# Attachment D

## Revision to Connecticut's
## State Implementation Plan

## 8-Hour Ozone Attainment Demonstration
## Technical Support Document

Connecticut Department of Environmental Protection
February 1, 2008

CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION

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## Acronyms and Abbreviations

| | |
|---|---|
| ACT | Alternative Control Techniques |
| ADT | Average Daily Traffic |
| AIM | Architectural and Industrial Maintenance |
| ASM 2525 | Accelerated Simulation Mode Vehicle Emissions Test (25 mph/25% Load) |
| ATV | All Terrain Vehicle |
| BOTW | Beyond on the Way |
| BTU | British Thermal Unit |
| CAA | Clean Air Act |
| CAAA | Clean Air Act Amendments |
| CAIR | Clean Air Interstate Rule |
| CALEV2 | California Low Emission Vehicle Program – Phase 2 |
| CARB | California Air Resources Board |
| CASTNet | Clean Air Status and Trends Network |
| CEEF | Connecticut Energy Efficiency Fund |
| CFR | Code of Federal Regulations |
| CI | Compression Ignition |
| CMAQ | Congestion Mitigation and Air Quality |
| CMAQ | EPA's Models-3/Community Multi-scale Air Quality Modeling System |
| CNG | Compressed Natural Gas |
| CO | Carbon Monoxide |
| COPD | Chronic Obstructive Pulmonary Disease |
| CT | Connecticut |
| CTDEP | Connecticut Department of Environmental Protection |
| CTDOL | Connecticut Department of Labor |
| CTDOT | Connecticut Department of Transportation |
| CTG | Control Technique Guideline |
| DC | District of Columbia |
| DV | Design Value |
| $DV_B$ | Baseline Measured Concentration |
| $DV_F$ | Estimated Future Design Value |
| ECMB | Energy Conservation Management Board |
| EE | Energy Efficiency |
| EGU | Electric Generating Unit |
| EPA | Environmental Protection Agency |
| ERT | Environmental Resources Trust |
| FCM | Forward Capacity Market |
| FHWA | Federal Highway Administration |
| FIP | Federal Implementation Plan |
| FMVCP | Federal Motor Vehicle Control Program |
| FR | Federal Register |
| FTA | Federal Transit Administration |
| FY | Fiscal Year |
| GVWR | Gross Vehicle Weight Rating |
| HC | Hydrocarbon |

| | |
|---|---|
| HEDD | High Electrical Demand Day |
| hp | Horsepower |
| HOV | High-Occupancy Vehicle |
| ICAO | United Nations International Civil Aviation Organization |
| ICI | Industrial/Commercial/Institutional |
| I/M | Inspection and Maintenance |
| ISO-NE | Independent Systems Operator – New England |
| lbs | Pounds |
| LEEDS | Leadership in Environmental Design Silver |
| LEV | Low Emission Vehicle |
| LPG | Liquid Propane Gas |
| MA | Massachusetts |
| MACT | Maximum Available Control Technology |
| MANE-VU | Mid-Atlantic/Northeast Visibility Union |
| MARAMA | Mid-Atlantic Regional Air Management Association |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MAT | Modeled Attainment Test |
| MD | Maryland |
| MM5 | Mesoscale Meteorological Model |
| MMBtu | Million British Thermal Units |
| MNGE | Mean Normalized Gross Error |
| MNB | Mean Normalized Bias |
| MOU | Memorandum of Understanding |
| MOBILE6 or MOBILE6.2 | EPA's On-Road Mobile Source Emissions Estimation Model |
| MPO | Metropolitan Planning Organization |
| MVEB | Motor Vehicle Emission Budgets |
| MW | Megawatt |
| MWh | Megawatt Hour |
| MWC | Municipal Waste Combustor |
| NAAQS | National Ambient Air Quality Standards |
| NARSTO | North American Research Strategy for Tropospheric Ozone |
| NESCAUM | Northeast States for Coordinated Air Use Management |
| NJ | New Jersey |
| NJDEP | New Jersey Department of Environmental Protection |
| NLEV | National Low Emission Vehicle Program |
| NO | Nitrogen Oxide |
| $NO_2$ | Nitrogen Dioxide |
| $NO_x$ | Oxides of Nitrogen |
| NONROAD or NONROAD2005 | EPA's Non-Road Emissions Estimation Model |
| NSR | New Source Review |
| NY | New York |
| NYC | New York City |
| NYSDEC | New York State Department of Environmental Conservation |
| OBD-II | On-Board Diagnostics – Phase 2 |
| OEM | Original Equipment Manufacturer |

| | |
|---|---|
| OH | Ohio |
| ORVR | Onboard Refueling Vapor Recovery |
| OTC | Ozone Transport Commission |
| OTR | Ozone Transport Region |
| PA | Pennsylvania |
| PAMS | Photochemical Assessment Monitoring Station |
| PEI | Periodic Emission Inventory |
| PFC | Portable Fuel Container |
| PL | Public Law |
| $PM_{2.5}$ | Fine Particulate Matter (particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers) |
| $PM_{10}$ | Particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers |
| ppb | Parts per billion |
| ppm | Parts per million |
| PSU/NCAR | Pennsylvania State University/National Center for Atmospheric Research |
| PV | Pressure Vacuum |
| RACM | Reasonably Available Control Measure |
| RACT | Reasonably Available Control Technology |
| RCSA | Regulations of Connecticut State Agencies |
| RE | Rule Effectiveness |
| RFG | Reformulated Gasoline |
| RFP | Reasonable Further Progress |
| RI | Rhode Island |
| ROP | Rate of Progress |
| RPO | Regional Planning Organization |
| RRF | Relative Response Factor |
| RRF | Resource Recovery Facility |
| RVP | Reid Vapor Pressure |
| SAFETEA | Safe, Accountable, Flexibility, Efficient Transportation Equity Act of 2003 |
| SAFETEA- LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act, A Legacy for Users |
| SCAQMD | South Coast Air Management Quality District |
| SI | Spark Ignition |
| SIP | State Implementation Plan |
| SLAMS/ | State & Local Air Monitoring System and |
| NAMS | National Air Monitoring System |
| SMOKE | Sparse Matrix Operator Kernel Emissions |
| $SO_2$ | Sulfur Dioxide |
| STIP | Statewide Transportation Improvement Program |
| SUV | Sport Utility Vehicle |
| TCM | Transportation Control Measure |
| TEA-21 | Transportation Equity Act for the 21st Century |
| TIP | Transportation Improvement Program |
| TNMOC | Total Non-Methane Organic Carbon |
| tpd | Tons per day |
| tpy | Tons per year |
| TSD | Technical Support Document |

| | |
|---|---|
| UMD | University of Maryland at College Park |
| USCA | United States Code Annotated |
| USDOT | United States Department of Transportation |
| USEPA | United States Environmental Protection Agency |
| VA | Virginia |
| VADEQ | Virginia Department of Environmental Quality |
| VMT | Vehicle Miles Traveled |
| VOC | Volatile Organic Compound |
| WV | West Virginia |
| WOE | Weight-of-Evidence |

# E.0 EXECUTIVE SUMMARY TO CONNECTICUT'S 8-HOUR OZONE ATTAINMENT DEMONSTRATION

This document presents the Connecticut Department of Environmental Protection's (CTDEP) air quality state implementation plan (SIP) revision for attaining the federal 8-hour National Ambient Air Quality Standard (NAAQS) for ground-level ozone.

## E.1 Abstract and Conclusions

The plan describes the national, regional and local control measures to be implemented to reduce emissions and uses air quality modeling and other analyses of air quality and meteorological data to assess the likelihood of reaching attainment in Connecticut by the 2010 attainment deadline.

As described in detail in the document, results of these analyses lead CTDEP to conclude that attainment will be achieved by the end of the 2009 ozone season in the five-county Greater Connecticut portion of the State. For the three-county Southwest Connecticut portion of the greater New York City nonattainment area, evidence suggests there is a credible case for attainment by the end of the 2009 ozone season, with the probability of attainment increasing in subsequent years, as emissions are reduced, such that attainment is highly likely to occur no later than the 2012 ozone season. Because ozone levels in Connecticut are dominated by transport from upwind areas, attainment can be assured in 2009 by securing additional emission reductions from upwind states that contribute significantly to nonattainment in Connecticut.

## E.2 Background

Ozone is a highly reactive gas, each molecule consisting of three oxygen atoms. Ground level, or tropospheric ozone is produced through a combination of atmospheric chemical reactions between volatile organic compounds (VOCs) and nitrogen oxides ($NO_X$) in the presence of sunlight. Ozone precursors are emitted from many human activities as well as from natural processes. Anthropogenic emissions of VOCs include evaporation and combustion of gasoline and evaporation of industrial and commercial solvents and a host of consumer products. VOCs emitted by vegetation and other biogenic sources in Connecticut are estimated to be equivalent in magnitude to anthropogenic VOC emission levels in 2002. Nitrogen oxides are generally formed as a product of high temperature combustion such as in internal combustion engines and utility and industrial boilers. Ozone and the pollutants that form ozone are often transported into Connecticut from pollution sources found hundreds of miles upwind.

The adverse effects of ozone exposure on lung health have been well documented in recent decades. Results show that ground-level ozone at concentrations currently experienced in the U.S. can cause several types of short-term health effects. Ozone can irritate the respiratory system, causing wheezing and coughing, can irritate the eyes and nose, and can cause headaches. Ozone can affect lung function, reducing the amount of air that can be inhaled and limiting the maximum rate of respiration, even in otherwise healthy individuals. Exposure to high levels of ozone can also increase the frequency and severity of asthmatic attacks, resulting in more emergency room visits, medication treatments and lost school days. In addition, ozone can enhance people's sensitivity to asthma-triggering allergens such as pollen and dust mites.

**1-hour Ozone NAAQS.** The 1970 CAA amendments established health and welfare protective limits, or national ambient air quality standards (NAAQS), for a number of air pollutants, including "photochemical oxidants," of which ozone was a key component. The 1977 CAA amendments modified the photochemical oxidants standard to focus only on ozone, leading to the establishment in 1979 of a 1-hour average ozone NAAQS of 0.12 parts per million (ppm). The U.S. Environmental Protection Agency (EPA) classified areas as "nonattainment" if monitors in the area measured ozone levels exceeding the NAAQS on more than three days over a 3-year period. Nonattainment areas were required to adopt programs to provide for attainment of the ozone standard no later than 1987. Despite implementation of a variety of emission reduction strategies and significant improvement in measured ozone levels, many areas, including Connecticut, did not attain the standard by the 1987 deadline.

In 1990, additional amendments to the CAA were enacted, including the establishment of different classification levels of 1-hour ozone nonattainment, based on the severity of the ozone problem in each area. Areas measuring more severe ozone levels were provided more time to attain but were also required to adopt more stringent control programs. Pursuant to the 1990 amendments, the EPA designated all of Connecticut as nonattainment for the 1-hour NAAQS. Southwest Connecticut (i.e., all of Fairfield County except the town of Shelton, plus the Litchfield County towns of Bridgewater and New Milford) was assigned to the New York-Northern New Jersey-Long Island (NY/NJ/CT) nonattainment area, with a severe classification and associated attainment date of 2007. The remainder of Connecticut, known as the Greater Connecticut area, was classified as serious nonattainment with a required attainment date of 1999.

CTDEP submitted a series of 1-hour ozone SIP revisions and attainment demonstrations for both the Southwest Connecticut and Greater Connecticut ozone nonattainment areas between 1998 and 2005. The attainment demonstrations relied on photochemical grid modeling, air quality trends and other corroborating weight-of-evidence (WOE) to demonstrate that adopted and mandated control programs within Connecticut and upwind areas were sufficient to enable all areas of the State to achieve attainment of the 1-hour ozone NAAQS by 2007. The attainment demonstration for Greater Connecticut included a technical analysis, showing that overwhelming transport of ozone and ozone precursor emissions (*i.e.*, VOCs and $NO_X$) from upwind areas precluded compliance by that area's required 1999 attainment date, and a request was made for an extension of the attainment date to 2007. EPA published a series of rulemakings approving CTDEP's attainment demonstrations and associated revisions between 1999 and 2007. Table E.1 summarizes control measures implemented to comply with the 1-hour ozone NAAQS.

**8-Hour Ozone NAAQS.** The CAA requires EPA to periodically review (every five years) and revise NAAQS as appropriate to ensure that public health is protected with an adequate margin of safety. Following revisions, states are then required to develop plans to ensure that air quality levels are reduced to below the level of the NAAQS.

Prompted by increasing evidence of health effects at lower concentrations over longer exposure periods, EPA promulgated a more stringent ozone health standard in 1997 based on an 8-hour averaging period. The revised NAAQS was established as an 8-hour average of 0.08 ppm. Compliance is determined in an area using the monitor measuring the highest 3-year average of

## Table E.1: Control Strategies Implemented Statewide in Connecticut to Meet the 1-Hour Ozone NAAQS

| Stationary Source Strategy | Initial Year | | Mobile Source Strategy | Initial Year |
|---|---|---|---|---|
| Consumer Products | 1999 | | Enhanced I/M (ASM 2525 phase-in cut points) | 2000 |
| Architectural & Industrial Maintenance Coatings | 2000 | | Enhanced I/M (ASM 2525 final cut points) | 2004 |
| Autobody Refinishing VOC Limits | 1999 | | OBD-II Enhanced I/M | 2004 |
| Stage I Vapor Recovery at Gasoline Service Stations | 1992 | | Reformulated Gasoline - Phase I | 1995 |
| Stage II Vapor Recovery at Gasoline Service Stations | 1994 | | Reformulated Gasoline - Phase II | 2000 |
| VOC RACT | 1984+ | | Tier 1 Motor Vehicle Controls | 1994 |
| Cutback Asphalt: Increased Rule Effectiveness | 1998 | | On-board Refueling Vapor Recovery | 1997-2005 |
| Gasoline Loading Racks: Increased Rule Effectiveness | 1998 | | National Low Emission Vehicle Program | 1998 (in CT) |
| CT $NO_X$ “RACT” Regulation | 1994 | | Tier 2 Motor Vehicle Controls/Low Sulfur Gasoline | 2004-2008 |
| OTC Phase II $NO_X$ Controls | 1999 | | California Low Emission Vehicle Phase 2 (CALEV2) | 2007 |
| $NO_X$ Budget Program (EPA $NO_X$ SIP Call) | 2003 | | Heavy-Duty Diesel Vehicle Controls and Fuels | 2004-2005 |
| Municipal Waste Combustor Controls | 2000, 2003 | | Non-Road Engine Standards | 1996-2008 |
| Automotive Refinishing Operations (Spray Guns) | 2002 | | | |
| Gasoline Stations Stage II & Pressure-Vent Valves | 2004, 2005 | | | |
| Portable Fuel Containers | 2004 | | | |

each year’s 4th highest daily maximum 8-hour ozone concentration. In February 2001, after extended delays resulting from legal challenges to this new NAAQS, the US Supreme Court upheld the EPA’s authority to establish the 8-hour ozone standards. As required through a subsequent consent decree with environmental groups, in April 2004 EPA published final area designations pursuant to CAA section 107(d) and the Transportation Equity Act for the Twenty-first Century (TEA–21) and final area classifications pursuant to CAA sections 172(a) and 181. These determinations became effective on June 15, 2004.

