and site exceedances with total site exceedances trending downward while CDD trends slightly upward.

**Figure 2-5.** *Annual Trend in Cooling Degree Days and Site Exceedances throughout Connecticut.*



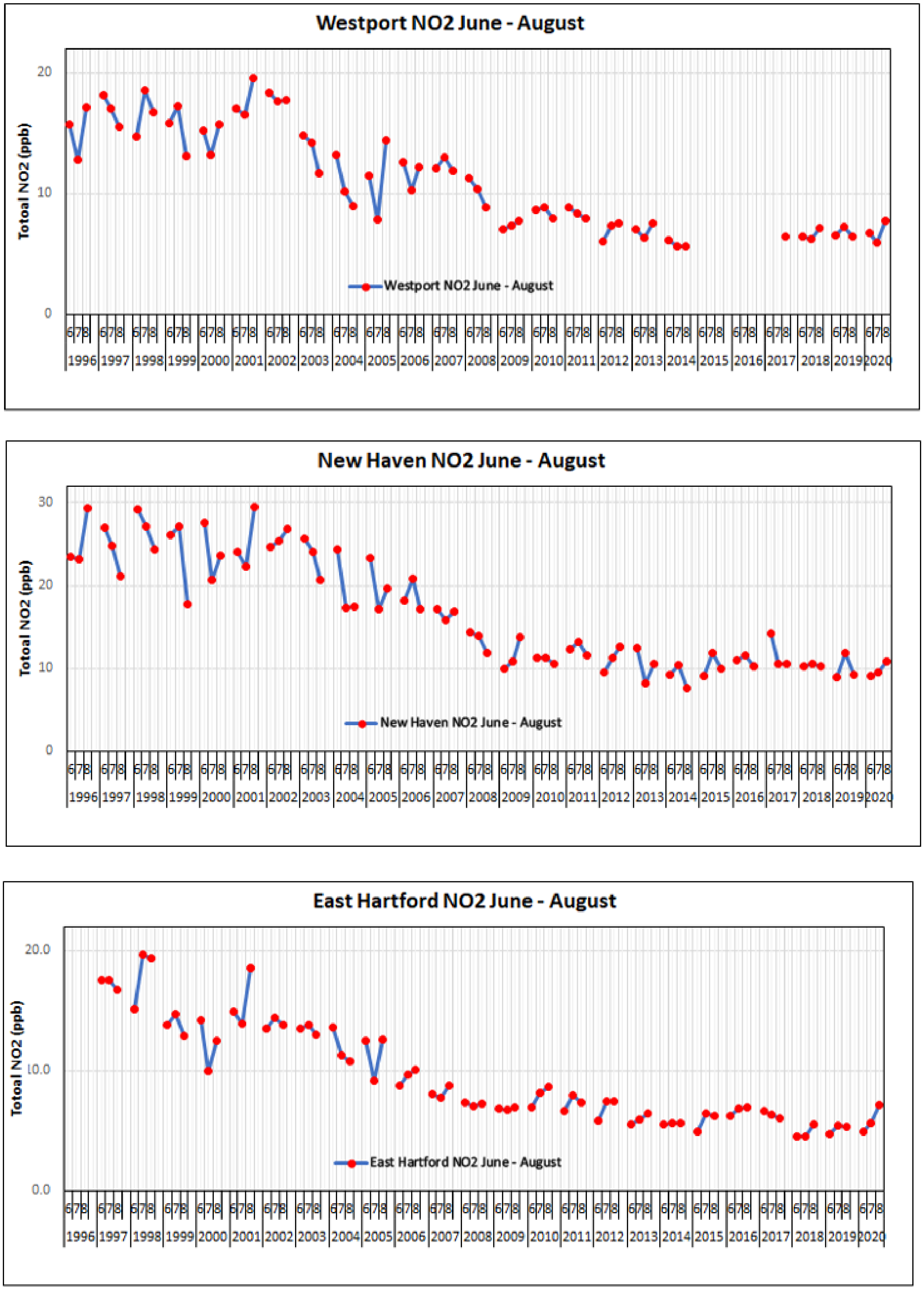

Overall, these trends show that ozone conducive days are less likely to produce widespread exceedances than in the past. The 2020 ozone season did not show an increase over prior year site exceedances as might have been expected due to the corresponding increase in CDD. This is likely attributable to reduced precursor emissions resulting from a variety of policies put in place to minimize the spread of COVID-19 during the spring and summer of 2020. However, the trend indicates that 2020 site exceedances would still likely have been less than occurred during the comparably warmer 2018 season even if the COVID-19 policies had not been implemented.

## 2.3 Trends in Nitrogen Oxide Concentrations

Nitrogen oxides are the predominant ozone precursor in Connecticut. Nitrogen dioxide ($NO_2$) concentrations are monitored at several locations in Connecticut. There are two locations, Westport and New Haven, in southwest Connecticut that measure nitrogen dioxide concentrations. East Hartford nitrogen dioxide concentrations are included from the Greater Connecticut nonattainment area. Figure 2-6 shows summertime monthly average nitrogen dioxide concentrations for the three sites trending back to 1996.

All three monitors show a significant decline in monthly average $NO_2$ concentrations, particularly during the years from approximately 2003 to 2009. Relatively sharper declines in ozone were seen during this same period. Monthly average $NO_2$ concentrations at New Haven trend from approximately 30 ppb to a recent 10 ppb. Westport and East Hartford trend from highs near 20 ppb to recent lows between 5 and 10 ppb. Of the three sites, which all have co-located ozone monitors, only Westport has an ozone design value exceeding the 2008 standards, indicating the importance and impact of other factors such as interstate pollutant transport.

**Figure 2-6.** *Summer Trends in $NO_2$ at Westport, New Haven and East Hartford Monitors.*



## 2.4 Enhanced Monitoring

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).[10] 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.

Connecticut submitted its first enhanced monitoring plan in 2019. Subsequent plan revisions are required every five years thereafter. Connecticut 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 can be found in Connecticut's Annual Air Monitoring Network Plan.[11]

[10] More information on LISTOS can be found at Long Island Sound Tropospheric Ozone Study — NESCAUM.

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

# 3. Inventory and Emissions Statements

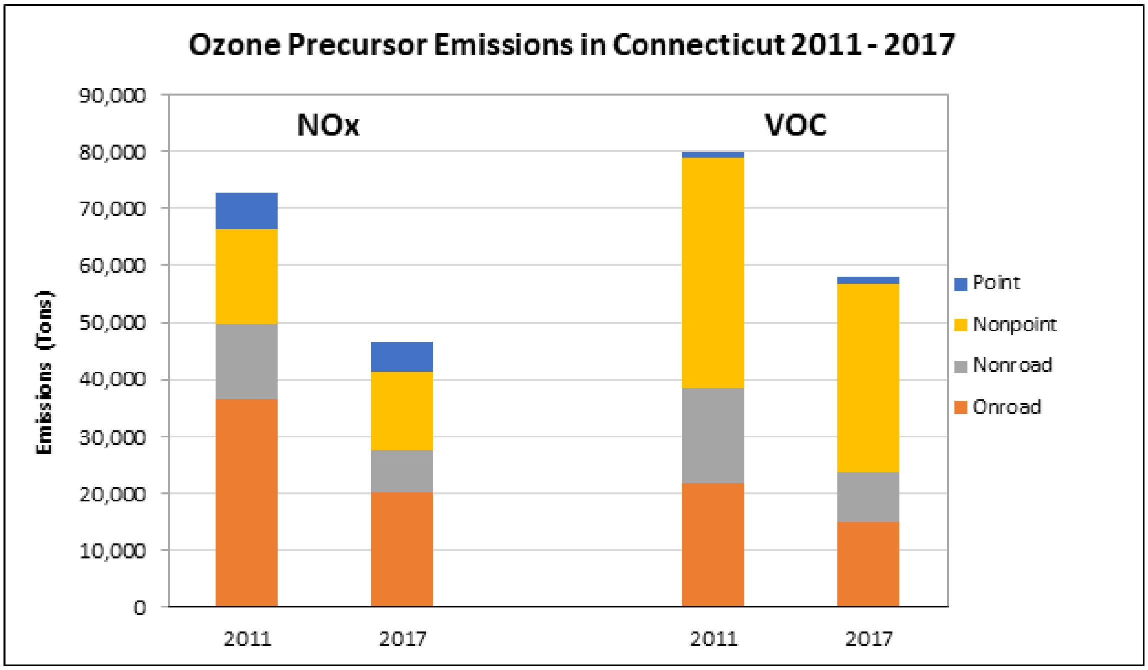
Connecticut submitted a baseline inventory for 2011 and submits Periodic Emissions Inventory (PEI) updates every three years. The base year, 2011, inventory was approved into the SIP as satisfying the requirements of CAA section 182(a)(1) on October 1, 2018, [83 FR 49298]. The 2014 and 2017 inventories are being submitted for SIP approval separately. Actual emissions from point sources are collected through Connecticut's emissions statement program, which was approved with Connecticut's infrastructure SIP for the 2008 ozone standards [81 FR 35637].

No other action with respect to inventories is necessary to satisfy Connecticut's re-designations to serious nonattainment.

## 3.1 Statewide Emissions Trends Summary

The chart and table below show a summary of NOx and VOC emissions from all anthropogenic sources in Connecticut for the base year, 2011, and 2017. 2017 is the most recently available National Emission Inventory (NEI) data year and the year for which Connecticut submitted its original attainment demonstration for the 2008 standards.

***Figure 3-1.*** *Connecticut Anthropogenic NOx and VOC Emissions by Major NEI Category, 2011 –2017 (Tons)*




| NEI Category | | NOx | | | VOC | |
|---|---|---|---|---|---|---|
| | | 2011 | 2017 | | 2011 | 2017 |
| Point | | 6,404 | 5,226 | | 1,042 | 1,189 |
| Nonpoint | | 16,719 | 13,709 | | 40,272 | 33,289 |
| Nonroad | | 13,046 | 7,329 | | 16,827 | 8,383 |
| Onroad | | 36,659 | 20,311 | | 21,669 | 15,197 |
| **Total** | | **72,828** | **46,575** | | **79,809** | **58,059** |

The NEI shows that total anthropogenic emissions of NOx decreased 36% from 2011 to 2017 while VOC emissions dropped 27%. The majority of reductions for both precursors come from the largest two sectors, the onroad and nonroad categories.