As shown in Figure E.1, Connecticut, along with other states in the Northeast and other areas of the country, was designated as nonattainment by EPA based on measured 8-hour ozone values from the 2001-2003 period. Portions of Connecticut were included in two nonattainment areas. Fairfield, New Haven, and Middlesex Counties were included as part of a moderate 8-hour ozone NAAQS nonattainment area, along with the New York and New Jersey counties that make up the metropolitan New York Consolidated Statistical Area. The remaining five counties in Connecticut were grouped as a separate moderate nonattainment area, known as the Greater Connecticut 8-hour ozone NAAQS nonattainment area.

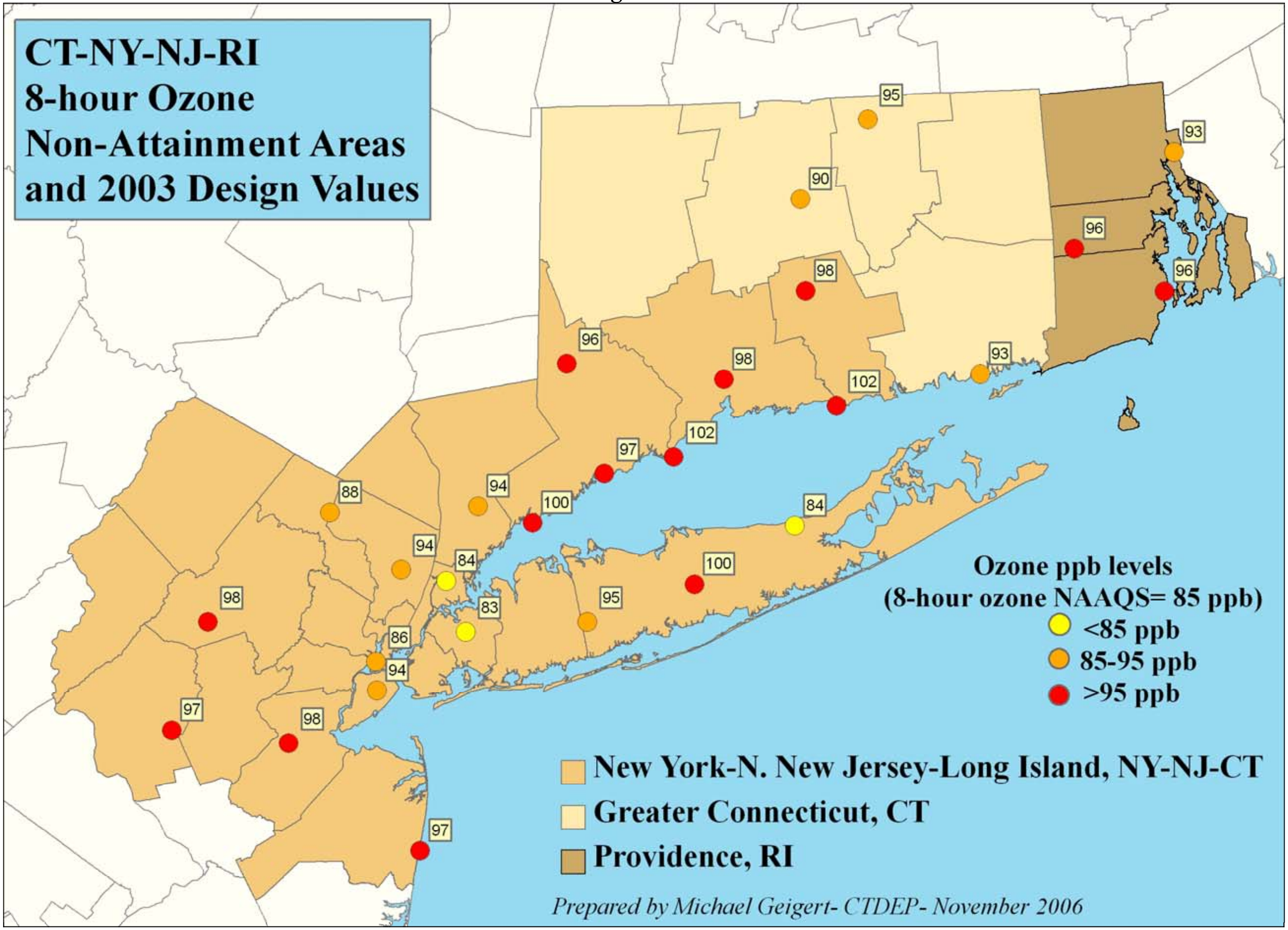
EPA published final 8-hour ozone implementation rules in two phases: Phase 1 on April 30, 2004 and Phase 2 on November 29, 2005. Those rules require moderate 8-hour ozone nonattainment areas, such as those in Connecticut, to submit revisions to the SIP that meet the following planning requirements:

- Reasonable Further Progress (RFP): Achieve 15% VOC reduction within 6 years after the baseline year of 2002 (i.e., reductions must occur by 2008). Equivalent $NO_X$ reductions can substitute for any portion of the required VOC reductions;
- Attainment demonstration: Using modeling and other technical analyses to demonstrate that adopted control measures are sufficient to project attainment of the 8-hour NAAQS by the end of the 2009 ozone season;
- New Source Review (NSR) and Reasonably Available Control Technology (RACT) major source applicability: 100 tons/year (tpy) for $NO_X$ and 50 tpy for VOC (CAA Section 184);
- NSR emission offset ratio: 1.15 to 1 for $NO_X$ and VOC;
- NSR permits: Required for new or modified major stationary sources;
- $NO_X$ control for RACT: requirement for major stationary VOC sources also applies to major $NO_X$ sources;
- RACM/RACT: Reasonably available control technology (RACT) required for all EPA-defined control technique guideline (CTG) sources and all other major sources; reasonably available control measures (RACM) required for all other sources;
- Basic Inspection and Maintenance (I/M): Required for light-duty motor vehicles;
- Stage II vapor recovery: Required for gas stations with a throughput of at 10,000 or more gallons per month;
- Transportation conformity budgets: Budgets that are consistent with the attainment plan are required to be established for the RFP year (i.e., 2008) and the attainment year (i.e., 2009); and
- Contingency measures: Implementation is required upon failure to meet RFP milestones or attainment.

In addition to prescribing the planning requirements for meeting the 8-hour NAAQS, EPA's ozone implementation rules specified the process for transitioning from the 1-hour to the 8-hour ozone NAAQS. The transition included revocation of the 1-hour NAAQS, effective June 15, 2005, and EPA's approach to preventing backsliding from 1-hour ozone requirements.

Given Connecticut's previous classifications as "severe" (Fairfield County) and "serious" (remainder of the State) for the 1-hour ozone NAAQS, Connecticut's regulations continue to

**Figure E.1**


CT-NY-NJ-RI
8-hour Ozone
Non-Attainment Areas
and 2003 Design Values
95
93
90
96
98
96
96
98
93
102
102
97
94
100
88
84
94
84
100
98
95
83
86
94
97
98
97
Ozone ppb levels
(8-hour ozone NAAQS= 85 ppb)
● <85 ppb
● 85-95 ppb
● >95 ppb
▨ New York-N. New Jersey-Long Island, NY-NJ-CT
▨ Greater Connecticut, CT
▨ Providence, RI
Prepared by Michael Geigert- CTDEP- November 2006

include more stringent NSR requirements pursuant to CAA section 182(d) than are required under the State's current "moderate" 8-hour ozone classification.

**Conceptual Model.** A conceptual overview of the ozone problem is provided in the document from both a regional and local perspective. The regional perspective was developed by the Northeast States for Coordinated Air Use Management (NESCAUM) for the Ozone Transport Commission (OTC) states (see Figure E.2) and is provided as Appendix 2A.

The report describes many of the mechanisms that lead to the buildup and transport of ozone across the eastern United States on hot summer days, with detailed descriptions of weather systems such as the Bermuda high pressure system which tends to stagnate in the southeastern U.S. while transporting surface ozone and precursors in a northeasterly direction towards Connecticut. One transport mechanism that has fairly recently come to light and can play a key role in moving pollution long distances is the nocturnal low-level jet. The jet is a regional scale phenomenon of higher wind speeds that often forms at night during ozone events a few hundred meters above the ground just above the stable nocturnal boundary layer. It can convey air pollution several hundreds of miles overnight from southwest to northeast, directly in line with the major population centers of the Northeast Corridor stretching from Washington, DC to Boston, Massachusetts.

Other transport mechanisms occur over smaller scales. These include land, sea, mountain, and valley breezes that can selectively affect relatively local areas. They play a vital role in drawing ozone-laden air into some areas, such as coastal Maine, that are far removed from major source regions.

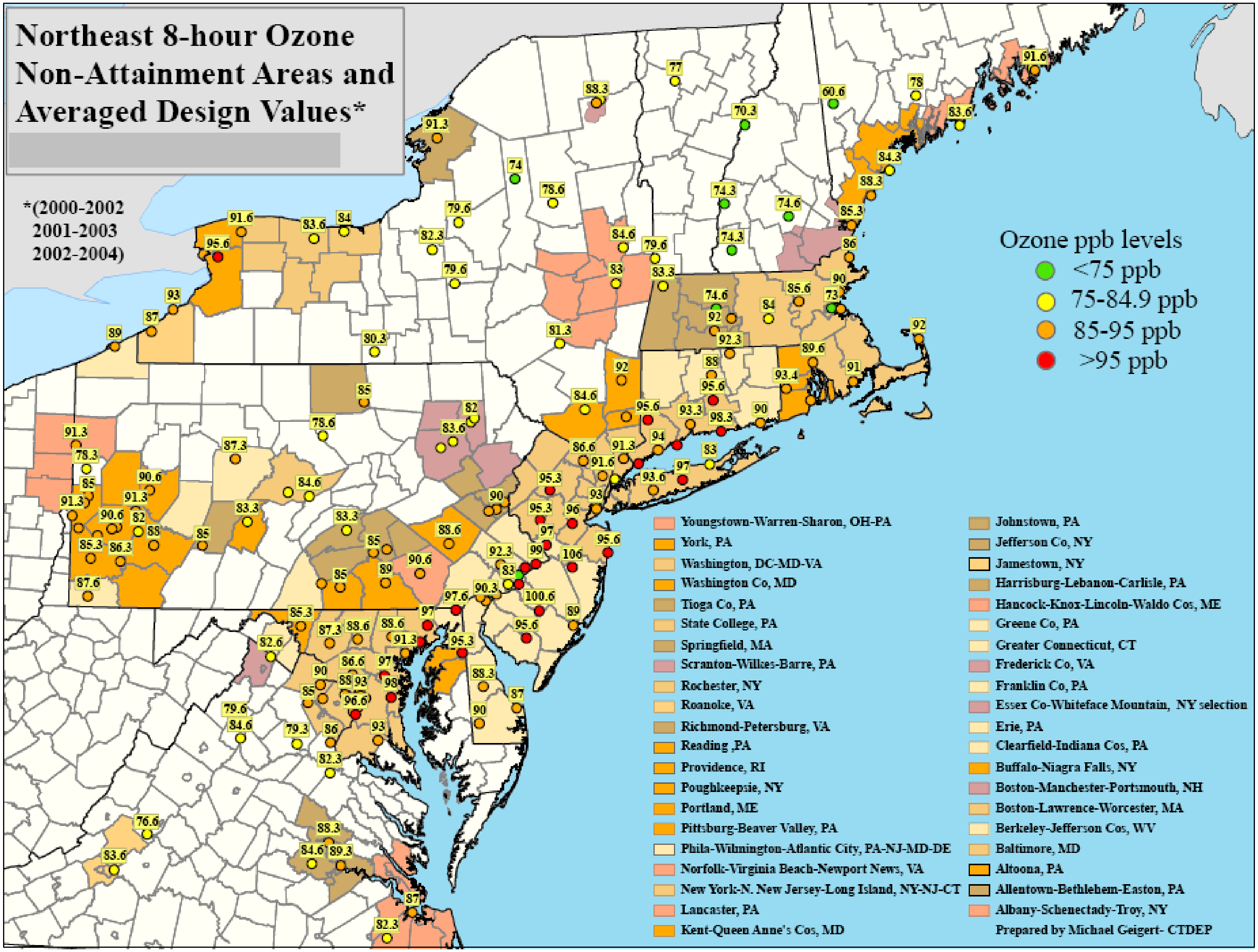
## E.3 Air Quality and Trends

The CTDEP has been monitoring ambient ozone levels throughout the state since the early 1970s. The current network consists of the eleven sites depicted on the map in Figure E.3. In addition to ozone monitoring, since 1994 Connecticut has operated up to four Photochemical Assessment Monitoring Stations (PAMS) to collect ambient concentrations of volatile organic compounds (VOCs), carbon monoxide (CO) and nitrogen oxides (NO and $NO_2$, which are collectively referred to as $NO_X$).

The form of the 8-hour ozone standard is the three-year average of the fourth highest 8-hour ozone levels for each year. Compliance with the standard is achieved when this "design value" is less than 0.08 parts per million (which equates to 85 parts per billion, or ppb, using standard round-off convention).

The trends in design values for each site in the Greater Connecticut area and Southwest Connecticut portion of NY/NJ/CT nonattainment area are plotted in Figures E.4 and E.5, respectively**.** The maximum design values in the Greater Connecticut non-attainment area have decreased by approximately 40% since the mid 1980s, from over 140 ppb to about 85 ppb in 2006. Similarly, the maximum design value in the Southwest Connecticut portion of NY/NJ/CT non-attainment area has decreased from over 155 ppb in 1983 to 90 ppb in 2006.

**Figure E.2**



Note: Values shown are the average of the three design values (3-year averages of the 4th maximum 8-hour ozone level) for the set of years 2000-2002, 2001-2003, and 2002-2004. The figure shows the regional nature of ozone levels in the OTR, with a number of closely adjacent nonattainment areas (average design values ≥ 85 ppb) along with a broader region of elevated regional ozone (e.g., average design values ≥ 75 ppb).

## Figure E.3: Connecticut Ozone Monitoring Sites in 2007

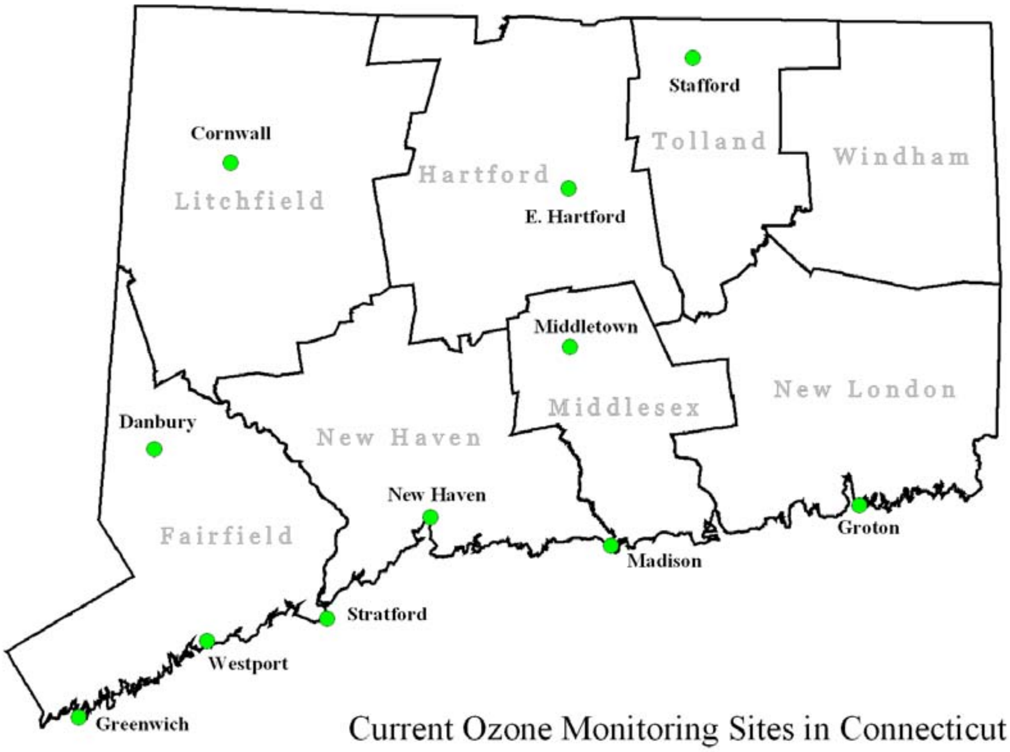
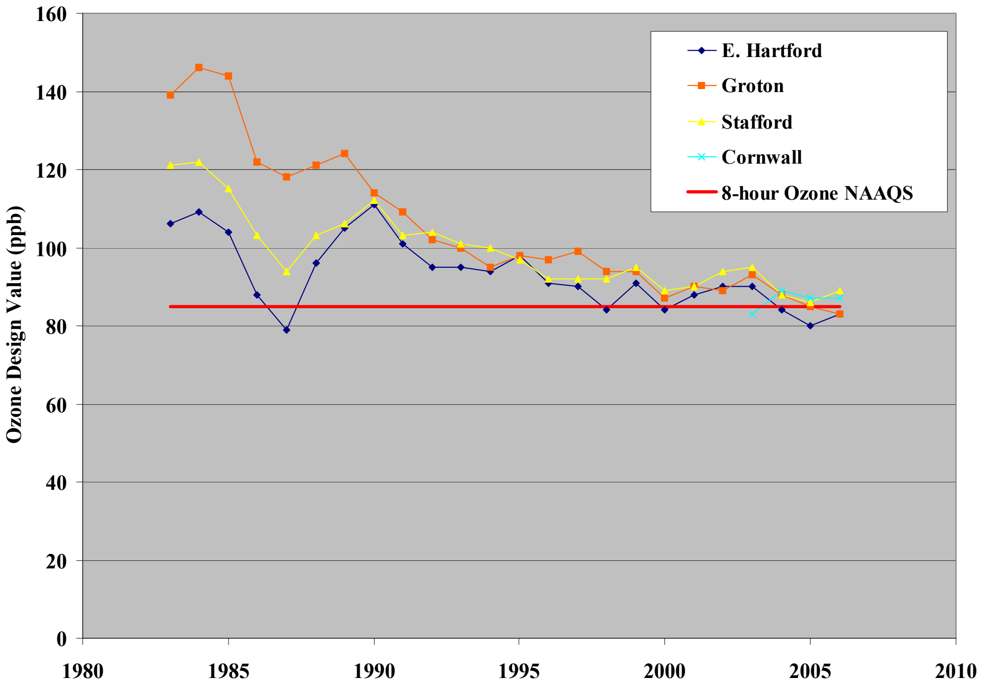


Figure E.4: Greater Connecticut Ozone Non-Attainment Area
8-Hour Ozone Design Value Trends



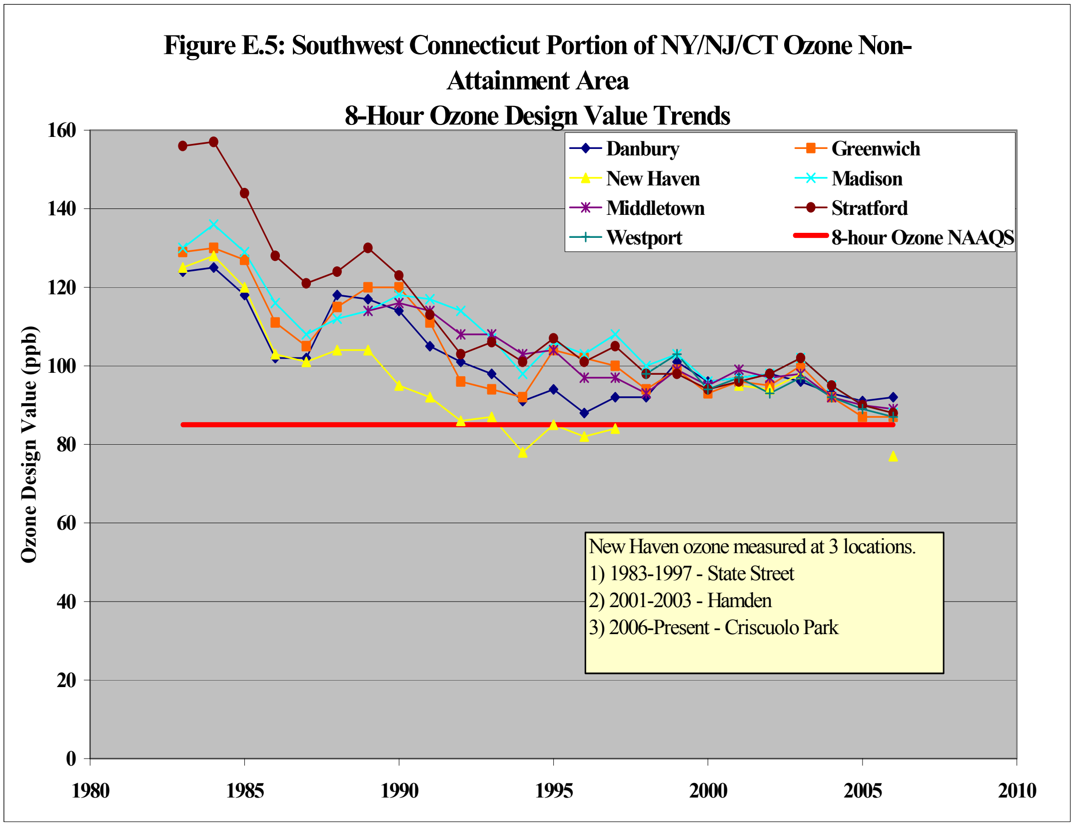


Figure E.5: Southwest Connecticut Portion of NY/NJ/CT Ozone Non-Attainment Area
8-Hour Ozone Design Value Trends

New Haven ozone measured at 3 locations.
1) 1983-1997 - State Street
2) 2001-2003 - Hamden
3) 2006-Present - Criscuolo Park

## E.4 Emissions and Controls: Base Year and Projections to 2009 and 2012

CTDEP has adopted, or is currently pursuing adoption of, several regulations to provide in-state reductions of ozone precursor (i.e., VOC and $NO_X$) emissions. These in-state measures, along with national measures targeted at on-road and non-road emission sources, are expected to provide significant emission reductions through 2009 and beyond. Section 4 documents the level of emissions in Connecticut in the baseline year of 2002, provides descriptions of the measures relied upon to meet CAA RFP and attainment requirements, and summarizes estimates of projected future emissions resulting from these state and federal measures.

**2002 Base Year Inventory.** Some adjustments were made to the December 2005 version of the 2002 Periodic Emissions Inventory (PEI) to account for recent updates to emission calculation methods and inputs. The resulting updated 2002 Base Year Inventory is used for demonstrating reasonable further progress compliance, and is summarized for VOC and $NO_X$ in Tables E.2 and E.3. On a statewide basis in 2002, biogenic sources contributed 50% of the total summer day VOC emissions, with the bulk of the remaining emissions accounted for by stationary area sources (20%), non-road mobile sources (16%) and on-road mobile sources (12%). For statewide $NO_X$ emissions in 2002, the largest contributing category was on-road mobile sources (57%), with large contributions from the non-road mobile (21%) and stationary point (17%) source sectors as well. A more complete source category breakdown of 2002 base year emissions is included in Appendix 4C.

### Table E.2: Summary of Connecticut's 2002 Base Year VOC Inventory*
### (tons / summer day)

| Source Category | Greater CT | Southwest CT | State Total |
|---|---|---|---|
| Stationary Point | 4.6 | 11.3 | 15.8 |
| Stationary Area | 75.5 | 84.1 | 159.7 |
| On - Road Mobile | 45.1 | 48.3 | 93.4 |
| Non - Road Mobile | 56.2 | 66.0 | 122.2 |
| **Total Anthropogenic VOC** | **181.4** | **209.7** | **391.1** |
| Biogenic VOC | 268.6 | 125.6 | 394.2 |
| **Total VOC** | **450.0** | **335.3** | **785.3** |

* Updates to the 2002 PEI include incorporation of emission estimates from EPA's most recent version of the NONROAD model, more recent traffic information input to the MOBILE6.2 model, and inclusion of evaporative VOC emissions from portable fuel containers (i.e., gasoline cans).

### Table E.3: Summary of Connecticut's 2002 Base Year $NO_X$ Inventory*
### (tons / summer day)

| Source Category | Greater CT | Southwest CT | State Total |
|---|---|---|---|
| Stationary Point | 19.0 | 37.7 | 56.8 |
| Stationary Area | 6.4 | 7.2 | 13.5 |
| On - Road Mobile | 89.3 | 102.7 | 192.0 |
| Non - Road Mobile | 30.8 | 38.7 | 69.5 |
| **Total Anthropogenic $NO_X$** | **145.5** | **186.3** | **331.8** |
| Biogenic $NO_X$ | 1.3 | 0.7 | 1.9 |
| **Total $NO_X$** | **146.8** | **187.0** | **333.7** |

* Updates to the 2002 PEI include incorporation of emission estimates from EPA's most recent version of the NONROAD model and more recent traffic information input to the MOBILE6.2 model.

## Post-2002 Control Measures Included in Future Year Projections

Numerous state and federal control strategies are included in the 8-hour Ozone Attainment Plan, resulting in significant emission reductions for all sectors of the emissions inventory: on road and non-road mobile sources as well as stationary area sources and point sources. Many of the state measures identified in this section came out of regional planning processes coordinated by the

OTC. The OTC process included development of model rules to regulate products, activities and stationary sources to reduce ozone precursor emissions. Model rules were prepared in 2001-2002 to serve 1-hour ozone NAAQS purposes and in 2005-2006 to serve as templates for creating additional reductions for 8-hour ozone NAAQS purposes.

### On-Road and Non-Road Mobile Sources and Fuels

There are various federal measures that reduce ozone precursors through more stringent emission standards for vehicles, engines and equipment; changes to fuel type and quality; and influences on human behavior associated with vehicle use. Such federal control measures, along with state counterparts, provide emissions reductions through 2007 and beyond. Control programs for on-road sources are summarized in Table E.4. Programs addressing non-road sources are summarized in Table E.5.

### Connecticut's Control of Stationary and Area Sources

Given federal efforts to address emissions from mobile sources, Connecticut has focused its post-2002 reduction strategy on stationary and area sources of VOC and $NO_X$. The twelve measures identified in Table E.6 create emissions reductions after the 2002 baseline emissions inventory year and, therefore, are creditable towards 8-hour ozone NAAQS RFP and attainment efforts.

Future year emission projections were developed from the 2002 Base Year Inventory, applying the growth factors described in Section 4.3.1 and the emission reductions described in Section 4.3.2. Resulting emission projections for 2008, 2009 and 2012 are depicted in Figures E.6 and E.7.

Both VOC and $NO_X$ emissions are projected to decrease dramatically in Connecticut over the 10-year period from 2002 to 2012 due to these federal and state control programs. Statewide anthropogenic VOC emissions are projected to decrease 19% by 2008, 25% by 2009 and 30% by 2012, after accounting for growth. Statewide $NO_X$ emission reductions are projected to be even greater, with estimated reductions of 25% by 2008, 31% by 2009 and 42% by 2012.

## Table E.4: On-Road Mobile Sources Control Strategies

| Control Strategy | Pollutant | | Federal Program | State Program | Rule Approval Date[1] | Initial Year of Implementation[2] |
|---|---|---|---|---|---|---|
| | VOC | $NO_X$ | | | | |
| Reformulated Gasoline - Phase I[3] | ● | ● | ● | | 12/23/1991[4] | 1995 |
| Reformulated Gasoline - Phase II[3] | ● | ● | ● | | 2/16/1994[4] | 2000 |
| Tier 1 Motor Vehicle Controls | ● | ● | ● | | 6/5/1991 | 1994 |
| National Low Emission Vehicle Program | ● | ● | ● | | 3/02/1998[5] | 1998 (in CT) |
| Tier 2 Motor Vehicle Controls/Low Sulfur Gasoline | ● | ● | ● | | 2/10/2000 | 2004-2008 |
| On-board Refueling Vapor Recovery | ● | | ● | | 4/6/1994 | 1997-2005 |
| Heavy-Duty Diesel Vehicle Controls and Fuels | ● | ● | ● | | 10/6/2000 | 2004-2005 |
| 2007 Highway Rule | ● | ● | ● | | 1/18/2001 | 2006-2007 |
| California Low Emission Vehicle Phase 2 (CALEV2) | ● | ● | ● | ● | [6] | 2007 |
| Enhanced I/M (ASM 2525 phase-in standards) | ● | ● | | ● | 3/10/1999 | 2000 |
| Enhanced I/M (ASM 2525 final standards) | ● | ● | | ● | 10/27/2000 | 2004 |
| OBD-II Enhanced I/M | ● | ● | | ● | [7] | 2004 |
| Highway Motorcycle Exhaust Emission Standards | ● | ● | ● | | 1/15/2004 | 2006-2010 |
| Mobile Source Air Toxics Rule | ● | ● | ● | | 3/29/2001 | 2002 |
| Control of Hazardous Air Pollutants | ● | ● | ● | | 2/26/2007 | 2009-2015 |
| Renewable Fuel Standard Program[8] | ● | ● | ● | | 5/01/2007 | 2006,2007-2012 |

[1] Unless otherwise noted, this is the date of Federal Register publication of either a final federal rule or EPA's approval of a state SIP submittal, as appropriate for the indicated control strategy.

[2] A range of implementation years is listed for some strategies due to phase-in of standards. In addition, all listed mobile source strategies (except enhanced I/M and reformulated gasoline) result in increased levels of emission reductions through and beyond 2007 due to the gradual turnover of the affected fleets.

[3] Reformulated gasoline requirements also result in a reduction in evaporative VOC emissions throughout the gasoline distribution system.

[4] Promulgated statewide under 40 CFR 80.70. Approved for 15% rate-of-progress on 03/10/99.

[5] EPA determined that the NLEV program was in place on 03/02/98. As a result, rules published on 06/06/97 and 01/07/98 went into effect.

[6] Regulation adopted 12/03/04. Not submitted to EPA as of the date of this submission.

[7] Amendment to incorporate OBD-II adopted 08/25/04. Not submitted to EPA as of the date of this submission.

[8] Renewable fuels may be blended into conventional gasoline or diesel fuel. Eventually, emission impacts may be witnessed in the non-road category, in addition to the on-road emission impacts.