Reductions in point source NOx emissions are due to the NOx budget program and its successor programs for power plants, fuel switching to natural gas from oil, retiring of older units and improved controls on new units.

Reductions in nonroad emissions are due to Federal rules to reduce emissions from new engines used in these sources. Regulatory programs that have reduced, and/or will continue to reduce, emissions from nonroad vehicles and equipment include Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel[12], Control of Emissions from Air Pollution from Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters Per Cylinder[13], and Control of Emissions from Nonroad Spark-Ignition Engines and Equipment[14].

Onroad mobile emission reductions are due to the State[15] Low and Zero Emission Vehicle Programs, and Federal requirements for onroad vehicles such as the Tier 2 motor vehicle emissions standards.[16] On December 4, 2015 Connecticut submitted a revision to its SIP for addition of the LEV and ZEV programs consisting of amended section 22a-174-36b, "Low Emission Vehicle II", and newly adopted section 22a-174-36c, "Low Emission Vehicle III Rule", of the Regulations of Connecticut State Agencies (RCSA). On January 16, 2018, EPA issued notice of proposed approval of that SIP revision[17], however EPA has yet to finalize this proposed action. As part of the control measures envisioned in this SIP, DEEP re-iterates its request that the LEV/ZEV SIP be approved without further delay. Federal requirements for onroad mobile sources and fuels were strengthened even further with the Tier 3 requirements[18]. More information on programs to control emissions from mobile sources can be found on EPA's Transportation, Air Pollution, and Climate Change website[19].

For both nonroad and light-duty onroad mobile sources, $NO_x$ emissions are expected to continue to decrease as fleets turn over and older more polluting vehicles and equipment are replaced by newer, cleaner, and increasingly zero-emission options. Connecticut recognizes that there is more that could be done to reduce emissions from medium and heavy-duty vehicles and is working toward adopting recently promulgated emission standards for these vehicle classes by the California Air Resources Board (CARB) and continues to call on EPA to strengthen and finalize its proposed standards for these classes, which have not changed since 2008. Point source NOx reductions beyond 2017 are also occurring due to Connecticut's municipal waste combustor rule and NOx RACT requirements.[20]

VOC decreases are attributable to Federal new engine standards for onroad and nonroad vehicles and equipment, the State Low and Zero Emission Vehicle Programs, area source rules such as consumer

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[12] https://www.gpo.gov/fdsys/pkg/FR-2004-06-29/pdf/04-11293.pdf
[13] https://www.gpo.gov/fdsys/pkg/FR-2008-06-30/pdf/R8-7999.pdf
[14] https://www.gpo.gov/fdsys/pkg/FR-2008-10-08/pdf/E8-21093.pdf
[15] CT LEV II Program RCSA 22a-174-36b and CT LEV III Program RCSA 22a-174-36c last amended 2018.
[16] Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements, Final Rule (https://www.gpo.gov/fdsys/pkg/FR-2000-02-10/pdf/00-19.pdf)
[17] https://www.federalregister.gov/documents/2018/01/16/2018-00477/air-plan-approval-connecticut-revision-of-the-low-emission-vehicles-program
[18] Tier 3 Motor Vehicle Emission and Fuel Standards, Final Rule (https://www.gpo.gov/fdsys/pkg/FR-2014-04-28/pdf/2014-06954.pdf)
[19] https://www.epa.gov/air-pollution-transportation
[20] RCSA 22a-174-22e, 22a-174-22f and 22a-174-38.

products, portable fuel containers, paints, autobody refinishing, asphalt paving applications, and solvent cleaning operations, and VOC storage tank rules. Evaporative VOC emissions from onroad mobile sources have also decreased due to state motor vehicle Inspection and Maintenance (I & M) programs and the wide-spread use of on-board refueling vapor recovery technology on motor vehicles. VOC emissions from nonroad and onroad mobile sources are expected to continue to decrease as older, more polluting vehicles are replaced by newer, cleaner ones, including an increasing number of zero emission vehicles.

## 4. Nonattainment New Source Review (NNSR)

Connecticut's construction and operating permit program requires that new sources of air pollution install best available air pollution control equipment and/or meet the lowest achievable emission rates depending on the potential of the source to emit a particular pollutant. The major source NNSR permit program additionally assures new emissions are offset at a ratio greater than will be emitted by the new source. Overall, the permit program helps ensure continued emission reductions as sources operators build new or expand existing production capacity in the State.

Connecticut certified that its NNSR program satisfied requirements for moderate nonattainment areas based on regulatory requirements in the Regulations of Connecticut State Agencies (RCSA) sections 22a-174-1 and 22a-174-3a. These rules were established to satisfy requirements for prior designations of serious and severe nonattainment for the 1-hour ozone standards.

Connecticut recertified that its NNSR program satisfied requirements for serious areas in a SIP submittal to EPA on December 21, 2020.[21]

## 5. Reasonably Available Control Measures (RACM)

Plans to implement RACM and reasonably available control technology (RACT) were discussed in the 2017 attainment demonstration SIP submittals. A RACT SIP revision satisfying requirements for moderate nonattainment areas within an ozone transport region (OTR) was submitted to EPA for approval on July 17, 2014 and approved July 31, 2017 [82 FR 35454]. RACM, submitted with the attainment demonstrations, was approved on October 1, 2018 as satisfying the requirements of CAA section 172(c)(1) [83 FR 49297]. Under the moderate designation Connecticut was required to implement RACT for sources with the potential to emit 100 tons or more of NOx and 50 tons or more of VOC. With the serious designation the threshold for assessing RACT on NOx sources decreased to 50 tons per year.

Connecticut has updated its RACM and RACT analyses to include sources of NOx with potential emissions of 50 to 100 tons per year. Results of that update were submitted to EPA as a SIP revision on December 21, 2020. No further action with respect to RACT or RACM is required.

[21] https://portal.ct.gov/DEEP/Air/Planning/Ozone/Reasonably-Available-Control-Technology

# 6. Motor Vehicle Inspection and Maintenance (I/M)

Connecticut's motor vehicle inspection and maintenance (I/M) program was established to meet the requirement 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 FR74019]. Connecticut recertified this program as satisfying the moderate requirements when it made the submittals in 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.

Because Connecticut is in the Ozone Transport Region (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.

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 the first and second generation of on-board diagnostics (OBD and OBDII).

Whereas EPA's I/M requirements only cover gasoline powered vehicles up to 8,500 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 recently signed a new contract with Opus Inspection Incorporated to provide administration of the Connecticut program for the next six years. Included in the new contract are additional 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.[22]

The table below demonstrates the basic requirements and the enhanced I/M program requirements.

**Table 6-1.** *Basic and Enhanced I/M Requirements.*

| Basic I/M Program | Enhanced I/M Program |
|---|---|
| • Requires onboard diagnostic (OBD) testing on Model Year (MY) 2001 and new vehicles<br>• Requires idle testing of vehicles MY 2000 and older vehicles. | • Requires OBD testing on MY 1996 and newer vehicles<br>• Requires more comprehensive tailpipe testing of MY 1995 and older vehicles |
| • Emission Control Device Inspection: None | • Emission Control Device Inspection: Visual inspection for the presence of catalytic converter and other major emission control equipment. |

This approved enhanced I/M program will continue to be implemented statewide and remains an important control strategy. Furthermore, on November 26, 2021, the Connecticut Department of Motor

[22] 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.

Vehicles entered into a new six-year inspection agreement with Opus Inspection to operate the state's enhanced I/M program. For purposes of this SIP, DEEP re-certifies its I/M program as enhanced and commits to submit an updated I/M SIP performance standard assessment to EPA.

# 7. Transportation Conformity

Transportation conformity addresses air pollution from on-road mobile sources such as cars, trucks, motorcycles, and buses. 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 budgets, also called motor vehicle emission budgets (MVEBs), are therefore set to prevent any increase in emissions from these sources.

MVEBs are set equal to the onroad emission estimates for the attainment year with a two 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 2020 onroad emissions were determined using EPA's MOVES2014b mobile source emissions model.[23] These values presented in the table below constitute the motor vehicle emissions budgets consistent with the required attainment year modeling and are more stringent than the MVEBs set in our 2017 SIP submittals.[24]

The Department of Energy and Environmental Protection (DEEP) annually reviews, and works with Connecticut Department of Transportation (DOT) to assure, transportation projects are within the MVEBs as required under section 176 of the Clean Air Act following procedures described in section 7 of our 2017 SIP submittals. SIP approved 2020 budgets, presented in the table below, will replace the less stringent 2017 budgets for conformity determinations in the respective nonattainment areas and will assist in expediting attainment for the 2015 ozone standards as well as the 2008 standards in the southwest Connecticut nonattainment area.

**Table 7-1.** *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 |

[23] https://portal.ct.gov/DOT/PP_Bureau/ConnDOT-Plans/Air-Quality-Conformity
[24] https://portal.ct.gov/DEEP/Air/Planning/Ozone/2008-Ozone-NAAQS-Attainment-Demonstrations

## 7.1 Transportation Control and Mobile Emissions

The 2020 mobile emissions budgets for VOCs and NOx reflect a continuation of a downward trend in mobile emissions over time.