## Table E.5: Federal Non-Road Mobile Sources Control Strategies

| Non-Road Engine Category | Date of Final Rule | Implementation Phase-In Period |
|---|---|---|
| ***Compression Ignition (diesel) Engines*** | | |
| Tier 1: Land-Based Diesel Engines > 50 hp | 06/17/1994 (59 FR 31306) | 1996-2000 |
| Tier 1: Small Diesel Engines < 50 hp | 10/23/1998 (63 FR 56968) | 1999-2000 |
| Tier 2: Diesel Engines (all sizes) | 10/23/1998 (63 FR 56968) | 2001-2006 |
| Tier 3: Diesel Engines 50 - 750 hp | 10/23/1998 (63 FR 56968) | 2006-2008 |
| Tier 4: All Diesel Engines (Except locomotive and marine vessels) | 06/29/2004 (69 FR 38958) | 2008-2015 |
| ***Spark-Ignition (e.g., gasoline) Engines*** | | |
| Phase 1: SI Engines < 25 hp (except marine & recreational) | 07/03/1995 (60 FR 34581) | 1997 |
| Phase 2: Non-Handheld SI Engines < 25 hp | 03/30/1999 (64 FR 15208) | 2001-2007 |
| Phase 2: Handheld SI < 25 hp | 04/25/2000 (65 FR 24268) | 2002-2007 |
| Gasoline SI Marine Engines (outboard & personal watercraft) | 10/04/1996 (61 FR 52088) | 1998-2000 |
| Large Spark-Ignition Engines >19 kW (or >25 hp) | 11/08/2002 (67 FR 68242) | 2004/2007 |
| Recreational Land-Based Spark-Ignition Engines | 11/08/2002 (67 FR 68242) | 2006-2012 |
| ***Marine Diesel Engines*** | | |
| MARPOL: New/Old Engines on Vessels Constructed Starting 1/1/2000 | 09/27/1997 MARPOL (Annex VI of International Convention on Prevention of Pollution from Ships) | 2000 |
| Commercial Marine Diesel Engines[1] (US-flagged vessels) | 12/29/1999 (64 FR 73300) | 2004/2007 |
| Recreational Marine Diesel Engines >37 kW (or >50 hp) | 11/08/2002 (67 FR 68242) | 2006-2009 |
| Marine Diesel Engines (US-flagged vessels) >30 liters/cylinder | 02/28/2003 (68 FR 9746) | 2004 |
| ***Locomotives*** | | |
| New & Remanufactured Locomotives and Locomotive Engines[2] | 04/16/1998 (63 FR 18978) | (see note 2)<br>Tier 0: 1973-2001<br>Tier 1: 2002-2004<br>Tier 2: 2005 + |
| ***Non-Road Diesel Fuel*** | 06/29/2004 (69 FR 38958) | 2007/2010 |
| ***Aircrafts*** | | |
| Control of Air Pollution From Aircraft and Aircraft Engines 1 | 05/08/1997 (62 FR 25356) | 1997 |
| Control of Air Pollution From Aircraft and Aircraft Engines 2 | 11/17/2005 (70 FR 69664) | 2005 |
| ***Future Control Measures*** | | |
| Proposed Locomotive & Marine Diesel Rule | 04/03/2007[3] (72 FR 15938) | 2008-2015 |
| Proposed Spark-Ignition Engines, Equipment, and Vessels Rule | 05/18/2007[3] (72 FR 28098) | 2009, 2011-2012 |

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

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

[3] This is a proposed rule, not yet finalized.

## Table E.6: Connecticut's Post-2002 Control Measures included in Future Year Projections

| Control Measure | Pollutant | Section of the Regulations of Connecticut State Agencies | Status of Regulation Adoption |
|---|---|---|---|
| **VOC Content Limits for Consumer Products** | VOC | 22a-174-40 | Adoption completed July 26, 2007 |
| **Design Improvements for Portable Fuel Containers (1) and (2)** | VOC | 22a-174-43 | Initial rule adopted May 10, 2004; amendment adopted January 29, 2007 |
| **VOC Content Limits for Architectural and Industrial Maintenance (AIM) Coatings** | VOC | 22a-174-41 | Adoption completed July 26, 2007 |
| **Restrictions on Asphalt in Paving Operations** | VOC | 22a-174-20(k) | Public hearing held May 1, 2007 |
| **Restrictions on the Manufacture and Use of Adhesives and Sealants** | VOC | 22a-174-44 | Public hearing held October 16, 2007 |
| **Automotive refinishing operations** | VOC | 22a-174-3b(d) | Adoption of amendment completed on April 4, 2006 |
| **Stage II Vapor Recovery – Gasoline Service Station Pressure Vent Valves** | VOC | 22a-174-30 | Adoption of amendment completed on May 10, 2004 |
| **Reduced Vapor Pressure Limitation for Solvent Cleaning** | VOC | 22a-174-20(*l*) | Adoption completed July 26, 2007 |
| **Standards for Municipal Waste Combustion** | $NO_X$ | 22a-174-38 | Adoption of amendment completed October 26, 2000 |
| **$NO_X$ Reductions from Industrial, Commercial and Institutional (ICI) Boilers** | $NO_X$ | 22a-174-22 | Public hearing held October 19, 2006 |
| **CAIR $NO_X$ Ozone Season Trading Program** | $NO_X$ | 22a-174-22c | Adoption completed September 4, 2007 |

**Figure E.6: Projected Anthropogenic VOC Emission Trends for Connecticut**

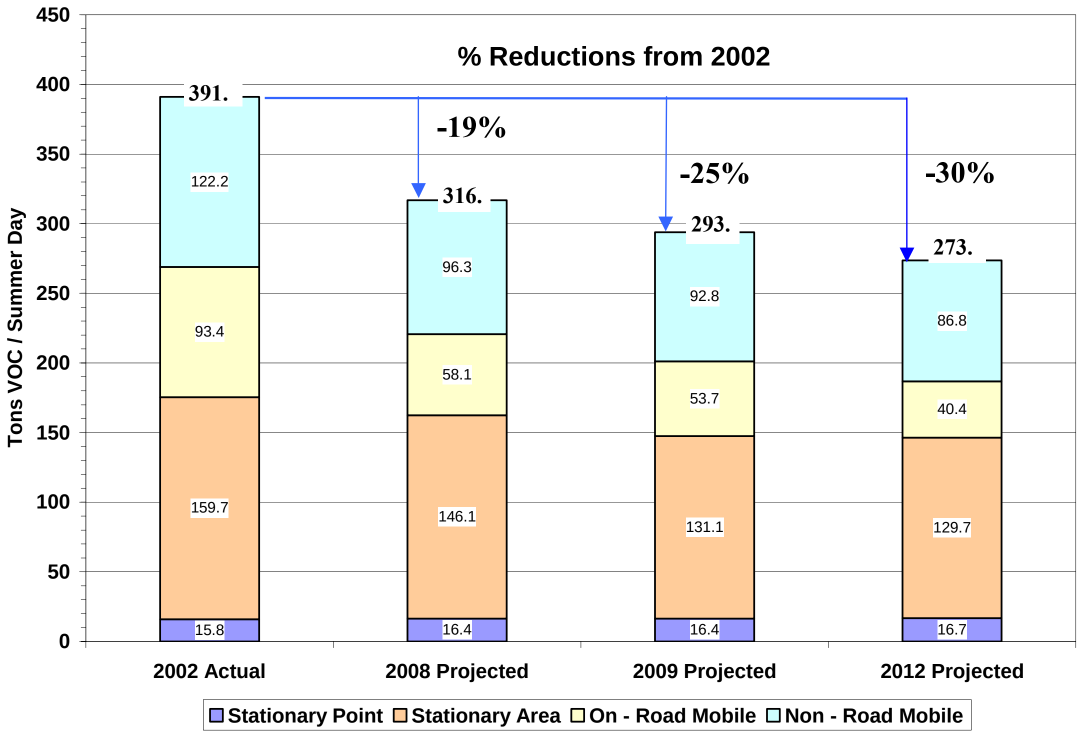
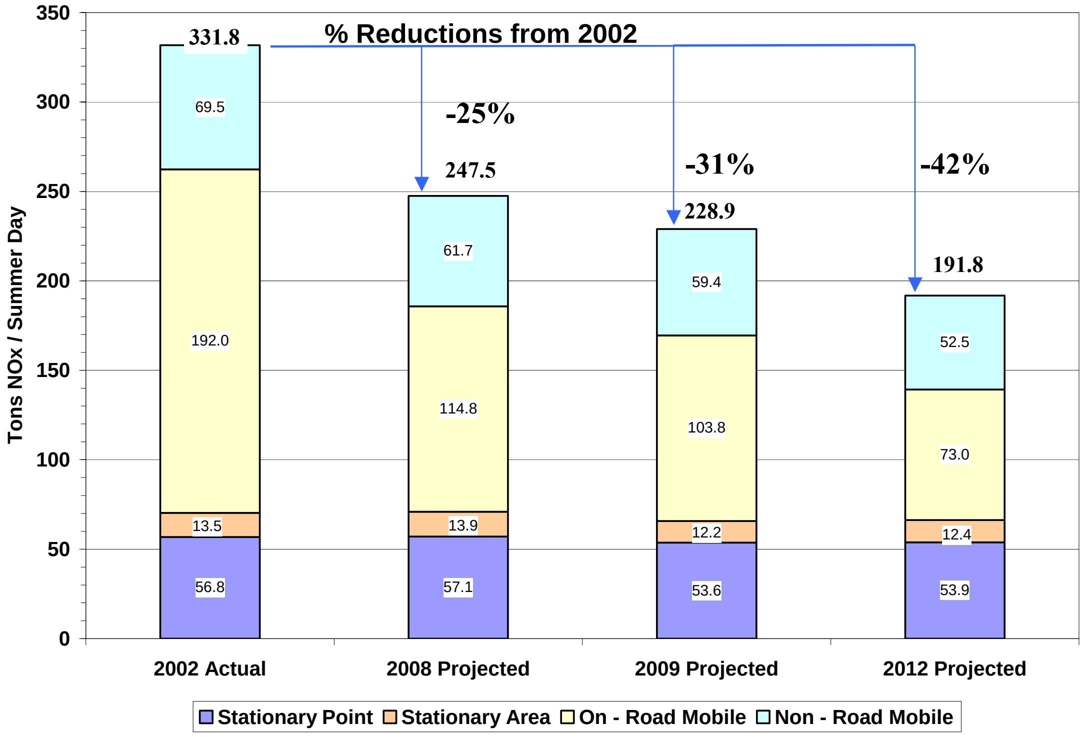


**Figure E-7: Projected Anthropogenic NOx Emission Trends for Connecticut**



## E.5 Reasonable Further Progress (RFP)

The Phase 2 Ozone Implementation Rule includes EPA's interpretation of the CAA requirement that nonattainment areas demonstrate RFP towards attaining the ozone NAAQS. For moderate 8-hour ozone nonattainment areas, such as Greater Connecticut and Southwest Connecticut, with attainment dates at least five years after designation, the rule requires a demonstration that areas will achieve at least a 15% emission reduction between 2002 and 2008. The 15% reduction requirement can be satisfied with any combination of VOC and $NO_X$ reductions. Additional reductions are also required to achieve attainment beyond 2008.

As shown in Tables E.7 and E.8, projected 2008 emissions in both areas are significantly less than the required RFP target levels corresponding to a total of 15% reduction in VOC and/or $NO_X$ emissions. For Greater Connecticut, the combined reduction of VOC and $NO_X$ emissions is projected to be 37.2%, more than double the required 15% reduction. Similarly for Southwest Connecticut, the projected combined VOC and $NO_X$ reduction of 37.8% is also more than double the RFP requirement for 2008.

**Table E.7: Greater Connecticut Demonstration of Reasonable Further Progress Comparison of 2008 Projected and Target Level Emissions (tons / summer day)**

| Description | Anthropogenic VOC | Anthropogenic $NO_X$ |
|---|---|---|
| 2008 RFP Target Levels<br>(Portion of Required 15% VOC+ $NO_X$ RFP) | 159.4<br>(10%) | 129.5<br>(5%) |
| 2008 Projected Emissions<br>(% Reduction Projected to be Achieved) | 149.3<br>(15.7%) | 107.0<br>(21.5%) |
| Combined VOC + $NO_X$ Reduction | 37.2% | |
| Excess Reduction Beyond 15% Requirement | 22.2% | |

**Table E.8: Southwest Connecticut Demonstration of Reasonable Further Progress Comparison of 2008 Projected and Target Level Emissions (tons / summer day)**

| Description | Anthropogenic VOC | Anthropogenic $NO_X$ |
|---|---|---|
| 2008 RFP Target Levels<br>(Portion of Required 15% VOC+ $NO_X$ RFP) | 184.6<br>(10%) | 165.9<br>(5%) |
| 2008 Projected Emissions<br>(% Reduction Projected to be Achieved) | 167.6<br>(18.3%) | 140.5<br>(19.5%) |
| Combined VOC + $NO_X$ Reduction | 37.8% | |
| Excess Reduction Beyond 15% Requirement | 22.8% | |

## E.6 Reasonably Available Controls Measures (RACM)

In accordance with CAA Section 172(c)(1), the "Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard" (the Implementation Rule) requires a state to apply all reasonably available control measures (RACM) that will assist the state in timely attainment of the ozone standard. A RACM analysis traditionally focuses on area, mobile and non-major point sources, and the measures that are considered RACM are those readily implemented measures that are economically and technologically feasible and that contribute to the advancement of attainment in a manner that is "as expeditious as practicable." RACM requires an area-specific analysis, in which the State considers the application of RACM for any source of VOCs or $NO_X$ within the state borders. The plan to implement these RACM was due June 15, 2007, and is therefore included with this demonstration of attainment.

Because atmospheric transport overwhelms the ability of Connecticut to advance its 8-hour ozone attainment date solely using in-state strategies, Connecticut's attainment demonstration relies heavily on emission reductions from upwind states to increase the probability of attainment of the 8-hour NAAQS by June 15, 2010. While none of the potential measures discussed meet the criteria to be considered RACM because they cannot advance our attainment date, CTDEP has pursued in-state emissions reductions in acknowledgement of the importance of coordinated actions by groups of states throughout the eastern U.S. to better position all states for attainment by the designated attainment date.

**RACT.** A subset of RACM is the reasonably available control technology (RACT) requirement. EPA has defined RACT as the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. Unlike RACM, RACT is limited to sources for which EPA has developed Control Technique Guidelines (CTGs) and major non-CTG sources. As the analytical work for implementing the CTGs is readily available, and because the RACT sources are, *a priori*, a significant focus for implementing control strategies, EPA expects requirements limiting emissions from RACT sources to be addressed more readily than the other control options. Connecticut submitted its RACT SIP to EPA on December 8, 2006. In recognition of Connecticut's longstanding efforts to improve air quality with respect to ozone and its precursor emissions, that SIP submittal included measures that went beyond RACT.

**OTC RACM Process.** As a member of the OTC, Connecticut has worked jointly with the other eleven member states and the District of Columbia to assess the nature and magnitude of the ozone problem in the region, evaluate potential new control approaches and recommend regional control measures to ensure attainment and maintenance of the ozone NAAQS. The OTC staff and staff from member states formed several workgroups to identify and evaluate candidate control measures. Initially, the workgroups compiled and reviewed a list of over 1,000 candidate control measures. These control measures were identified through published sources such as EPA's Control Technique Guidelines, STAPPA/ALAPCO "Menu of Options" documents, the AirControlNET database, emission control initiatives in other states including California, state/regional consultations, and stakeholder input. The workgroups developed a preliminary list of approximately fifty candidate control measures to be considered for more detailed analysis with respect to the potential for emissions reductions, cost effectiveness, and ease of implementation. These measures were anticipated to be most effective in reducing ozone air quality levels in the Northeastern and Mid-Atlantic States.