**Figure 7-1.** *Connecticut Onroad Motor Vehicle Emissions Trends from EPA NEI.*

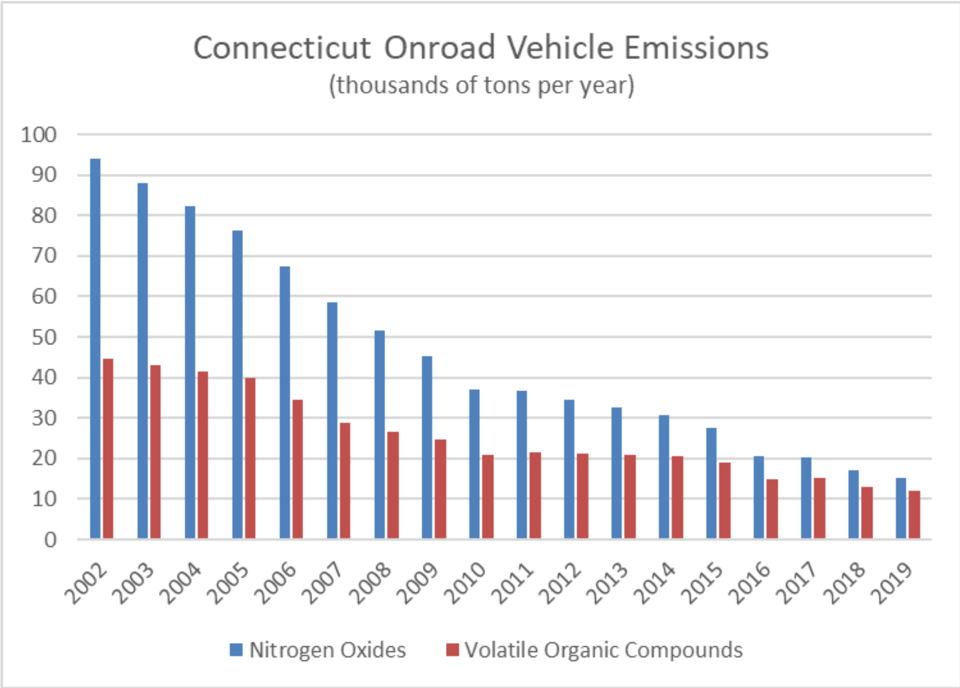
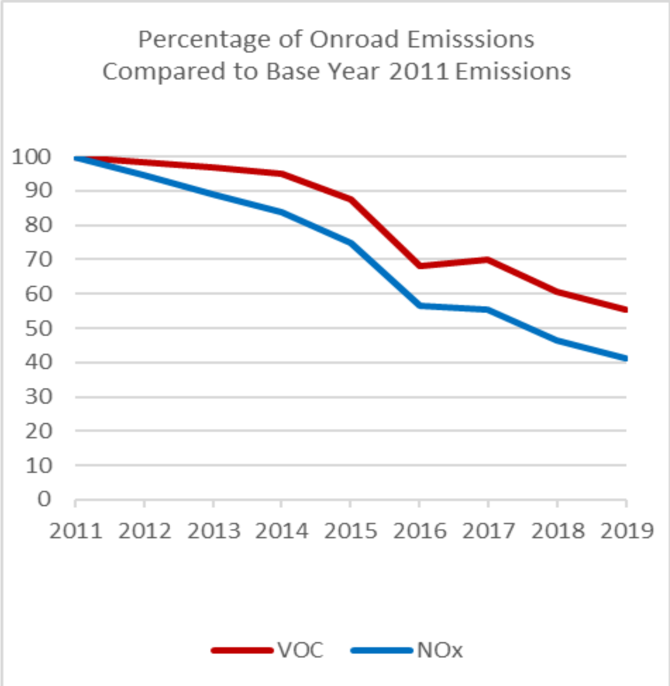



**Figure 7-2.** *Percentage of Onroad Emissions Compared to Base Year 2011 Emissions.*



The steady reductions in mobile emissions are attributable largely to a series of increasingly stringent state and federal regulations requiring cleaner vehicles and fuels, including Connecticut's adoption of the California Low and Zero Emissions Vehicle programs and the federal Tier III regulations for motor vehicles. Trends toward reduced mobile emissions are occurring despite the negative effects of a shift toward the use of higher-emitting, less fuel-efficient sport utility vehicles instead of passenger cars. Since the turn of the century, total vehicle miles traveled (VMT) in Connecticut reached a peak of just above 32 billion VMT in 2007, while dropping to just below 31 billion VMT in 2013 and fluctuating to about 31.5 billion VMT since 2015.[25]

Trends toward lower vehicle emissions are expected to continue as more low- and zero- emission vehicles integrate into the fleet and as EPA enhances programs such as its anti-tampering policy regarding vehicle emission controls. Additionally, VMT reductions in 2020 resulting from a wide variety of policies put in place to limit the spread of COVID-19 are expected to continue as work-from-home policies are likely to remain in place. Further reductions should result from *Connecticut's Climate Change Action Plan* and *EVRoadmap* which seek to increase transportation electrification and reduce VMT and vehicle emissions.

## 8. Clean Fuels/Substitute Program

Connecticut has fulfilled its clean fuel requirements with respect to oxygenated fuels, RCSA section 22a-174-28, and the Low and Zero Emission Vehicle programs set out in RCSA sections 22a-174-36, -36b and -36c.

These regulations were submitted for approval into Connecticut's SIP [most recently LEV III and ZEV II at 83 FR 2097] and have previously fulfilled requirements for serious nonattainment areas based on past designations as serious and severe. Therefore, no further action is required by Connecticut with respect to this requirement.

## 9. Reasonable Further Progress (RFP)

Connecticut demonstrated in its 2017 SIP submittals for the 2008 ozone standards that it would meet rate of progress requirements for 15% reductions in emissions of volatile organic compounds (VOCs) and/or nitrogen oxides (NOx) within six years of the baseline in accordance with CAA section 182(b) for its moderate nonattainment areas through 2017. Connecticut is required to meet additional 3% per year reductions in emissions of VOC/NOx as RFP through 2020 to satisfy requirements resulting from the reclassifications of its nonattainment areas to serious in accordance with CAA section 182(c). This results in a total of 24% reduction from baseline VOC/NOx emissions for each of Connecticut's nonattainment areas.

Due to the clean data determination for the Greater Connecticut nonattainment area, the additional RFP demonstration is required only for Southwest Connecticut at this time.

[25] *Connecticut's Statewide Long Range Transportation Plan 2018-2050*, CTDOT, Figure 6-7 at https://portal.ct.gov/-/media/DOT/documents/dpolicy/lrp/2018lrp/FINALConnecticutSLRTP20180313pdf.pdf and *Connecticut Transportation by the Numbers* at https://www.bts.dot.gov/sites/bts.dot.gov/files/states2020/Connecticut.pdf

## 9.1 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 2011. This is identical to the 2011 base year summer day inventory presented in Section 4 of the 2017 SIP submittal and is reproduced in the table below.[26] The table presents the high ozone season day emissions for the anthropogenic portion of the southwest Connecticut inventory. This is the starting point for calculation of required target level emissions to show reasonable further progress.

**Table 9-1.** *Base year RFP Inventory for Southwest Connecticut*

| Ozone Precursor Pollutant | 2011 Base RFP Inventory (tons/day) | | | | | |
|---|---|---|---|---|---|---|
| | Stationary Point | Stationary Area | On-Road Mobile | Non-Road Mobile | Emission Offset Bank | Total |
| NOx | 18.0 | 6.9 | 55.8 | 32.2 | 2.3 | 115.1 |
| VOC | 2.0 | 52.9 | 31.1 | 29.7 | NA | 115.6 |

## 9.2 Calculation of Target Levels

Consistent with past practice, DEEP has elected to establish 2020 target levels at a ratio of 2:1 NOx to VOC, thus a 16% reduction in NOx emissions from the baseline and an 8% reduction in VOC. While both pollutants contribute to ozone formation, the preference for NOx reductions recognizes that Connecticut's ozone problem is generally NOx limited. The table below shows the calculation of the Target Levels for southwest Connecticut's 2020 ozone season day inventory.

**Table 9-2.** *Determination of 2020 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 (2011) | 115.1 | 115.6 |
| 2. RFP Reductions needed (Base*0.16) for NOx and (Base*0.08) for VOC | 18.4 | 9.2 |
| 3. 2020 Target Level (Base-RFP Reductions needed) | 96.7 | 106.4 |

## 9.3 Compliance with RFP Requirements

Compliance with the RFP requirements is met provided that projected 2020 ozone season day emissions for southwest Connecticut are less than or equal to the calculated RFP Target Levels.

For the purposes of reasonable further progress an inventory for 2020 specific to southwest Connecticut (Fairfield, New Haven and Middlesex counties) is required. A 2020 inventory was projected using interpolation of 2017ek and 2023en inventories.[27] The 2017 and 2023 inventories were developed with input from Connecticut as part of a MARAMA-led regional workgroup responsible for creating modeling inventories. Interpolation was based on ozone season day emissions (May through September) pulled from files at EPA's ftp website for air emission inventories.[28]

[26] SouthwestConnecticutAttainmentSIPFINALpdf.pdf

[27] Documentation of inventory development for 2011en, 2017ek and 2023en is provided at https://www.epa.gov/sites/production/files/2017-11/documents/2011v6.3_2023en_update_emismod_tsd_oct2017.pdf

[28] Files named 20(17 or 23)(ek or en)_county_monthly_report.xlsx at https://gaftp.epa.gov/Air/emismod/2011/v3platform/reports/2011ek_and_2017ek/ and https://gaftp.epa.gov/Air/emismod/2011/v3platform/reports/2011en_and_2023en/

The emission inventory for the 2017 SIP submittal disaggregated airport emissions; fueling emissions; and municipal waste emissions and reorganized EGU point source emissions. DEEP reviewed aggregated 2011en[29] and 2017ek[30] emissions and compared them to the disaggregated base year and projected emissions reported in the 2017 SIP submittal for southwest Connecticut and concluded that the disaggregated sources are not sufficient to alter the outcome of the RFP review. Therefore, sources were not disaggregated for this 2020 review and are included in emissions from the major tiers to which they belong when presented in Attachment A which details the RFP calculations.

The table below compares projected 2020 ozone season day emissions for Southwest Connecticut to the required RFP target levels. Both NOx and VOC emission levels in 2020 are projected to be well below the target levels, thus meeting the RFP requirement. Projected NOx emissions in 2020 are 50% less than 2011 emission levels, while the RFP target requires a 16% emission reduction. Similarly, projected VOC emissions in 2020 are 30% less than 2011 emission levels, while the RFP target requires an 8% reduction. The excess emission reductions beyond the RFP requirement are available for use to meet any further contingency measure requirements. Moreover, these reductions demonstrate RFP milestones were met and satisfy the requirements of CAA section 182(g).