**TCMs**. The RACM analysis also consists of an evaluation of transportation control measures (TCMs) and their contribution to transportation and air quality planning in Connecticut. It is customary that the statewide transportation planning process in Connecticut includes the identification, evaluation, selection, and implementation of appropriate TCMs. The Connecticut Department of Transportation (CTDOT) produces annual updates to the Statewide Transportation Improvement Program (STIP), documenting projects to be funded under federal transportation programs for a three-year period.

One of the federal funding sources for the STIP is the Federal Highway Administration's Congestion Mitigation and Air Quality (FHWA CMAQ) Program. Funds are used for projects that reduce emissions from vehicles, improve traffic congestion, and/or improve air quality. A detailed list of projects is provided in Section 6 and Appendix 6A. Some examples of projects eligible for FHWA CMAQ funding are:

- Programs for improved public transit;
- Restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high-occupancy vehicles (HOV);
- Employer-based transportation management plans, including incentives;
- Traffic flow improvement programs that achieve emission reductions;
- Fringe and transportation corridor parking facilities serving multiple-occupancy vehicle programs or transit service;
- Programs for the provision of all forms of high-occupancy, shared-ride services;
- Sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;
- Programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of cyclists, in both public and private areas; and
- Employer-sponsored programs to permit flexible work schedules.

## E.7 Transportation Conformity

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

Projected future emission levels in Connecticut resulting from the various control strategies were summarized previously. The on-road portion of these emission estimates will serve as transportation conformity emission budgets for the 8-hour ozone NAAQS, as listed in Table E.9. Emission budgets are being established for the RFP milestone year of 2008, the required attainment year of 2009 and a future year of 2012. The 2012 budget, although not required by the CAA or EPA regulation, provides an enforceable mechanism to ensure continued reduction in on-road emissions beyond the required attainment year.

**Table E.9: Transportation Conformity Emission Budgets (tons per summer day)**

| Area | 2008 | | 2009 | | 2012 | |
|---|---|---|---|---|---|---|
| | VOC | $NO_X$ | VOC | NOx | VOC | NOx |
| SWCT Portion NY/NJ/CT | 29.7 | 60.5 | 27.4 | 54.6 | 20.6 | 38.2 |
| Greater Connecticut | 28.5 | 54.3 | 26.3 | 49.2 | 19.8 | 34.8 |
| Statewide Total | 58.1 | 114.8 | 53.7 | 103.8 | 40.4 | 73.0 |

## E.8 Attainment Demonstration: Modeling and Weight of Evidence

EPA requires that states with moderate (and above) ozone nonattainment areas prepare and adopt SIP revisions demonstrating attainment of the 8-hour ozone standard using photochemical grid modeling and weight-of-evidence (WOE) analyses. States with moderate nonattainment areas are required to attain the 8-hour ozone NAAQS by June 15, 2010. Because the June 15, 2010 deadline occurs in the middle of the 2010 ozone season, Connecticut and other states with moderate nonattainment areas must demonstrate NAAQS compliance for the preceding ozone season of 2009.

**Grid Modeling.** Sections 8.1 through 8.4 of this document describe the procedures followed, data inputs and results of the regional photochemical grid modeling exercise. Section 8.5 describes various WOE analyses that supplement the modeling results in assessing the likelihood of attaining the 8-hour NAAQS in both the Greater Connecticut nonattainment area and the Southwest Connecticut portion of the NY/NJ/CT nonattainment area. Figure E.8 shows the geographic domains used for the OTR modeling, including an outer grid with a grid resolution of 36 km for the national domain and an imbedded 12 km grid for the eastern domain. The modeling platform was EPA's Community Model for Air Quality (the CMAQ Model).

Figures E.9, E.10 and E.11 show the modeling results for Connecticut for 2002, 2009 and 2012, respectively. The plotted results for 2002 are based on the five-year average of fourth highest monitored ozone concentrations each year for the period centered on 2002 (i.e., 2000-2004). For 2009 and 2012 plots, the 2002 values are multiplied times the relative response factors (RRF) derived from the ratio of modeled ozone in the future year divided by the modeled ozone in the base year.

CTDEP's primary conclusions based on the results of the photochemical modeling and WOE analyses are:

1) There is a high level of probability that the **Greater Connecticut** area will achieve attainment of the 8-hour ozone NAAQS by the end of the 2009 ozone season; and
2) A credible case has been made that **Southwest Connecticut** will attain by the end of the 2009 ozone season. The probability of attainment increases as additional emission reductions occur in each subsequent year, such that attainment by 2012 is highly probable. Expeditious additional emission reductions from upwind states will also enhance the probability of earlier attainment in Southwest Connecticut.

**Figure E.8: Modeling Domain Used for OTC Modeling**

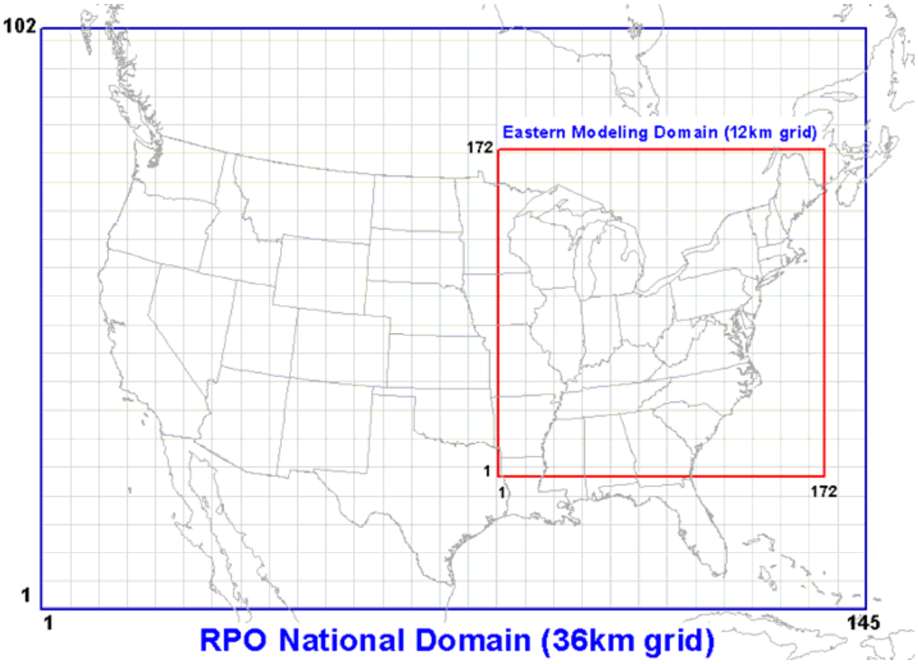
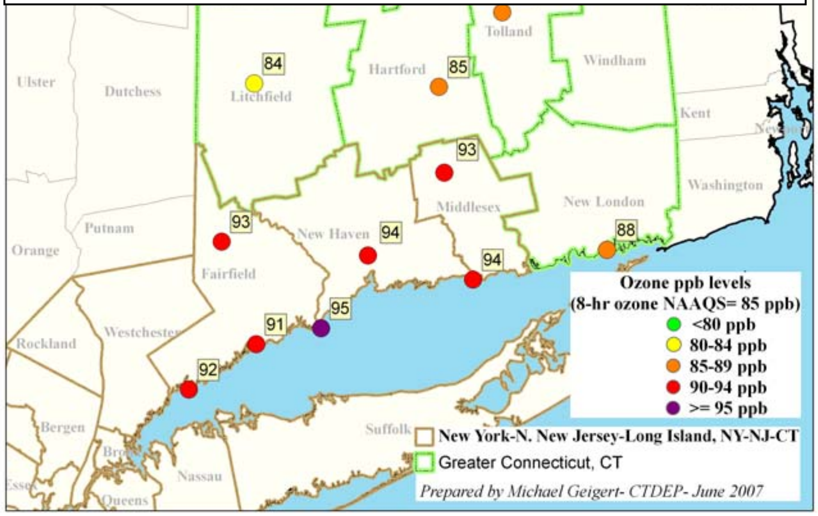


**Figure E.9 CT 2002 Design Concentrations used in Modeling (CTDEP $DV_B$ Method)**



*Prepared by Michael Geigert- CTDEP- June 2007*

**Figure E.10 CT 2009 Ozone Modeling Results (CTDEP $DV_B$ Method)**

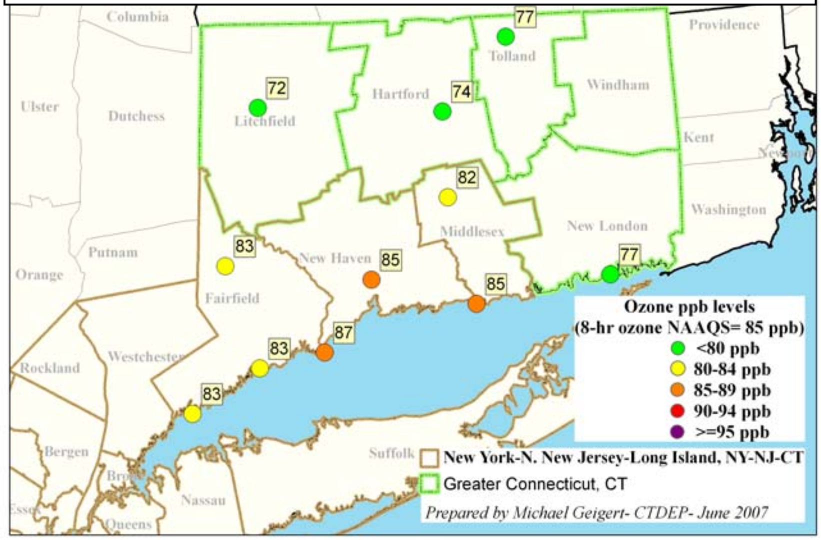
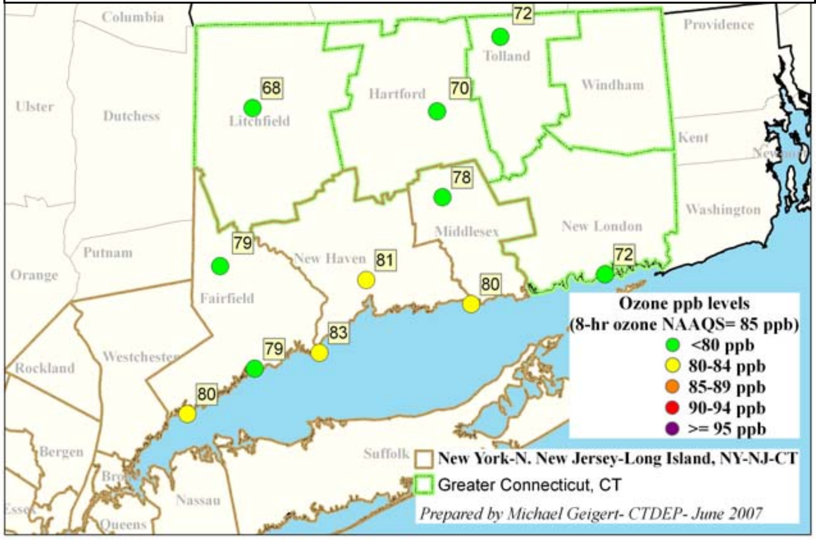


**Figure E.11 CT 2012 Ozone Modeling Results (CTDEP $DV_B$ Method)**



**Weight of Evidence.** All seven Southwest Connecticut monitors are projected by the model to have 2009 design values within the "inconclusive" range (i.e., 82 ppb to 87 ppb) where EPA recommends the use of supplemental weight-of-evidence analysis techniques to better assess the probability of attaining by 2009. Several WOE analyses are presented in the main document. Included are discussions of uncertainty in model input data and formulations, variability in meteorology from year to year, observed air quality trends, comparison of modeled and monitored ozone levels, additional emission reductions not included in the CMAQ modeling and other relevant considerations. The results of these analyses support CTDEP's conclusion that there is a credible case for attainment throughout all of Southwest Connecticut by the end of the 2009 ozone season.

## E.9 Contingency Measures

Section 172(c)(9) of the CAA and EPA's Phase 2 8-hour ozone implementation rule require states with 8-hour ozone nonattainment areas to include contingency measures in the SIP to be implemented if the area fails to satisfy a reasonable further progress milestone or fails to attain the 8-hour ozone NAAQS by the applicable attainment date. Such measures must be fully adopted rules that are ready for implementation quickly upon failure to achieve RFP or attainment.

As previously described in the document, the suite of control programs that have been adopted in each of Connecticut's nonattainment areas are projected to provide combined VOC and $NO_X$ reductions that exceed the 15% RFP requirement by more than 20% relative to the 2002 adjusted base year inventory. These surpluses of emission reductions in 2008 will far exceed the additional 3% reduction required by the RFP contingency requirement in each area. As a result, any combination of these SIP measures providing a 3% VOC reduction can be specified for inclusion in the RFP contingency plan.

Connecticut's RFP contingency plan requirement will be met by using a portion of the expected emission reductions occurring from state rules limiting VOC emissions from architectural and industrial maintenance coatings (AIM) and solvent cleaning. As more fully described in Section 4 these regulations will result in a combined VOC reduction exceeding 16 tons/summer day by 2009, providing more than a 4% reduction relative to the 2002 adjusted base year VOC inventory, thus satisfying the 3% reduction requirement.

The failure-to-attain contingency plan must identify control measures sufficient to secure an additional 3% reduction in ozone precursor emissions should a moderate nonattainment areas fail to attain the 8-hour ozone NAAQS by the June 2010 required attainment date. EPA will determine each moderate area's attainment status in 2010, using measured 2009 ozone design values. If EPA determines that an area has failed to attain, the contingency plan would be triggered for implementation beginning with the 2011 ozone season.

Connecticut's failure-to-attain contingency plan requirement will be met by using a portion of the expected emission reductions occurring from federal measures tightening engine and fuel standards for on-road vehicles and non-road equipment. As more fully described in Section 4, these adopted federal programs will continue to provide an increasing level of VOC and $NO_X$ emission reductions through 2012 and beyond. Total VOC emission reductions from these two sectors are estimated to be 19.3 tons/summer day between 2009 and 2012 (i.e., 13.3 tons/summer day from on-road vehicles and 6.0 tons/summer day from non-road equipment; see Table 4.3.2). Assuming the reductions increase linearly between 2009 and 2012, VOC reductions between 2009 and 2011 would total 12.9 tons/summer day. This equates to a 3.3% VOC reduction relative to the 2002 adjusted base year VOC inventory, satisfying the 3% reduction requirement.

## E.10 Commitments

The ultimate success of this attainment demonstration will be dependent upon the fulfillment of a number of commitments made by Connecticut, other states and EPA to adopt, implement and enforce a wide array of ozone precursor control measures and to comply with relevant CAA requirements. Section 10 summarizes the commitments CTDEP has made elsewhere in this SIP document and makes requests of EPA to pursue additional national control measures and to exercise its CAA authority to ensure that other states no longer contribute significantly to ozone violations in Connecticut.