**Table 9-3.** *Comparison of 2020 Projected Emissions to the Required RFP Target Levels for Southwest Connecticut*

| Description | NOx (tons/ozone season day) | VOC (tons/ozone season day) |
|---|---|---|
| 2020 RFP Emission Target Levels (required precursor reduction) | 96.7 (16%) | 106.4 (8%) |
| 2020 Projected Emissions (% reduction projected from 2011-2020) | 57.5 (50%) | 80.9 (30%) |

# 10. Contingency Measures

On October 1, 2018, the Department submitted, and EPA subsequently approved, contingency measures in satisfaction of the requirement set forth in CAA section 182(c)(9) [83 FR 42297]. Given the likelihood that Connecticut will fail to attain until such time that EPA addresses interstate transport, Connecticut commits to continue existing emission control programs that will continue to reduce emissions beyond reasonable further progress (RFP) milestones and exceed EPA's contingency measure requirements.

[29] Notes the most recent edition of the 2011 modeling file.
[30] Notes the most recent edition of the 2017 modeling file.

# 11. 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 applicable attainment date. EPA recommends the use of photochemical grid models for evaluating ozone control strategies.

Photochemical models are complex; they require regional scale emission inventories and meteorological data for the selected episodes and scenarios modeled, which require significant time and resources to develop. Varying inputs such as growth factors, chemistry, and predicted changes in energy dispatch can result in differing outputs and resultant conclusions. This section focuses on attainment in the southwest Connecticut nonattainment area as the Greater Connecticut nonattainment area already monitors attainment of the 2008 ozone standards. In the August 2017 SIP submittal for southwest Connecticut, DEEP demonstrated that attainment is met provided upwind states fulfill overdue Clean Air Act requirements under section 110(a)(2)(d).[31] Unfortunately, Connecticut has yet to be provided meaningful relief from the overwhelming effects interstate transport of ozone and ozone precursors.

Here DEEP revisits the 2017 model results and summarizes modeling conducted by the Ozone Transport Committee (OTC)/Mid-Atlantic/Northeast Visibility Union (MANE-VU) for 2020.

## 11.1. Attainment Demonstrations Submitted in 2017

In the attainment demonstration accompanying DEEP's 2017 SIP submittal for the southwest Connecticut nonattainment area, DEEP clearly established that transport from upwind states was the primary cause of nonattainment in Connecticut. DEEP compared EPA modeling results for the final Cross State Air Pollution Rule (CSAPR) to other modeling results from OTC and monitoring information from 2016 – the most recent year available at the time – to show that EPA's projections were overly optimistic. Table 11-1 shows the extent to which EPA underestimated ozone with a direct comparison to actual 2017 ozone design values.

***Table 11-1***. *Actual vs. Predicted Model Results for EPA's final CSAPR update*.

| Monitor Site | Actual 2017 Design Value (ppb) | EPA CAMx 2017 Projected Design Value (ppb) (Table 8-2 of 2017 SIP –from final CSAPR Update) | EPA underestimate of Ozone (ppb) |
|---|---|---|---|
| Greenwich | 79 | 74 | 5 |
| Danbury | 77 | 71 | 6 |
| Stratford | 83 | 75 | 8 |
| Westport | 83 | 76 | 7 |
| Middletown | 79 | 69 | 10 |
| New Haven | 77 | 66 | 11 |
| Madison | 82 | 76 | 6 |

[31] See sections 8 and 9 of: https://portal.ct.gov/-/media/DEEP/air/ozone/ozoneplanningefforts/SouthwestConnecticutAttainmentSIPFINALpdf.pdf

Because EPA projected nonattainment to be fully resolved at five of those monitors, EPA considered any significant contribution to those receptors to be fully eliminated.[32] By 2018, EPA dispensed with the remaining two monitors, Westport and Madison, with its proposed CSAPR Closeout Rule aided in part by its decision to look to a future attainment date of 2023.[33] Thus Connecticut was denied potential upwind reductions that could have led to timely attainment of the 2008 ozone standard.

## 11.2. OTC/MANE-VU Modeling

The model platform and configuration for the regional modeling studies conducted by OTC/MANE-VU are described briefly below. The full details of the OTC modeling are documented in the Technical Support Document (TSD): *Ozone Transport Commission/Mid-Atlantic Northeastern visibility Union 2011 Based Modeling Platform Support Document – October 2018 Update*.

### Air Quality Model Selection

The OTC/MANE-VU modeling was conducted using both the Community Multi-scale Air Quality Model version 5.0.2 (CMAQ) and the Comprehensive Air Quality Modeling with Extensions version 6.3 (CAMx). CMAQ and CAMx are photochemical grid models capable of simulating ozone production and transport on a regional or national scale. With respect to ozone, CMAQ was used for modeling of design values for 2020 and CAMx was used for source apportionment modeling in 2023. We focus on the 2020 modeling here as that is the attainment year for areas designated serious nonattainment for the 2008 standards.

### Modeling Domain and Grid Resolution

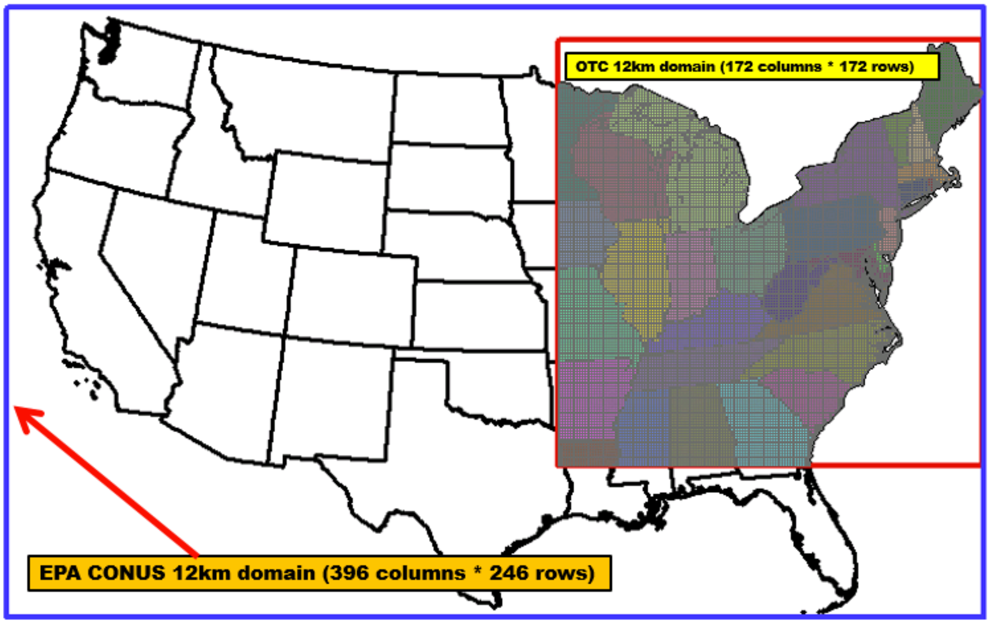
The OTC/MANE-VU models used a domain consisting of 12 km square grids covering the eastern US with a 172x172 mesh in the horizontal and 35 vertical layers to a height of 50 mb pressure. This modeling domain represents a subset of EPA's continental modeling. Figure 11-2 shows EPA's original modeling domain, and the subset OTC/MANE-VU modeling domain.

Connecticut is located well downwind from the domain boundaries to account for transport of ozone and precursors from upwind states.

[32] See for example 83FR31917 "… implementation of the state's emissions budget would fully eliminate the state's significant contribution to downwind nonattainment and interference with maintenance of the 2008 ozone NAAQS because the downwind air quality problems to which the state was linked were projected to be resolved…"

[33] CSAPR Closeout Rule, published 12/21/2018 at 83FR65878

**Figure 11-2.** *The Modeling Domains for EPA and OTC/MANE-VU.*




## Initial and Boundary Conditions

The boundary conditions of the 12 km OTC/MANE-VU CMAQ modeling were established by running CAMx with the EPA CONUS domain and the 3D output option. The results were fit to the OTC domain boundary. OTC provided a 15-day ramp-up period for CMAQ modeling to diminish the influence of initial conditions.

## Meteorological Model Selection and Configuration

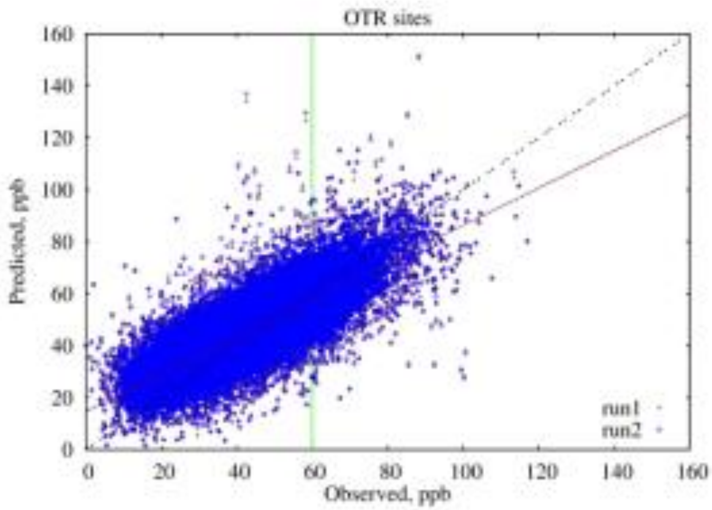
OTC/MANE-VU expects the 12 km Weather Research Forecasting Model (WRF) v3.4 model to be acceptable for sound CMAQ modeling. Further detailed analyses in the TSD indicate that while use of WRF v3.4 provides reasonable approximations of temperature, mixing ratios, and PBL over land, the model warrants improvement in characterizing PBL over water.

## Emissions Inventories

The modeling inventories were prepared in a regional collaboration led by MARAMA with state input. The OTC/MANE-VU modeling for 2020 uses an inventory projected from the base year 2011 inventory with sectors interpolated from the 2023 “el” and “en” inventories with upgraded projections from ERTAC EGU v2.7. A full description of the MARAMA GAMMA 2020 inventory can be found in section 8 of the TSD.

## Model Performance

The figure below shows the predicted CMAQ daily maximum 8-hour ozone values versus observed values for monitors in the Ozone Transport Region (OTR). Model results show an over prediction at all levels throughout the OTR with 63% of predicted values exceeding the observed. At the higher end (i.e. greater than 60 ppb) CMAQ tends toward underprediction of values with 68% of the predicted values being less than the observed.




## Model Results

Table 11-2 shows actual 2020 ozone design values compared to the CMAQ photochemical modeling results as documented in the TSD. Monitors in Greater Connecticut are predicted to maintain compliance with the 2008 standards though they compare poorly with actual monitored data. Modeled values are underpredicted by 6 ppb at the three inland sites. When water grids are excluded from the nine-grid average (3x3) ozone values surrounding the Groton monitor, the model predicts to within 1 ppb. The model unexpectedly indicates better performance at the shoreline site which has consistently monitored the highest ozone levels in Greater Connecticut.

In Southwest Connecticut, the two inland monitors at Danbury and Middletown are projected to attain the 2008 standards with excellent agreement in Danbury, though Middletown is underpredicted by 8 ppb. The New Haven monitor, which is uncharacteristic of our shoreline monitors and is likely influenced by NOx emissions from local commercial marine vessels, is underpredicted by 5-8 ppb depending on whether or not the water grids are excluded from the model prediction calculation. Madison, the eastern most of the southwest Connecticut shoreline monitors is underpredicted by 7 ppb. At the remaining shoreline monitors, Greenwich, Stratford, and Westport, the model correctly predicts nonattainment, though with errors of 6 to 1 ppb depending on inclusion of water grids.

**Table 11-1.** *Preliminary 2020 Design Values and OTC/MANE-VU CMAQ Projected 2020 Modeled Ozone Design Values (DV) in parts per billion.*

| | Monitor Site | Preliminary 2020 DV | Modeled 2020 DV (3x3) | Modeled 2020 DV (Less Water) |
|---|---|---|---|---|
| Southwest Connecticut | Greenwich | 82 | 76 | 83 |
| | Danbury | 71 | 71 | 71 |
| | Stratford | 80 | 76 | 75 |
| | Westport | 79 | 83 | 76 |
| | Middletown | 74 | 66 | 66 |
| | New Haven | 72 | 67 | 64 |
| | Madison | 80 | 73 | 73 |
| | | | | |
| Greater Connecticut | Cornwall | 65 | 59 | 59 |
| | East Hartford | 67 | 61 | 61 |
| | Groton | 73 | 70 | 74 |
| | Stafford | 69 | 63 | 63 |

In general, the 2020 modeling results are overly optimistic. However, the models predict, with a difference of only one part per billion, the highest design value in a nonattainment area without respect to monitor location. Both modeling and monitoring indicate that greater Connecticut will continue to attain the standard, while nonattainment along the southwest Connecticut shoreline is indicative of significant ozone transport.

## 12. Transport Prevents Attainment

As demonstrated in our prior SIP submittals, Connecticut is heavily impacted by ozone transport.[34] In addition to local sources of air pollution, Connecticut's air quality is significantly impacted by air pollution transported over hundreds of miles from sources outside the OTR. There are three meteorological mechanisms that contribute to the transport of air pollution into and within the OTR: ground level transport, transport by the nocturnal low-level jet, and westerly transport aloft. Ground-level transport is the result of interaction between the broad meteorological features and local effects, such as sea breeze.

Our 2017 SIP submittal for southwest Connecticut focused on EPA's "CSAPR Update" modeling and showed that Connecticut could not attain the standard until EPA fully addressed the impacts of interstate air pollution transport. Neither the CSAPR rule nor the subsequently issued CSAPR Close-Out rule, however, included reductions at a scale sufficient to provide a meaningful remedy to address ozone non-attainment in Connecticut.

The CSAPR Close-Out rule did not withstand legal challenge. In *Wisconsin v EPA*, the U.S. Court of Appeals for the D.C. Circuit specifically pointed out the impossible position EPA's approach to transport placed Connecticut using DEEP's Westport monitor as an example.[35] In 2020, at the direction of the Court, EPA again conducted contribution modeling in an attempt to address ozone transport under the 2008 ozone standards.[36] Unfortunately, the resultant "Revised CSAPR Update" rule is predicted to deliver less than 0.3 ppb ozone reductions to downwind states.[37]

The 2020 Revised CSAPR Update modeling results shown in Table 12-1 indicate that eleven upwind states still significantly contribute to nonattainment of the 2008 standards in Connecticut. It also shows the inefficacy of EPA's effort to resolve transport. Once again, the Westport monitor exemplifies the impossibility of the situation. With a contribution from Connecticut of 2.73 ppb and a total concentration from all sources of 78.28 ppb, the Westport site could not possibly attain the 2008 standard of 75 ppb even if Connecticut could eliminate its entire contribution to the monitor. New York, New Jersey and Pennsylvania contribute 14.4, 8.62 and 6.86 ppb respectively, to the Westport monitor – significantly more than Connecticut's 2.73 ppb. Even Ohio contributes nearly as much as Connecticut at 2.55 ppb.

The Clean Air Act clearly and strictly **prohibits** upwind states from causing or interfering with attainment and maintenance of standards in a downwind state. The prohibition is expected to become effective in SIPs submitted within three years of promulgation of the standards and therefore applies to the first designated attainment date for an affected area. Connecticut has been reclassified to higher

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[34] In addition to the SIP submittals, DEEP has pointed out EPA's flawed approach to transport in comments on proposed federal rules, for example:
CSAPR Update, February 1, 2016
https://portal.ct.gov/-/media/DEEP/air/ozone/ozoneplanningefforts/CTcommentsProposedCSAPRUpdatepdf.pdf;
CSAPR Closeout, August 31, 2018
https://portal.ct.gov/-/media/DEEP/air/ozone/ozoneplanningefforts/CSAPRCloseoutCommentspdf.pdf;
Proposed approval of Kentucky's Transport SIP, May 18, 2018
https://portal.ct.gov/-/media/DEEP/air/ozone/ozoneplanningefforts/EPAKYGNSIPSignedpdf.pdf;
Revised CSAPR Update, December 14, 2020
https://portal.ct.gov/-/media/DEEP/air/ozone/CTDEEP-Commissioner-Dykes--Revised-CSAPR-Update-Comments.pdf.

[35] Wisconsin v. EPA; USCA case 16-1406.

[36] EPA's modeling results are available at https://www.epa.gov/csapr/revised-cross-state-air-pollution-rule-update under the heading "Data File with Ozone Design Values and Ozone Contributions." The file lists the contribution by each state to the modeled projected average 2021, 2023, and 2028 ozone design value for each monitor.

[37] Revised Cross-State Air Pollution Rule Update | Cross-State Air Pollution Rule (CSAPR) | US EPA

nonattainment status twice since promulgation of the 2008 standards without benefit of the originally required transport remedy. Connecticut showed in 2017, and the U.S. Court of Appeals for the D.C. Circuit agreed, that attainment in southwest Connecticut is fully dependent on transport. EPA modeling for 2020 shows this is still true.

As upwind states and EPA continue to fail to adhere to Clean Air Act prohibitions on air pollution transport, southwest Connecticut faces yet another reclassification. Reclassification to higher nonattainment status does not remedy transport and will not materially improve air quality in Connecticut. Reclassification will, however, lead to increased regulatory burdens being imposed on sources in Connecticut. As such, DEEP again requests EPA address upwind states' continuing noncompliance with CAA section 110(a)(2)(D)(ii) and not otherwise defer or diminish assessment of, and accountability for, transport with reclassification.

**Table 12-1.** *EPA Revised CSAPR Update Modeling Results.*

| EPA Revised CSAPR Update Modeling Results | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Southwest CT Monitors (ppb) | | | | | | |
| **Contributor** | **Greenwich** | **Danbury** | **Stratford** | **Westport** | **Middletown** | **Madison** | **New Haven** |
| **NY** | 18.62 | 14.88 | 14.42 | 14.44 | 10.7 | 12.54 | 13.01 |
| **NJ** | 7.77 | 9.21 | 7.7 | 8.62 | 5.11 | 5.71 | 6.35 |
| **PA** | 6.02 | 6.08 | 6.72 | 6.86 | 6.09 | 5.64 | 5.97 |
| **CT** | 6.31 | 2.81 | 4.16 | 2.73 | 5.33 | 3.96 | 4.45 |
| **OH** | 1.54 | 1.32 | 2.34 | 2.55 | 3.09 | 2.35 | 2.14 |
| **MI** | 1.35 | N/A | 1.16 | 1.71 | 1.21 | 1.62 | 1.05 |
| **IN** | N/A | N/A | N/A | 0.81 | N/A | 0.8 | N/A |
| **WV** | 0.79 | 0.94 | 1.45 | 1.49 | 1.62 | 1.55 | 1.33 |
| **MD** | N/A | 1.34 | 1.21 | 1.2 | 1.19 | 1.56 | 1.21 |
| **VA** | N/A | 1.18 | 1.29 | 1.3 | 1.35 | 1.69 | 1.3 |
| **KY** | N/A | N/A | 0.78 | 0.87 | 0.86 | 0.79 | N/A |
| **IL** | 0.87 | N/A | 0.99 | 1.26 | 1.16 | 1.08 | 0.89 |
| **<0.76 ppb** | 5.26 | 6.55 | 6.06 | 4.98 | 6.54 | 4.52 | 6.36 |
| **Other** | 26.28 | 26.35 | 27.9 | 29.46 | 27.33 | 29.9 | 25.68 |
| **Modeled Concentration** | **74.81** | **70.66** | **76.18** | **78.28** | **71.58** | **73.71** | **69.74** |

Notes:
1) If a state's contribution is "NA", it is not significant for that monitor and its contributions are included in the <0.76 ppb category.
2) "Other" includes Initial/Boundary Conditions, Biogenics, Off-shore Marine, Canada/Mexico, and Fires.

## 13. Conclusion

Mobile sources are responsible for the vast majority of air pollution in Connecticut. DEEP commits to pursuing additional reductions from this sector as a contingency measure required by CAA section 182(c)(9), however these reductions and the eventual widespread adoption of electrified transportation options in Connecticut will not, of and by itself, provide a viable path to attainment. While Connecticut has met all the required elements of an attainment plan with regard to the reclassification to serious nonattainment for the 2008 ozone NAAQS in southwest Connecticut, it remains EPA's obligation to address the impacts of interstate transport as required under the CAA. Additionally, Greater Connecticut is, and is likely to remain, in compliance with the 2008 ozone NAAQS and currently meets all necessary requirements associated with the reclassification to serious nonattainment.