As more fully described in Section 4, Connecticut has adopted, or is currently pursuing adoption of a number of new and revised regulations that will provide a significant level of ozone precursor emission reductions by the June 2010 attainment deadline. Connecticut has already adopted and initiated implementation of several post-2002 control strategies, including the enhanced motor vehicle emission inspection maintenance program and regulations restricting emissions from portable fuel containers, automotive refinishing operations, gasoline station pressure vent valves, and municipal waste combustion units. Table E.10 summarizes the status of the 8-hour ozone SIP regulations that CTDEP is committing to pursue through Connecticut's rulemaking process.

**Table E.10: 8-hour ozone SIP regulations that CTDEP is committing to pursue**

| Control Measure | Pollutant | Section of the Regulations of Connecticut State Agencies |
|---|---|---|
| Standards for **Municipal Waste Combustion** | $NO_X$ | 22a-174-38 (In-Place) |
| Stage II Vapor Recovery – **Gasoline Service Station Pressure Vent Valves** | VOC | 22a-174-30 (In-Place) |
| **Automotive Refinishing** Operations | VOC | 22a-174-3b(d) (In-Place) |
| Design Improvements for **Portable Fuel Containers** | VOC | 22a-174-43 (In-Place) |
| Reduced Vapor Pressure Limitation for **Solvent Cleaning** | VOC | 22a-174-20(*l*) (In-Place) |
| $NO_X$ Reductions from **ICI Boilers** | $NO_X$ | 22a-174-22 (Hearing Held) |
| **CAIR** $NO_X$ Ozone Season Trading Program | $NO_X$ | 22a-174-22c (In-Place) |
| VOC Content Limits for **Architectural Coatings** | VOC | 22a-174-41 (In-Place) |
| Restrictions on **Asphalt** in **Paving** Operations | VOC | 22a-174-20(k) (Hearing Held) |
| VOC Content Limits for **Consumer Products** | VOC | 22a-174-40 (In-Place) |
| Restrictions on the Manufacture and Use of **Adhesives and Sealants** | VOC | 22a-174-44 (Hearing Held) |

In addition to formal SIP commitments to pursue adoption of the regulations summarized in Table E.10, CTDEP and other state agencies are involved with several non-SIP initiatives that have or will produce ozone precursor emission reductions to further improve ozone levels. These non-SIP programs, which are described more fully in Section 8.5.5, include:

- **High Electric Demand Day** (HEDD) initiative: Currently, EGU emissions on hot summer days with peak power demand can be more than double the emissions on an average summer day. Four northeastern states have recently signed a memorandum of understanding (MOU) to pursue reductions of peak day emissions from electricity generation. Negotiations continue with other states and stakeholders to expand this initiative. In addition, the recent passage of a new comprehensive Connecticut law addressing electricity and energy efficiency (CT Energy Act) will also play a key role in shaping the final form of the HEDD initiative in Connecticut.
- The **Connecticut Energy Efficiency Fund** (CEEF) provides about $60 million each year to support energy efficiency projects for business, government and residences. Available estimates indicate that CEEF projects funded since 2001 have resulted in the avoidance of $NO_X$ emissions on the order of two tons per day. Demand response programs are also being implemented; including a new initiative that provides discounted rates to residential customers who reduce peak summer electrical usage.
- **Connecticut's legislature** has committed $1 billion to programs designed to reduce traffic congestion, including development of a New Haven-Hartford-Springfield, MA commuter rail line, other expanded transit alternatives, increased telecommuting and flexible employee scheduling, and increased port and rail freight options.

**New EPA Control Technique Guidelines.** EPA is in the process of adopting several new Control Technique Guideline (CTG) requirements for various VOC source categories. Table E.11 provides a summary of the new EPA CTG categories. As appropriate, Connecticut will analyze the need to adopt requirements to address these CTGs for sources in the state and pursue adoption of such requirements in subsequent SIP submittals. Although emission reductions from

**Table E.11: CTGs Scheduled for Adoption by EPA Since 2005**

| Control Techniques Guideline (CTG) Category |
|---|
| Lithographic Printing Materials |
| Letterpress Printing Materials |
| Flexible Packaging Printing Materials |
| Flat Wood Paneling Coatings |
| Industrial Cleaning Solvents |
| Paper, Film, and Foil Coatings |
| Metal Furniture Coatings |
| Large Appliance Coatings |
| Miscellaneous Metal Products Coatings |
| Fiberglass Boat Manufacturing Materials |
| Miscellaneous Industrial Adhesives |
| Plastic Parts Coatings |
| Auto and Light Duty Truck OEM Coatings |

these categories are expected to occur prior to 2012, they are not included in the attainment demonstration modeling. As a result, future adoption of CTG-related rules will provide emission reductions beyond those modeled, increasing the likelihood of future attainment.

**Connecticut's Reliance on Other States and EPA.** Connecticut's recently submitted Section 110(a)(2)(D) SIP revision includes a discussion of EPA's CAIR modeling analysis, which identifies numerous upwind states as contributing significantly to 8-hour ozone NAAQS nonattainment in Connecticut. The analysis showed that Connecticut is the only state in the CAIR program subject to transport exceeding 90% of projected 2010 ozone levels, illustrating the unique and overwhelming influence upwind emissions have on Connecticut's prospects for achieving timely attainment. EPA's modeling also predicts that CAIR will provide minimal relief to Connecticut, reducing by less than one percent the ozone and precursor transport affecting the state on high ozone days.

EPA's CAIR modeling highlights the importance of securing sufficient upwind reductions to enable Connecticut to achieve timely attainment. As described in Section 8, the modeling used in this attainment demonstration is based on the OTC's "beyond-on-the-way" suite of control measures. CTDEP is pursuing adoption of these measures, and is dependent on upwind states doing the same.

Although the weight-of-evidence analyses included in Section 8 support CTDEP's conclusion that 8-hour ozone attainment is likely in Greater Connecticut by 2009 and may be achieved in Southwest Connecticut by 2009, the probability of attainment can be enhanced if additional non-modeled upwind reductions are secured. CTDEP requests that EPA, when reviewing ozone attainment demonstrations and other related SIP revisions, ensures that adequate emission controls are adopted and implemented by upwind states such that no other state continues to significantly contribute to ozone nonattainment in Connecticut.

CTDEP also requests that EPA adopt additional national and regional emission control programs to ensure equitable and cost-efficient progress can be made to achieve both the current and soon-to-be-revised 8-hour ozone NAAQS. To that end, EPA should follow through on timely promulgation of the CTGs listed in Table E.11, and ensure states comply in a timely manner. In addition, EPA should move forward to adopt the most stringent possible non-road and on-road emission standards for all mobile source categories and work with states to address HEDD emissions that exacerbate ozone air quality problems on hot summer days.

# 1.0 Introduction and Background

## 1.1 Purpose of Document

This document presents the Connecticut Department of Environmental Protection's (CTDEP) air quality state implementation plan (SIP) revision for attaining the federal 8-hour National Ambient Air Quality Standard (NAAQS) for ground-level ozone. The plan describes the national, regional and local control measures to be implemented to reduce emissions and uses air quality modeling and other analyses of air quality and meteorological data to assess the likelihood of reaching attainment in Connecticut by the 2010 attainment deadline.

As described in detail in subsequent sections of this document, results of these analyses lead CTDEP to conclude that attainment is likely to be achieved by the end of the 2009 ozone season in the five-county Greater Connecticut portion of the State. For the three-county Southwest Connecticut portion of the greater New York City nonattainment area, evidence suggests that there is a credible case for attainment by the end of the 2009 ozone season, with the probability of attainment increasing in subsequent years, as emissions are reduced, such that attainment is highly likely to occur no later than the 2012 ozone season. Because ozone levels in Connecticut are dominated by transport from upwind areas, attainment can be assured in 2009 by securing additional emission reductions from upwind states that contribute significantly to nonattainment in Connecticut.

## 1.2 Ozone Production and Health Effects

Ozone is a highly reactive gas, each molecule consisting of three oxygen atoms. It is formed naturally at high altitudes (in the stratosphere) where it acts beneficially to absorb potentially damaging ultraviolet solar radiation before it reaches the earth's surface. Protection of stratospheric ozone is addressed under Title VI of the Clean Air Act (CAA).

Tropospheric, or ground-level ozone is produced through a combination of atmospheric chemical reactions between volatile organic compounds (VOCs) and nitrogen oxides ($NO_X$) in the presence of sunlight. Ozone precursors are emitted from many human activities as well as from natural processes. Anthropogenic emissions of VOCs include evaporation and combustion of gasoline and evaporation of industrial and commercial solvents and a host of consumer products. VOCs emitted by vegetation and other biogenic sources in Connecticut are estimated to be equivalent in magnitude to anthropogenic VOC emission levels in 2002. Nitrogen oxides are generally formed as a product of high temperature combustion such as in internal combustion engines and utility and industrial boilers. A small quantity of $NO_X$ is produced by lightning and emitted by microbial processes in soil. Variability in weather patterns contributes to considerable yearly differences in the magnitude and frequency of high ozone concentrations. Ozone and the pollutants that form ozone are often transported into Connecticut from pollution sources found hundreds of miles upwind.

The adverse effects of ozone exposure on lung health have been well documented in recent decades. Results show that ground-level ozone at concentrations currently experienced in the U.S. can cause several types of short-term health effects. Ozone can irritate the respiratory system, causing wheezing and coughing, can irritate the eyes and nose, and can cause headaches. Ozone can affect lung function, reducing the amount of air that can be inhaled and limiting the maximum rate of respiration, even in otherwise healthy individuals. Exposure to high levels of ozone can also increase the frequency and severity of asthmatic attacks, resulting in more emergency room visits, medication treatments and lost school days. In addition, ozone can enhance people's sensitivity to asthma-triggering allergens such as pollen and dust mites.

Other possible short-term effects resulting from exposure to high levels of ozone include aggravation of symptoms in those with chronic lung diseases, such as emphysema, bronchitis and chronic obstructive pulmonary disease (COPD) and increased susceptibility to respiratory infections due to impacts of ozone on the immune system. Studies have also raised the concern that repeated short-term exposure to high levels of ozone could lead to permanent damage to lung function, especially in the developing lungs of children.

### 1.3 Previous Ozone NAAQS SIP History

The 1970 CAA amendments established health and welfare protective limits, or national ambient air quality standards (NAAQS), for a number of air pollutants, including "photochemical oxidants", of which ozone was a key component. The 1977 CAA amendments modified the photochemical oxidants standard to focus only on ozone, leading to the establishment in 1979 of a 1-hour average ozone NAAQS of 0.12 parts per million (ppm). The U.S. Environmental Protection Agency (EPA) classified areas as "nonattainment" if monitors in the area measured ozone levels exceeding the NAAQS on more than three days over a 3-year period. Nonattainment areas were required to adopt programs to provide for attainment of the ozone standard no later than 1987. Despite implementation of a variety of emission reduction strategies and significant improvement in measured ozone levels, many areas, including Connecticut, did not attain the standard by the 1987 deadline.

In 1990, additional amendments to the CAA were enacted, including the establishment of different classification levels of 1-hour ozone nonattainment, based on the severity of the ozone problem in each area. Areas measuring more severe ozone levels were provided more time to attain but were also required to adopt more stringent control programs. Pursuant to the 1990 amendments, the EPA designated all of Connecticut as nonattainment for the 1-hour NAAQS. Southwest Connecticut (i.e., all of Fairfield County except the town of Shelton, plus the Litchfield County towns of Bridgewater and New Milford) was assigned to the New York-Northern New Jersey-Long Island nonattainment area, with a severe classification and associated attainment date of 2007. The remainder of Connecticut, known as the Greater Connecticut area, was classified as serious nonattainment with a required attainment date of 1999.

CTDEP submitted initial attainment demonstrations for both the Southwest Connecticut and Greater Connecticut ozone nonattainment areas on September 16, 1998. The attainment demonstrations relied on photochemical grid modeling, air quality trends and other corroborating weight-of-evidence (WOE) to demonstrate that adopted and mandated control programs within Connecticut and upwind areas were sufficient to enable all areas of the State to achieve attainment of the 1-hour ozone NAAQS by 2007. The attainment demonstration for Greater Connecticut included a technical analysis, showing that overwhelming transport of ozone and ozone precursor emissions (*i.e.*, VOCs and $NO_X$) from upwind areas precluded compliance by that area's required 1999 attainment date, and a request for an extension to 2007. EPA published proposed rulemakings regarding CTDEP's attainment demonstrations on December 16, 1999.[1]

For Greater Connecticut, EPA proposed (in the December 16, 1999 rulemaking) to approve both the 2007 attainment date extension request and the attainment demonstration for the area, contingent upon submittal of an adequate motor vehicle emissions budget that was consistent with attainment. CTDEP submitted the required motor vehicle budgets for Greater Connecticut in February 2000, which were found adequate by EPA on June 16, 2000.[2] As a result, EPA issued final approvals for the 2007 attainment date extension, motor vehicle budgets and attainment demonstration for Greater Connecticut on January 3, 2001.[3]

EPA's December 16, 1999 rulemaking also proposed to approve the ozone attainment SIP for the Southwest Connecticut portion of the New York-Northern New Jersey- Long Island nonattainment area, contingent upon the satisfaction of certain specified conditions. The conditions for SIP approval included: 1) submittal of an adequate 2007 motor vehicle emissions budget consistent with attainment; 2) submittal of measures achieving additional emission reductions identified by EPA as necessary for attainment by 2007 (i.e., the "attainment shortfall"); 3) submittal of an emission reduction rate-of-progress plan for the period from 1999 through 2007; and 4) a commitment to submit the results of a mid-course review of attainment progress by the end of 2003. On July 28, 2000, EPA issued a supplemental notice to the December 16, 1999 rulemaking indicating that a state for which the SIP includes the benefits of EPA's Tier 2 Vehicle and Low Sulfur Gasoline program must commit to revising the 2007 motor vehicle emissions budgets within one year after the official release of EPA's MOBILE6 emissions model.[4] Also, EPA subsequently extended the date for submitting a mid-course review assessing progress towards 1-hour ozone attainment to December 31, 2004, in order to allow inclusion of regional emission reductions resulting from EPA's $NO_X$ SIP Call.[5]

CTDEP addressed EPA's conditional approval of the Southwest Connecticut attainment demonstration with SIP revisions submitted on February 8, 2000 and October 15, 2001, as follows:

- The February 8, 2000 revision included 2007 mobile source budgets, which were subsequently found to be adequate by EPA on June 16, 2000.[6] This SIP revision also included commitments to adopt tighter limits on municipal waste combustor units, to submit additional control measures to address the EPA-identified attainment shortfalls, to revise motor vehicle emission budgets within one year after release of MOBILE6 and to perform a mid-course review by the end of 2003.
- The October 15, 2001 revision included Connecticut's post-1999 rate-of-progress (ROP) plan and associated ROP contingency measures, additional $NO_X$ limits applicable to

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[1] 64 FR 70332 and 64 FR 70348.

[2] 65 FR 37778.

[3] 66 FR 634.

[4] 65 FR 46383.

[5] Wegman, Lydia & Mobley, David, "Mid-Course Review Guidance for the 1-Hour Ozone Nonattainment Areas that Rely on Weight-of-Evidence for Attainment Demonstration," memo to EPA Air Division Directors, March 28, 2002.