## Attachment A

# MOVES2014b Input Summary

This report documents the sources of information used to develop Connecticut specific inputs for MOVES2014b, which was used to develop the 2020 Motor Vehicle Emission Budgets (MVEBs) in the Revision to Connecticut's State Implementation Plan - Ozone Attainment Demonstration for Areas Classified Serious Nonattainment for the 2008 Ozone Standards.

## Contents

## Fuel Formulation and Fuel Supply

The fuel formulation table defines the properties (such as RVP, sulfur level, ethanol volume, etc.) of each fuel and the fuel supply table identifies the fuel formulations used in a region and each formulation's respective market share.

The MOVES2014b default values for fuel formulation and fuel supply were used for the 2020 analysis year because Connecticut does not have a full local fuel property study as recommended in the *MOVES2014b Technical Guidance Document,* Section 4.9.1: "EPA strongly recommends using the default fuel properties for a region unless a full local fuel property study exists."

The change from county level (MOVES2010b) to regional level (MOVES2014b) for these inputs better account for fuel production and distribution networks, natural borders, and regional/state/local variations in fuel policy and increase confidence that the default fuels in a particular region represent the actual fuels used in that region.

## Fuel Usage Fraction

The fuel usage fraction table allows the user to change the frequency at which E-85 capable vehicles, also known as flex-fuel vehicles, use E-85 fuel versus conventional fuel, when appropriate.

According to the USDOE Alternative Fueling Station Locator, there are only three public E-85 stations located in Connecticut. Two in New London County and one in Fairfield County. It is safe to conservatively assume that E-85 usage in E-85 passenger vehicles is minimal at this time.

Because of the lack of fueling stations within the state, Connecticut has conservatively assumed that E-85 capable vehicles (SourceBinFuelTypeID=5) are using gasoline (fuelSupplyFuelTypeID=1) 100% of the time and adjusted the default MOVES input appropriately.

## AVFT

The AVFT (fuel type and vehicle technology) table allows users to modify the fraction of vehicles capable of using different fuels and technologies in each model year. Specifically, the AVFT table allows users to define the split between diesel, gasoline, E-85, CNG, and electricity, for each vehicle type and model year.

This table should only be modified if local data is available. If local data is used for present years, that information can be assumed for future years. In most cases, the default VMT split between diesel, gasoline, CNG, and E-85 should be used. There is also a special case for transit buses where the input should be adjusted to reflect the usage of CNG transit buses. If there are no CNG buses in the fleet then the input should be adjusted. Because some transit buses in Connecticut are powered by CNG, we did not adjust the input for transit buses.

MOVES2014b default data was used for this input and the same defaults were used for each county.

## Source Type Population

Source type (vehicle type) population is used by MOVES to calculate start and evaporative emissions. Start and evaporative emissions depend more on how many vehicles are parked and started than on how many miles they are driven. In MOVES, start and resting evaporative emissions are related to the population of vehicles in an area.

Local data from analysis of 2019 Connecticut registration data was used for 11 Motorcycle, 43 School Bus, and 54 Motor Home source types. Data from an EPA sponsored decode of 2017 state vehicle registration data was used for 21 Passenger Car, 31 Passenger Truck, 32 Light Commercial Truck, 51 Refuse Truck, 52 Single Unit Short-haul Truck, 53 Single Unit Long-haul truck source types. Local data from analyses of 2011 Connecticut registration data was used for 41 Intercity bus, 42 Transit Bus, 61 Combination Short-haul Truck and 62-Combination Long-haul Truck source types. These data sets were scaled to the project base year using the growth in MOVES Default VMT for the relevant time periods.

Future year populations were calculated based on a ratio of Connecticut specific base and future year MOVES HPMS Vehicle Type VMT to obtain a growth factor for each HPMS Vehicle Type. Distributions of source types within an HPMS Vehicle Type were assumed to remain the same as established in the base year.

## Source Type Age Distribution

Source type age distribution input defines the age distribution of the local vehicle fleet which can vary greatly in different areas of the country. MOVES covers a 31-year range of vehicle ages, with vehicles 30 years and older grouped together. MOVES allows the user to specify the fraction of vehicles in each of 30 vehicle ages for each of the 13 source types in the model.

Local data was developed from an analysis of Connecticut's 2019 motor vehicle registration data and an EPA sponsored analysis of 2017 state registration data for the 2017 NEI. As allowed by *MOVES2014b Technical Guidance Document,* Section 4.4, MOVES national default age distributions were used in cases where locally registered vehicle data was not necessarily representative. The following table summarizes where local data was used and where MOVES2014b default data was used:

| **Local Data** | | **MOVES2014a Default Data** | |
|---|---|---|---|
| 11 | Motorcycle | 41 | Intercity Bus |
| 21 | Passenger Car | 42 | Transit Bus |
| 31 | Passenger Truck | 61 | Combination Short Haul Truck |
| 32 | Light Commercial Truck | 62 | Combination Long Haul Truck |
| 43 | School Bus | | |
| 51 | Refuse Truck | | |
| 52 | Single Unit Short Haul Truck | | |
| 53 | Single Unit Long Haul Truck | | |
| 54 | Motor Home | | |

For the 2020 analysis, the Connecticut specific age distribution for each source type was carried over without modification instead of using the new EPA "Age Distribution Projection Tool for MOVES2014". This is allowed by M*OVES2014b Technical Guidance Document,* Section 4.4.

## I/M Coverage

This input reflects the characteristics and SIP requirements of Connecticut's Inspection and Maintenance (I/M) program. MOVES only calculates I/M program benefits for gasoline vehicles and this discussion is limited to gasoline vehicles.

Connecticut's I/M program has both a grace period (4 years) and an exemption age (25 years). The imcoverage table inputs "begModelYearID" and "endModelYearID" were adjusted to reflect these factors and a plus one is included in both the grace period and exemption age calculations to account for the model year preceding the calendar year. Connecticut's I/M program also specifies an inspection frequency of every two years.

I/M compliance and waiver rates were determined by the values in Connecticut's SIP. The SIP compliance rate is 96% and the waiver rate is 1%. These values were used along with the regulatory class coverage adjustment factors provided in Appendix A of the *MOVES2014b Technical Guidance Document* to calculate a compliance factor for each I/M program type. [Compliance Factor = Compliance Rate * (1 - Waiver Rate) * Reg Class Adj.] Connecticut also tests gasoline vehicles up to 10,000 lbs.

Connecticut's I/M program applies across the state so all counties used the same I/M coverage inputs.

**Passenger Cars (sourceTypeID - 21)**

> *For 1996 & newer*: Regulatory class adjustment factor is 100% for OBD testing (Test Standard IDs: 51, 43) since all cars in this source type are under 8,500 lbs. [Calculation: (0.96)*(1-0.01)*(1) = 0.9504]

**Passenger Trucks (sourceTypeID - 31)**

> *For 1996 & newer:* Regulatory Class Adjustment is 100% since all vehicles in this source type up to 10,000 lbs get an OBD test (51, 43). [Calculation: (0.96)*(1-0.01)*(1) = 0.9504]

**Light Commercial Trucks (sourceTypeID - 32)**

> *For 1996 & newer:* Regulatory Class Adjustment is 100% since all vehicles in this source type up to 10,000 lbs get an OBD test (51, 43). [Calculation: (0.96)*(1-0.01)*(1) =0 .9504]

## Met Data

Local temperature and humidity data are required inputs for SIP and regional conformity analyses with MOVES. Ambient temperature is a key factor in estimating emission rates for on-road vehicles with substantial effects on most pollutant processes. Relative humidity is also important for estimating NOx emissions from motor vehicles.

### Met Annual

The annual temperature and humidity data maintained consistency with the MARAMA annual modeling effort which used the NMIM National County Database (version NCD20090531) for the 2007 analyses. These values were used to set the existing annual NOx and PM2.5 budgets.

## Met Summer

This temperature input was created for the development of 2008 ozone SIP motor vehicle emissions budgets.

Temperature inputs for a typical high ozone day for Connecticut's non-attainment areas were calculated by first determining the ten highest 8-hr ozone concentrations that occurred in the entire state on unique days in the months of June through August during the three year period (2008-2010) preceding the base year (2011). These values were obtained from the Connecticut Department of Environmental Protection Annual Summary Information for Ozone Website as shown in the following table:

**Table 3: Ten Highest Ozone Concentrations on Unique Days, 2008-2010**

| Date | Site | 8-hour Ozone Concentration (ppb) |
|---|---|---|
| 6/10/2008 | Greenwich | 105 |
| 7/19/2008 | Madison | 105 |
| 7/18/2008 | Greenwich | 102 |
| 6/28/2008 | Danbury | 93 |
| 7/16/2010 | Danbury | 91 |
| 6/7/2008 | Middletown | 91 |
| 6/14/2008 | Westport | 89 |
| 7/28/2010 | Stafford | 87 |
| 7/3/2008 | Stafford | 87 |
| 8/17/2009 | Westport | 85 |

For each of the ten highest ozone days in Table 3, the maximum and minimum temperatures that occurred each day were obtained from the National Oceanic and Atmospheric Administration (NOAA) Local Climatological Data Publication Website for Bradley international Airport in Windsor Locks, CT for the greater Hartford ozone non-attainment area and Igor I. Sikorsky Memorial Airport in Bridgeport, CT for the CT portion of the NY-NJ-CT ozone non-attainment area.

**Table 4: Maximum and Minimum Temperatures for Ten Highest Ozone Days, 2008-2010**

| Date | Greater CT Bradley Airport | | CT Portion of NY-NJ-CT Sikorsky Airport | |
|---|---|---|---|---|
| | Max Temp (°F) | Min Temp (°F) | Max Temp (°F) | Min Temp (°F) |
| 6/10/2008 | 98 | 69 | 96 | 70 |
| 7/19/2008 | 94 | 67 | 92 | 77 |
| 7/18/2008 | 93 | 65 | 92 | 72 |
| 6/28/2008 | 90 | 65 | 86 | 67 |
| 7/16/2010 | 93 | 70 | 87 | 73 |
| 6/7/2008 | 93 | 60 | 86 | 61 |
| 6/14/2008 | 88 | 58 | 84 | 65 |
| 7/28/2010 | 90 | 62 | 87 | 69 |
| 7/3/2008 | 90 | 63 | 87 | 67 |
| 8/17/2009 | 94 | 69 | 91 | 73 |
| **AVERAGE** | **92.3** | **64.8** | **88.8** | **69.4** |

The calculated average maximum and minimum temperatures for each nonattainment area were then input into EPA's Meteorological Data Converter MOBILE6 (XLS) to produce a 24 hour temperature profile for a typical high ozone day in CT for each non-attainment area.