[6] 65 FR 37778.

municipal waste combustors adopted in October 2000, a commitment to pursue the adoption of additional control measures to eliminate the EPA-identified shortfall so as to attain the 1-hour ozone standard by November 2007 and a commitment to submit a mid-course review for the Southwest Connecticut and Greater Connecticut nonattainment areas by December 31, 2004.

On December 11, 2001,[7] EPA published final approval of the September 16, 1998 attainment demonstration for Southwest Connecticut, as modified on February 8, 2000, and the additional elements submitted on October 15, 2001.

Two subsequent SIP revisions addressed additional commitments for the nonattainment areas, as follows:

- A June 17, 2003 submission included 2007 MOBILE6.2 motor vehicle emissions budgets for the Southwest Connecticut and Greater Connecticut nonattainment areas. EPA approved these budgets on December 18, 2003[8] and found them adequate for conformity purposes on January 20, 2004.[9]
- A December 1, 2004 submission included additional "shortfall" control measures adopted in 2002, 2003 and 2004 and calculations of the emissions reductions associated with those measures. EPA published approval of the shortfall measures on August 31, 2006.[10]

CTDEP satisfied its final remaining 1-hour ozone SIP commitment with the January 10, 2005 submittal of the Mid-Course Review, which concluded that air quality improvements were on pace to provide for attainment of the 1-hour ozone NAAQS by the 2007 deadline. Table 1.3 summarizes control measures implemented to comply with the 1-hour ozone NAAQS.

## 1.4 Current 8-Hour Ozone NAAQS SIP Requirements

The CAA requires EPA to periodically review (every five years) and revise NAAQS as appropriate to ensure that public health is protected with an adequate margin of safety. Following revisions, states are then required to develop plans to ensure that air quality levels are reduced to below the level of the NAAQS.

### 1.4.1 8-Hour Ozone NAAQS Designations

Prompted by increasing evidence of health effects at lower concentrations over longer exposure periods, EPA promulgated a more stringent ozone health standard in 1997 based on an 8-hour averaging period. The revised NAAQS was established as an 8-hour average of 0.08 ppm. Compliance is determined in an area using the monitor measuring the highest 3-year average of each year's 4th highest daily maximum 8-hour ozone concentration. In February 2001, after extended delays resulting from legal challenges to this new NAAQS, the US Supreme Court upheld the EPA's authority to establish the 8-hour ozone standards. As required by the Courts through a subsequent consent decree with environmental groups, in April 2004 EPA published

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[7] 66 FR 63921.

[8] 68 FR 70437.

[9] 69 FR 2711.

[10] 71 FR 51761.

## Table 1.3: Control Strategies Implemented Statewide in Connecticut to Meet the 1-Hour Ozone NAAQS

| Control Strategy | Pollutant | | Federal Program | State Program | EPA Approval Date | Initial Year of Implementation |
|---|---|---|---|---|---|---|
| | VOC | $NO_X$ | | | | |
| ***Stationary Sources*** | | | | | | |
| Consumer Products | ● | | ● | | 09/11/1998 | 1999 |
| Architectural & Industrial Maintenance Coatings | ● | | ● | | 09/11/1998 | 2000 |
| Autobody Refinishing VOC Limits | ● | | ● | | 09/11/1998 | 1999 |
| Stage I Vapor Recovery at Gasoline Service Stations | ● | | | ● | 10/18/1991 | 1992 |
| Stage II Vapor Recovery at Gasoline Service Stations | ● | | | ● | 12/17/1993 | 1994 |
| VOC RACT | ● | | | ● | 03/21/1984 | 1984 |
| Cutback Asphalt: Increased Rule Effectiveness | ● | | | ● | 10/24/1997 | 1998 |
| Gasoline Loading Racks: Increased Rule Effectiveness | ● | | | ● | 10/24/1997 | 1998 |
| CT $NO_X$ “RACT” Regulation | | ● | | ● | 10/06/1997 | 1994 |
| OTC Phase II $NO_X$ Controls | | ● | | ● | 09/28/1999 | 1999 |
| $NO_X$ Budget Program (EPA $NO_X$ SIP Call) | | ● | | ● | 12/27/2000 | 2003 |
| Municipal Waste Combustor Controls | | ● | | ● | 04/21/2000;12/06/2001 | 2000, 2003 |
| Automotive Refinishing Operations (Spray Guns) | ● | | | ● | 08/31/2006 | 2002 |
| Gasoline Service Stations Stage II & Pressure-Vent Valves | ● | | | ● | 08/31/2006 | 2004, 2005 |
| Portable Fuel Containers | ● | | | ● | 08/31/2006 | 2004 |
| ***Mobile Sources*** | | | | | | |
| Enhanced I/M (ASM 2525 phase-in cutpoints) | ● | ● | | ● | 03/10/99 | 2000 |
| Enhanced I/M (ASM 2525 final cutpoints) | ● | ● | | ● | 10/27/00 | 2004 |
| OBD-II Enhanced I/M | ● | ● | | ● | Awaiting EPA approval | 2004 |
| Reformulated Gasoline - Phase I[4] | ● | ● | ● | | 12/23/91 | 1995 |
| Reformulated Gasoline - Phase II[4] | ● | ● | ● | | 02/16/94 | 2000 |
| Tier 1 Motor Vehicle Controls | ● | ● | ● | | 06/05/91 | 1994 |
| On-board Refueling Vapor Recovery | ● | | ● | | 04/06/94 | 1997-2005 |
| National Low Emission Vehicle Program | ● | ● | ● | | 03/02/98 | 1998 (in CT) |
| Tier 2 Motor Vehicle Controls/Low Sulfur Gasoline | ● | ● | ● | | 2/10/00 | 2004-2008 |
| California Low Emission Vehicle Phase 2 (CALEV2) | ● | ● | ● | ● | Awaiting EPA approval | 2007 |
| Heavy-Duty Diesel Vehicle Controls and Fuels | ● | ● | ● | | 10/06/00 | 2004-2005 |
| Non-Road Engine Standards | ● | ● | ● | | 1994-2000 | 1996-2008 |

final area designations pursuant to CAA section 107(d) and the Transportation Equity Act for the Twenty-first Century (TEA–21) and final area classifications pursuant to CAA sections 172(a) and 181.[11] These determinations became effective on June 15, 2004.

As shown in Figure 1.4.1, Connecticut, along with other states in the Northeast and other areas of the country, was designated as nonattainment by EPA based on measured 8-hour ozone values from the 2001-2003 period. Portions of Connecticut were included in two nonattainment areas. Fairfield, New Haven, and Middlesex Counties were included as part of a moderate 8-hour ozone NAAQS nonattainment area, along with the New York and New Jersey counties that make up the metropolitan New York Consolidated Statistical Area. The remaining five counties in Connecticut were grouped as a separate moderate nonattainment area, known as the Greater Connecticut 8-hour ozone NAAQS nonattainment area.

### 1.4.2 EPA 8-Hour Ozone NAAQS Implementation Rules

EPA published final 8-hour ozone implementation rules in two phases: Phase 1 on April 30, 2004[12] and Phase 2 on November 29, 2005.[13] Those rules require moderate nonattainment areas, such as those in Connecticut, to submit revisions to the SIP that meet the following planning requirements:

- Reasonable Further Progress (RFP): Achieve 15% VOC reduction within 6 years after the baseline year of 2002 (i.e., reductions must occur by 2008). Equivalent $NO_X$ reductions can substitute for any portion of the required VOC reductions.
- Attainment demonstration: Using modeling and other technical analyses to demonstrate that adopted control measures are sufficient to project attainment of the 8-hour NAAQS by the end of the 2009 ozone season.
- New Source Review (NSR) and Reasonably Available Control Technology (RACT) major source applicability: 100 tons/year (tpy) for $NO_X$ and 50 tpy for VOC (CAA Section 184).
- NSR emission offset ratio: 1.15 to 1 for $NO_X$ and VOC.
- NSR permits: Required for new or modified major stationary sources.
- $NO_X$ control for RACT: requirement for major stationary VOC sources also applies to major $NO_X$ sources.
- RACM/RACT: RACT required for all EPA-defined control technique guideline (CTG) sources and all other major sources. Reasonably available control measures (RACM) required for all other sources.
- Basic Inspection and Maintenance (I/M): Required for light-duty motor vehicles.
- Stage II vapor recovery: Required for gas stations with a throughput of at 10,000 or more gallons per month.

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[11] 69 FR 23858.

[12] 69 FR 23951.

[13] 70 FR 71612.

- Transportation conformity budgets: Budgets that are consistent with the attainment plan are required to be established for the RFP year (i.e., 2008) and the attainment year (i.e., 2009).
- Contingency measures: Implementation is required upon failure to meet RFP milestones or attainment.

In addition to prescribing the planning requirements for meeting the 8-hour NAAQS, EPA's ozone implementation rules specified the process for transitioning from the 1-hour to the 8-hour ozone NAAQS. The transition included revocation of the 1-hour NAAQS, effective June 15, 2005, and EPA's approach to preventing backsliding from 1-hour ozone requirements.

Given Connecticut's previous classifications as "severe" (Fairfield County) and "serious" (remainder of the State) for the 1-hour ozone NAAQS, Connecticut's regulations continue to include more stringent requirements pursuant to CAA section 182(d) than are required under the State's current "moderate" 8-hour ozone classification. These more stringent requirements include:

- Lower NSR and RACT point source applicability thresholds of 25 tpy or 50 tpy (depending on location);[14]
- Higher NSR offset ratio requirements of 1.3 to 1 or 1.2 to 1 (depending on location);[15] and
- Lower permit thresholds for point sources of 15 tpy.[16]

### 1.4.3 D.C. Circuit Court Ruling on EPA's Implementation Rule

Responding to a petition originated by the South Coast Air Quality Management District (SCAQMD), the U.S. Court of Appeals for the District of Columbia Circuit issued a ruling on December 22, 2006 vacating the EPA's Phase 1 rule to implement the 8-hour ozone NAAQS.[17] Although the Court upheld EPA's revocation of the 1-hour NAAQS, it ruled that EPA took improper action regarding the 8-hour classification scheme and several anti-backsliding provisions, including the treatment of New Source Review (NSR), section 185 penalties, contingency plans and motor vehicle conformity demonstrations.

On March 22, 2007, EPA submitted a motion requesting rehearing on the Court's decision on the Phase I Ozone Implementation Rule. The motion requests rehearing by the original panel on: 1) classifications; 2) CAA section 172(e) anti-backsliding issues (new source review, section 185 fees, and contingency measures); and 3) the scope of the Court's vacatur. On June 8, 2007 the same Court ruled on EPA's petition and in part stated that it intended to vacate only the parts of the Rule for which it (the Court) had sustained challenges, urging EPA to promptly promulgate a revised rule "that effectuates the statutory mandate…deemed necessary to protect the public health a decade ago."

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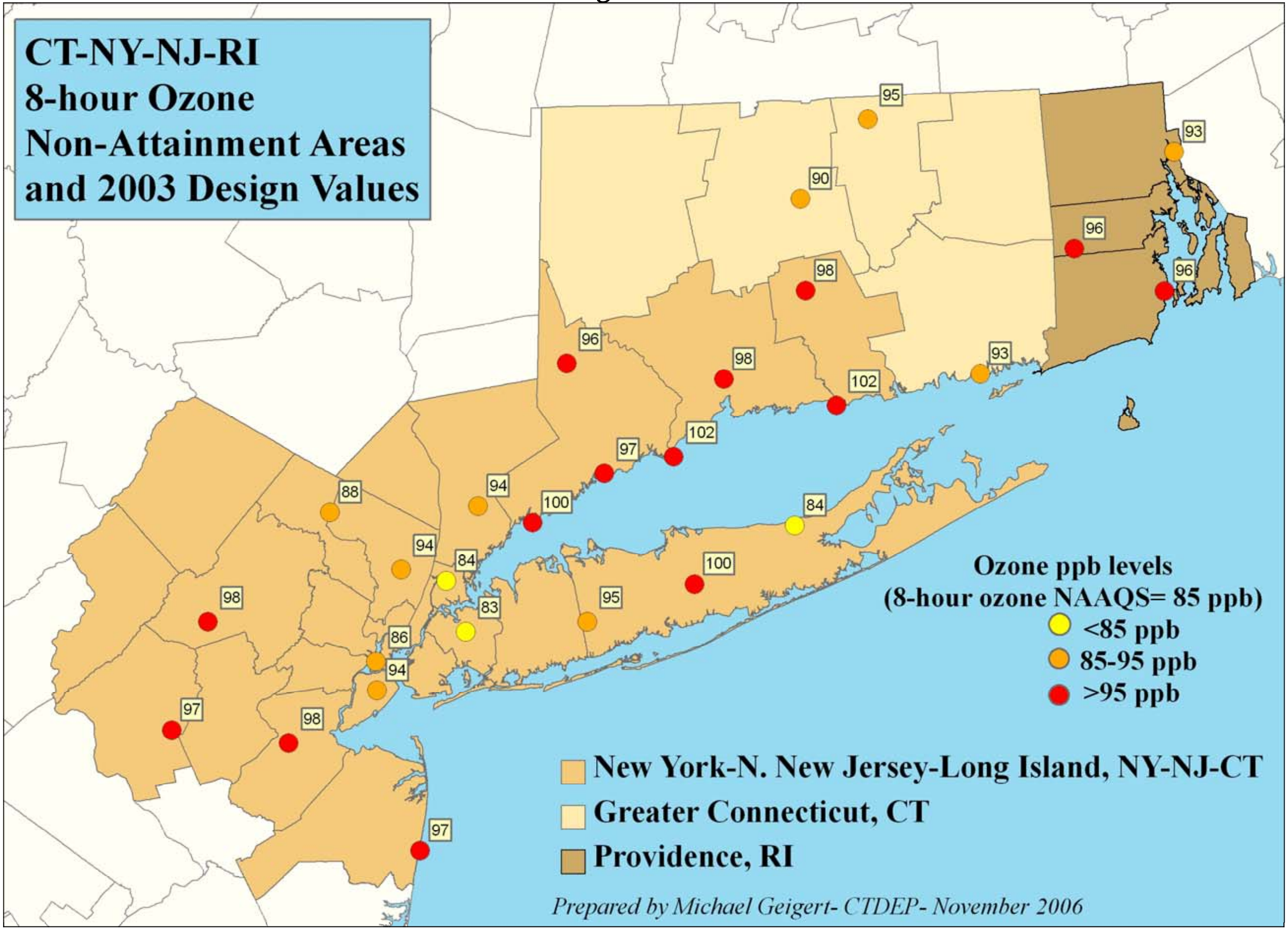
[14] RCSA 22a-174-1(57).

[15] RCSA 22a-174-3a(k)(4)(B)(x).

[16] RCSA 22a-174-3a(a)(1)(D).

[17] 69 FR 23951.

Figure 1.4.1



CT-NY-NJ-RI 8-hour Ozone Non-Attainment Areas and 2003 Design Values

Prepared by Michael Geigert- CTDEP- November 2006

As of this writing, it is unclear how or when this case will be resolved, or how it will impact 8-hour ozone planning requirements for Connecticut. In the interim, CTDEP has assembled this plan based on the requirements specified by EPA in the contested implementation rule. In the future, CTDEP will prepare and submit revisions to this plan, as necessary, to comply with the implementation rule that survives final litigation on this matter.