Humidity inputs for a typical high ozone day for Connecticut's non-attainment areas were calculated by first determining the hour by hour humidity profile for each of the ten highest 8-hr ozone days as listed in Table 3.

Hour by Hour humidity values were obtained from the National Oceanic and Atmospheric Administration (NOAA) Quality Controlled Local Climatological Data Website for Bradley international Airport in Windsor Locks, CT for the greater Hartford ozone non-attainment area and Igor I. Sikorsky Memorial Airport in Bridgeport, CT for the CT portion of the NY-NJ-CT ozone non-attainment area. An average humidity value was then calculated for each hour of the day to produce a 24-hour humidity profile for a typical high ozone day in CT for each non-attainment area. Results can be found in Tables 5 and 6.

These temperature and humidity profiles were input to MOVES to obtain summer day emission estimates for each Connecticut county and non-attainment area.

Any temperature assumptions used for regional conformity analyses must also be consistent with the temperature assumptions used to establish the motor vehicle emissions budgets in the SIP as required in the transportation conformity rule, 40 CFR §93.122(a)(6).

**Table 5: Hour by Hour Humidity Values for Ten Highest Ozone Days at Bradley Airport**

| Hour | 6/10/08 | 7/19/08 | 7/18/08 | 6/28/08 | 7/16/10 | 6/7/08 | 6/14/08 | 7/28/10 | 7/3/08 | 8/17/09 | AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 87 | 84 | 81 | 90 | 90 | 93 | 73 | 78 | 76 | 90 | **84.2** |
| **2** | 87 | 81 | 87 | 87 | 93 | 93 | 75 | 84 | 81 | 93 | **86.1** |
| **3** | 90 | 87 | 84 | 90 | 90 | 93 | 78 | 90 | 81 | 93 | **87.6** |
| **4** | 93 | 84 | 84 | 90 | 90 | 93 | 84 | 87 | 81 | 93 | **87.9** |
| **5** | 93 | 87 | 87 | 90 | 93 | 93 | 87 | 87 | 81 | 93 | **89.1** |
| **6** | 87 | 84 | 81 | 84 | 90 | 93 | 78 | 84 | 68 | 93 | **84.2** |
| **7** | 79 | 74 | 71 | 79 | 87 | 93 | 73 | 71 | 61 | 90 | **77.8** |
| **8** | 69 | 71 | 69 | 71 | 79 | 90 | 68 | 62 | 58 | 79 | **71.6** |
| **9** | 59 | 69 | 60 | 69 | 72 | 87 | 62 | 58 | 56 | 67 | **65.9** |
| **10** | 52 | 63 | 57 | 61 | 70 | 76 | 58 | 53 | 47 | 61 | **59.8** |
| **11** | 46 | 57 | 53 | 57 | 63 | 67 | 56 | 48 | 45 | 57 | **54.9** |
| **12** | 42 | 50 | 50 | 51 | 57 | 63 | 53 | 46 | 40 | 52 | **50.4** |
| **13** | 35 | 44 | 47 | 47 | 50 | 59 | 51 | 47 | 36 | 47 | **46.3** |
| **14** | 33 | 38 | 44 | 45 | 49 | 56 | 48 | 50 | 39 | 35 | **43.7** |
| **15** | 33 | 37 | 44 | 45 | 56 | 50 | 76 | 47 | 38 | 32 | **45.8** |
| **16** | 35 | 44 | 44 | 48 | 59 | 50 | 85 | 47 | 43 | 34 | **48.9** |
| **17** | 40 | 46 | 48 | 61 | 61 | 49 | 76 | 55 | 81 | 37 | **55.4** |
| **18** | 45 | 48 | 59 | 57 | 65 | 59 | 79 | 61 | 79 | 44 | **59.6** |
| **19** | 50 | 57 | 60 | 63 | 84 | 61 | 84 | 67 | 81 | 65 | **67.2** |
| **20** | 53 | 58 | 60 | 67 | 87 | 67 | 87 | 72 | 79 | 74 | **70.4** |
| **21** | 57 | 67 | 58 | 71 | 87 | 63 | 84 | 77 | 87 | 79 | **73** |
| **22** | 64 | 74 | 71 | 74 | 87 | 77 | 87 | 79 | 90 | 79 | **78.2** |
| **23** | 84 | 76 | 74 | 76 | 85 | 74 | 90 | 82 | 87 | 85 | **81.3** |
| **24** | 87 | 82 | 76 | 82 | 85 | 82 | 90 | 82 | 84 | 87 | **83.7** |

**Table 6: Hour by Hour Humidity Values for Ten Highest Ozone Days at Sikorsky Airport**

| Hour | 6/10/08 | 7/19/08 | 7/18/08 | 6/28/08 | 7/16/10 | 6/7/08 | 6/14/08 | 7/28/10 | 7/3/08 | 8/17/09 | AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 76 | 79 | 79 | 81 | 87 | 84 | 76 | 79 | 71 | 85 | **79.7** |
| **2** | 76 | 79 | 79 | 81 | 90 | 87 | 81 | 76 | 71 | 85 | **80.5** |
| **3** | 79 | 79 | 76 | 84 | 87 | 87 | 78 | 79 | 68 | 90 | **80.7** |
| **4** | 81 | 79 | 82 | 84 | 90 | 90 | 81 | 76 | 73 | 90 | **82.6** |
| **5** | 81 | 85 | 79 | 87 | 90 | 90 | 81 | 76 | 76 | 90 | **83.5** |
| **6** | 79 | 79 | 76 | 87 | 90 | 93 | 78 | 71 | 71 | 90 | **81.4** |
| **7** | 69 | 74 | 71 | 84 | 87 | 93 | 78 | 69 | 66 | 87 | **77.8** |
| **8** | 67 | 69 | 69 | 76 | 85 | 81 | 71 | 67 | 64 | 82 | **73.1** |
| **9** | 59 | 69 | 67 | 71 | 77 | 81 | 64 | 60 | 62 | 77 | **68.7** |
| **10** | 57 | 65 | 62 | 67 | 77 | 76 | 58 | 58 | 58 | 79 | **65.7** |
| **11** | 50 | 57 | 58 | 60 | 67 | 69 | 60 | 55 | 52 | 72 | **60** |
| **12** | 44 | 50 | 53 | 53 | 70 | 64 | 53 | 55 | 49 | 63 | **55.4** |
| **13** | 35 | 52 | 55 | 55 | 72 | 60 | 53 | 57 | 43 | 59 | **54.1** |
| **14** | 45 | 44 | 47 | 63 | 70 | 58 | 62 | 55 | 46 | 52 | **54.2** |
| **15** | 42 | 47 | 44 | 67 | 70 | 63 | 65 | 63 | 46 | 52 | **55.9** |
| **16** | 44 | 54 | 44 | 65 | 68 | 71 | 69 | 65 | 49 | 45 | **57.4** |
| **17** | 48 | 59 | 44 | 60 | 67 | 59 | 69 | 69 | 53 | 55 | **58.3** |
| **18** | 48 | 59 | 61 | 62 | 70 | 65 | 62 | 72 | 52 | 65 | **61.6** |
| **19** | 51 | 67 | 63 | 67 | 77 | 67 | 67 | 74 | 58 | 67 | **65.8** |
| **20** | 62 | 74 | 70 | 71 | 82 | 69 | 84 | 79 | 64 | 74 | **72.9** |
| **21** | 62 | 79 | 72 | 76 | 79 | 69 | 84 | 82 | 64 | 77 | **74.4** |
| **22** | 74 | 79 | 74 | 76 | 79 | 71 | 87 | 82 | 66 | 77 | **76.5** |
| **23** | 71 | 82 | 79 | 82 | 79 | 71 | 87 | 85 | 74 | 85 | **79.5** |
| **24** | 79 | 82 | 79 | 87 | 85 | 71 | 82 | 85 | 74 | 85 | **80.9** |

## Hotelling Inputs

The hotelling inputs are used to import total hotelling hours for long-haul combination trucks (source type = 62) by hour of day, day type, month, and vehicle model year.

The hotelling hours input was based off hotelling data developed by EPA for the 2017 NEI. This data was deemed to be more representative than the default hotelling hours in MOVES2014b for Connecticut. MOVES2014b default hotelling hours data was calculated only for rural restricted roadways in each county. In Connecticut, for example, Fairfield County has no rural restricted roads and MOVES2014b defaults would show no hotelling for this county when in fact there is hotelling in this county. The EPA 2017 NEI values take into account both rural and urban restricted roads and parking space availability to calculate hotelling hours and results in a much more representative hotelling hours input for Connecticut. This is the best available data source for this input at this time.

The hotelling hours input was adjusted for the 2020 analysis year by taking the ratio of HPMSVtypeVMT for ID=60 to the HPMSVtypeVMT for the future year and adjusting each county's hotelling hours to account for the increases in future year VMT.

The hotelling activity distribution input was not changed from MOVES2014b defaults. This input defines the fraction of hotelling hours that are in each of the hotelling modes by model year. The hotelling modes are: Extended Idle, Diesel Auxiliary Power (APU), Battery Power, and Engine-Off.

## Vehicle Type VMT

The HPMS Vehicle Type VMT input represents annual vehicle-miles of travel in each Connecticut county for each of the five vehicle types. The vehicle types are consistent with those used in the Highway Performance Monitoring System (HPMS).

The month, day and hour VMT Fraction inputs represent the fraction of total annual VMT that occurs in a given month, the fraction of total monthly VMT that occurs on weekdays (dayID = 5) versus weekends (dayID = 2), and the fraction of total daily VMT that occurs in a given hour, respectively.

These inputs contain a combination of multiple data sources including default VMT mixes, locally collected VMT mixes, and modeled VMT figures developed using CT DOT's PERson FORcasting Model (PERFORM). The VMT mix by HPMS road type and MOVES vehicle type is created utilizing the process outlined below in the Road Type Distribution description. County level VMT totals by HPMS road type are calculated with CT DOT's PERFORM statewide travel demand model. Please note that these VMT totals are based on HPMS VMT factors that have been derived from HPMS VMT figures categorized by Urban Area. HPMS VMT factors from 2015 were utilized in the PERFORM. The VMT mix, County VMT by road type, and the locally collected fraction of VMT by hour is then input into EPA's MOVES VMT converter to calculate and format County level daily VMT by MOVES vehicle types (HPMSvType) and a VMT fraction by source type, road type, day type, and hour of the day. The daily VMT figures are then input into EPA's MOVES Annual Average Daily VMT converter, which utilizes PERFORM calculated seasonal VMT factors as well as default weekend day adjustment factors to develop County level annual VMT totals by MOVES vehicle types (HPMSvType).

## Average Speed Distribution

This input represents the distribution of vehicle-hours traveled among 16 speed bins and MOVES requires this information for every combination vehicle source type, road type, and hour of the day. It is also separated seasonally to allow for summer, winter, and annual average adjustment factors.

These inputs are generated starting with CT DOT's PERFORM using average speed by functional classification and the local fraction of VMT by hour of the day. The resultant data sets consist of a matrix of 14 speed bins by hour of the day based on the MOBILE6.2 formatted speed distribution needs. This is then input into EPA's average speed converter to expand the MOBILE6.2 speed bin 14 to MOVES speed bins 14, 15, and 16.

## Road Type Distribution

Road type distribution represents the percent of VMT on each of five road types used in MOVES. These road types are off-network, rural restricted access, rural unrestricted access, urban restricted access, and urban unrestricted access. MOVES requires this distribution for each vehicle source type.

This input is created by utilizing a statewide EPA default VMT mix of VMT fraction by the MOVES vehicle types (vType16) and locally collected statewide HPMS vehicle mix containing the fraction of the CT DOT vehicle type counts on each roadway type by functional classification. CT DOT and CT DEEP created a VMT pre-processor that would reconcile the two VMT mixes by properly mapping the 13 CT DOT vehicle types to the 16 MOVES vehicle types. The resultant VMT mix of HPMS road type by MOVES vehicle type fraction is then input into EPA's MOVES VMT converter to calculate and format VMT by source type and road type for input into MOVES.

## Ramp Fraction

Ramp fraction indicates the percent of vehicle-hours traveled (VHT) that occurs on ramps for rural restricted access roadways (road type = 2) and urban restricted access roadways (road type = 4).

These inputs are generated starting with CT DOT's PERFROM using forecasted VMT figures by roadway type. The county level expressway and ramp VMT are divided into urban and rural designations and input into a MOVES ramp fraction pre-processor along with average speeds for urban and rural expressways and ramps. This pre-processor is designed by CT DOT to calculate the percentage of urban and rural expressway Vehicle Hours of Travel (VHT) that occurs on ramps within each county.

## LEV and NLEV Databases

EPA has provided two databases for MOVES to be used in states other than California that adopted California Low Emission Vehicle (LEV) standards, and states in the Ozone Transport Commission (OTC) that received early implementation of NLEV standards.

The National Low Emission Vehicle (NLEV) Program was the result of an agreement between EPA, Ozone Transport Commission (OTC) states, and the auto manufacturers to introduce new emission standards in the OTC states beginning with the 1999 model year and in the rest of the country beginning with the 2001 model year. The default MOVES database does not include the effects of this early program before the 2001 national implementation. Because Connecticut is an OTC state and adopted the early NLEV program, this database was imported to model the effects of the program in 1999 and 2000 in CT before the national program took effect in 2001.

EPA has also created a separate input database for those states that have adopted the California LEV program regulations. The effects of these LEV standards are not included in the default MOVES emissions database. Because states adopted the LEV standards at different points in time, using the full EPA provided LEV database may not be appropriate. Connecticut implemented the California LEV standards in 2008. As such, the EPA provided database was modified in in accordance with the EPA document *Instructions for Using LEV and NLEV Inputs for MOVES2014* to create a Connecticut specific input.

# Attachment B

## Tables of Reasonable Further Progress Calculations.

**2011 Base Year Inventory (Periodic Emission Inventory) Emissions in Tons per Ozone Season Day**

| | Mobile | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Non Road | | OnRoad | | C3 Marine | | C1C2 and Rail | | Airport | |
| | NOx | VOC | NOx | VOC | NOx | VOC | VOC | NOx | VOC | NOx |
| **Fairfield** | 12.652 | 15.482 | 25.130 | 14.610 | 0.844 | 0.028 | 0.054 | 1.771 | 0.035 | 0.017 |
| **Middlesex** | 2.430 | 4.014 | 6.090 | 3.130 | 1.405 | 0.051 | 0.012 | 0.305 | 0.004 | 0.002 |
| **New Haven** | 9.640 | 9.850 | 24.570 | 13.330 | 1.402 | 0.048 | 0.060 | 1.725 | 0.027 | 0.020 |
| **Total** | **24.722** | **29.346** | **55.790** | **31.070** | **3.651** | **0.126** | **0.127** | **3.800** | **0.066** | **0.039** |

| | Non Point | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage II Gas Stations | | Municipal Landfills | | Nonpoint | | Np Refueling | | PFC | | Agfire | | RWC | |
| | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC |
| **Fairfield** | 0.000 | 0.384 | 0.000 | 0.090 | 3.320 | 21.900 | 0.000 | 1.368 | 0.000 | 1.638 | 0.000 | 0.000 | 0.004 | 0.028 |
| **Middlesex** | 0.000 | 0.085 | 0.000 | 0.009 | 0.610 | 4.323 | 0.000 | 0.318 | 0.000 | 0.205 | 0.000 | 0.000 | 0.002 | 0.016 |
| **New Haven** | 0.000 | 0.365 | 0.000 | 0.075 | 2.930 | 19.935 | 0.000 | 1.221 | 0.000 | 0.875 | 0.000 | 0.000 | 0.004 | 0.027 |
| **Total** | **0.000** | **0.835** | **0.000** | **0.174** | **6.860** | **46.158** | **0.000** | **2.907** | **0.000** | **2.717** | **0.000** | **0.000** | **0.010** | **0.071** |

| | Stationary Point | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Refueling Point | | Oil and Gas | | NON ERTAC IPM | | EGU | | MWC | | Non-EGU Point | |
| | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC |
| **Fairfield** | 0.000 | 0.000 | 0.036 | 0.051 | 0.004 | 0.000 | 3.185 | 0.107 | 3.560 | 0.023 | 0.244 | 0.315 |
| **Middlesex** | 0.000 | 0.000 | 1.798 | 0.108 | 0.000 | 0.000 | 4.796 | 0.137 | 0.000 | 0.000 | 1.506 | 0.050 |
| **New Haven** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.100 | 0.141 | 0.298 | 0.001 | 0.424 | 1.062 |
| **Total** | **0.000** | **0.000** | **1.833** | **0.159** | **0.004** | **0.000** | **10.081** | **0.385** | **3.858** | **0.024** | **2.173** | **1.426** |

**2020 Emissions (Interpolated from EPA 2017ek and 2023en) Emissions in Tons per Ozone Season Day**

| | Mobile | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Non Road | | OnRoad | | C3 Marine | | C1C2 and Rail | | Airport | |
| | NOx | VOC | NOx | VOC | NOx | VOC | VOC | NOx | VOC | NOx |
| **Fairfield** | 7.445 | 10.480 | 9.165 | 6.840 | 0.886 | 0.050 | 0.040 | 1.129 | | |
| **Middlesex** | 1.710 | 2.700 | 2.230 | 1.495 | 1.419 | 0.080 | 0.020 | 0.131 | | |
| **New Haven** | 5.970 | 6.535 | 9.000 | 6.285 | 1.436 | 0.077 | 0.059 | 1.134 | | |
| **Total** | **15.125** | **19.715** | **20.395** | **14.620** | **3.741** | **0.207** | **0.119** | **2.394** | | |

| | Non Point | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage II Gas Stations | | Municipal Landfills | | Nonpoint | | Np Refueling | | PFC | | Agfire | | RWC | |
| | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC |
| **Fairfield** | | | | | 4.070 | 20.870 | | | | | 0.000 | 0.000 | 0.020 | 0.180 |
| **Middlesex** | | | | | 0.730 | 4.075 | | | | | 0.000 | 0.010 | 0.010 | 0.070 |
| **New Haven** | | | | | 3.610 | 19.050 | | | | | 0.000 | 0.050 | 0.020 | 0.185 |
| **Total** | | | | | **8.410** | **43.995** | | | | | **0.000** | **0.060** | **0.050** | **0.435** |

| | Stationary Point | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Refueling Point | | Oil and Gas | | NON ERTAC IPM | | EGU | | MWC | | Non-EGU Point | |
| | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC | NOx | VOC |
| **Fairfield** | | | 0.030 | 0.050 | 1.515 | 0.315 | 1.910 | 0.100 | | | | |
| **Middlesex** | | | 0.535 | 0.060 | 0.755 | 0.040 | 0.900 | 0.075 | | | | |
| **New Haven** | | | 0.000 | 0.000 | 0.315 | 0.995 | 0.830 | 0.100 | | | | |
| **Total** | | | **0.565** | **0.110** | **2.585** | **1.350** | **3.640** | **0.275** | | | | |

| | **2011 Total** | | **2020 Total** | |
|---|---|---|---|---|
| | **NOx** | **VOC** | **NOx** | **VOC** |
| **Fairfield** | 50.765 | 56.113 | 26.170 | 38.925 |
| **Middlesex** | 18.943 | 12.462 | 8.420 | 8.625 |
| **New Haven** | 43.112 | 47.018 | 22.315 | 33.335 |
| **Tri-County Total** | **112.821** | **115.593** | **56.905** | **80.885** |
| **Emission Offset** | **2.3** | | **0.57** | |

Interpolated emissions for 2020 were calculated from summer day emissions from EPA inventory files.
Data taken from "2017ek_county_monthly_report.xlsx" and "2023en_county_monthly_report.xlsx" found at :

https://gaftp.epa.gov/Air/emismod/2011/v3platform/reports

2020 Emission Offsets are taken from the DEEP Emissions Reduction Credit Registry