### 1.5 Summary of Conclusions

As supported by the information described in detail in subsequent sections, CTDEP concludes that 8-hour ozone NAAQS attainment is likely to be achieved by the end of the 2009 ozone season in the five-county Greater Connecticut portion of the State. For the three-county Southwest Connecticut portion of the greater New York City nonattainment area, evidence suggests that there is a credible case for attainment by the end of the 2009 ozone season, with the probability of attainment increasing in subsequent years, as emissions are reduced, such that attainment is highly likely to occur no later than the 2012 ozone season. Because ozone levels in Connecticut are dominated by transport from upwind areas, attainment can be assured in 2009 by securing additional emission reductions from upwind states that contribute to nonattainment in Connecticut.

## 2.0 Nature of the Ozone Air Quality Problem in the Northeast and Connecticut

Despite much progress over the last three decades, ground-level ozone remains a pervasive regional problem in the northeastern United States, with frequent exceedances of the 8-hour ozone NAAQS occurring during hot summer days. In this section, a conceptual overview of the ozone problem is provided from both a regional and local perspective. The regional perspective is extracted directly from a report[1] developed by NESCAUM for the OTC states. The full NESCAUM report is provided as Appendix 2A.

## 2.1 Regional Conceptual Description of the Ozone Problem

The Ozone Transport Region (OTR) of the eastern United States covers a large area that is home to over 62 million people living in Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and northern Virginia. Each summer, the people who live within the OTR are subject to episodes of poor air quality resulting from ground-level ozone pollution that affects much of the region (see Figure 2.1.1). During severe ozone events, the scale of the problem can extend beyond the OTR's borders and include over 200,000 square miles across the eastern United States. Contributing to the problem are local sources of air pollution as well as air pollution transported hundreds of miles from distant sources outside the OTR.

To address the ozone problem, the Clean Air Act Amendments require states to develop State Implementation Plans (SIPs) detailing their approaches for reducing ozone pollution. As part of this process, states are urged by the U.S. Environmental Protection Agency (USEPA) to include in their SIPs a conceptual description of the pollution problem in their nonattainment areas. This document provides the conceptual description of the ozone problem in the OTR states, consistent with the USEPA's guidance.

Since the late 1970s, a wealth of information has been collected concerning the regional nature of the OTR's ground-level ozone air quality problem. Scientific studies have uncovered a rich complexity in the interaction of meteorology and topography with ozone formation and transport. The evolution of severe ozone episodes in the eastern U.S. often begins with the passage of a large high pressure area from the Midwest to the middle or southern Atlantic states, where it assimilates into and becomes an extension of the Atlantic (Bermuda) high pressure system (see Figure 2.1.2). During its passage east, the air mass accumulates air pollutants emitted by large coal-fired power plants and other sources located outside the OTR. Later, sources within the OTR make their own contributions to the air pollution burden. These expansive weather systems favor the formation of ozone by creating a vast area of clear skies and high temperatures. These two prerequisites for abundant ozone formation are further compounded by a circulation pattern favorable for pollution transport over large distances. In

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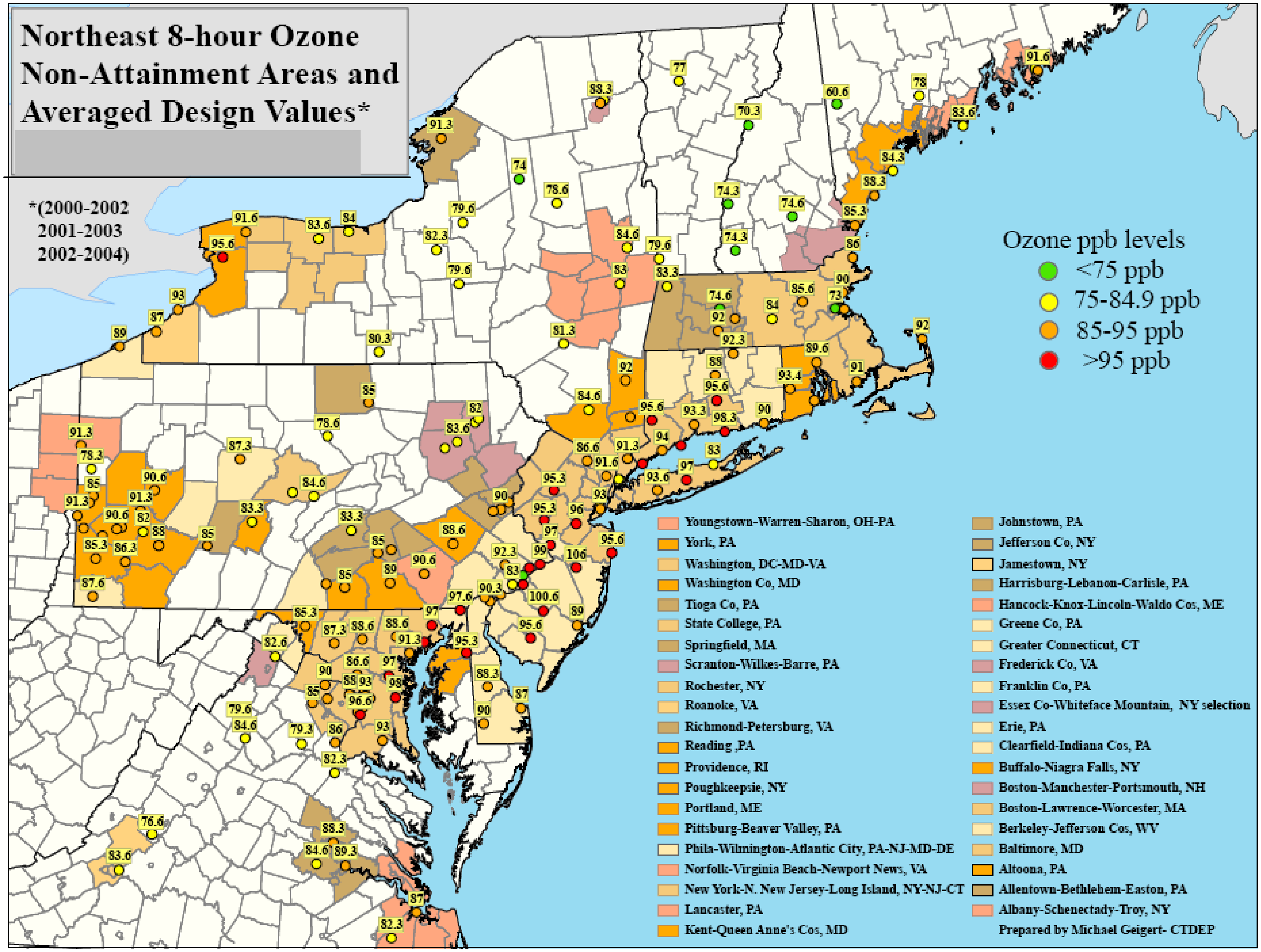
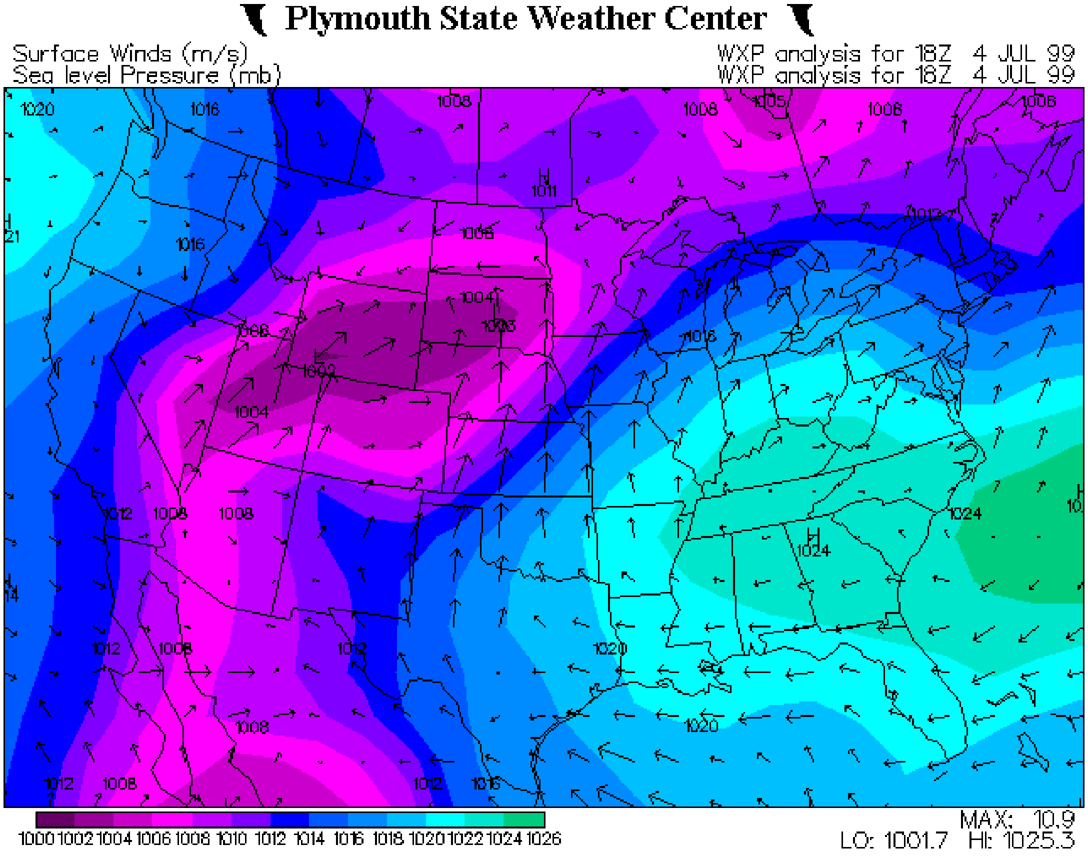
[1] The narrative in Section 2.1 was extracted, verbatim, from the Executive Summary of "The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description," NESCAUM, October 2006. Supplemental figures (as noted in the text) are reproduced from the body of that report. Notes accompanying the figures have been augmented for clarity by paraphrased material from the text. The complete NESCAUM document is provided in Appendix 2A and is available at: http://bronze.nescaum.org/committees/attainment/conceptual/2006-1013b--O3%20conceptual%20model%20draft%20final%20--%20ALL.pdf.

**Figure 2.1.1**



Note: Values shown are the average of the three design values (3-year averages of the 4th maximum 8-hour ozone level) for the set of years 2000-2002, 2001-2003, and 2002-2004. The figure shows the regional nature of ozone levels in the OTR, with a number of closely adjacent nonattainment areas (average design values ≥ 85 ppb) along with a broader region of elevated regional ozone (e.g., average design values ≥ 75 ppb).

**Figure 2.1.2 Typical weather pattern associated with severe ozone episodes in the OTR**



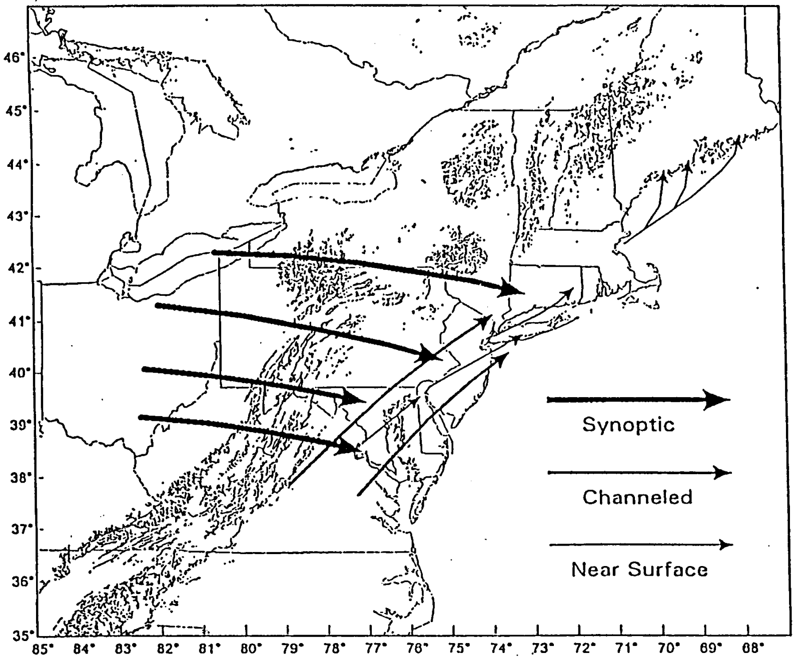
This figure shows the classic synoptic weather pattern at the Earth's surface associated with severe ozone episodes within the OTR. A quasi-stationary high pressure system (the Bermuda high) extends from the Atlantic Ocean westward into interior southeastern U.S., where a second weaker high is located. Surface winds, circulating clockwise around the high, are especially light in the vicinity of the secondary high. Farther north, a southwesterly flow strengthens toward New York and southern New England. This situation illustrates two circulation regimes often existing in OTR ozone episodes: more stagnant conditions in southern areas and a moderate transport flow in the OTR from southwest to northeast. In addition, high pressure systems exhibit subsidence, which results in temperature inversions aloft, and cloud free skies.

the worst cases, the high pressure systems stall over the eastern United States for days, creating ozone episodes of strong intensity and long duration.

One transport mechanism that has fairly recently come to light and can play a key role in moving pollution long distances is the nocturnal low level jet. The jet is a regional scale phenomenon of higher wind speeds that often forms during ozone events a few hundred meters above the ground just above the stable nocturnal boundary layer. It can convey air pollution several hundreds of miles overnight from the southwest to the northeast, directly in line with the major population centers of the Northeast Corridor stretching from Washington, DC to Boston, Massachusetts. The nocturnal low level jet can extend the entire length of the corridor from Virginia to Maine, and has been observed as far south as Georgia. It can thus be a transport mechanism for bringing ozone and other air pollutants into the OTR from outside the region, as well as move locally formed air pollution from one part of the OTR to another.

Other transport mechanisms occur over smaller scales. These include land, sea, mountain, and valley breezes that can selectively affect relatively local areas. They play a vital role in drawing ozone-laden air into some areas, such as coastal Maine, that are far removed from major source regions (see Figure 2.1.3).

**Figure 2.1.3 Conceptual picture of different transport regimes contributing to ozone episodes in the OTR**



Transport Regimes Observed During NARSTO-Northeast

Long-range (synoptic scale) transport occurs from west to east across the Appalachian Mountains. Regional scale transport in channeled flows also occurs from west to east through gaps in the Appalachian Mountains and in nocturnal low level jets from southwest to northeast over the Northeast Corridor. Daytime sea breezes can affect local coastal areas by bringing in air pollution originally transported near the surface across water parallel to the coast (e.g., along the Maine coastline)[2].

With the knowledge of the different transport scales into and within the OTR, a conceptual picture of bad ozone days emerges. After sunset, the ground cools faster than the air above it, creating a nocturnal temperature inversion. This stable boundary layer extends from the ground to only a few hundred meters in altitude. Above this layer, a nocturnal low level jet can form with higher velocity winds relative to the surrounding air. It forms from the fairly abrupt removal of frictional forces induced by the ground that would otherwise slow the wind. Absent this friction, winds at this height are free to accelerate, forming the nocturnal low level jet. Ozone above the stable nocturnal inversion layer is likewise cut off from the ground, and thus it is not subject to removal on surfaces or chemical destruction from low level emissions (see Figure 2.1.4). Ozone in high concentrations can be entrained in the nocturnal low level jet and transported several hundred kilometers downwind overnight. The next morning as the sun heats

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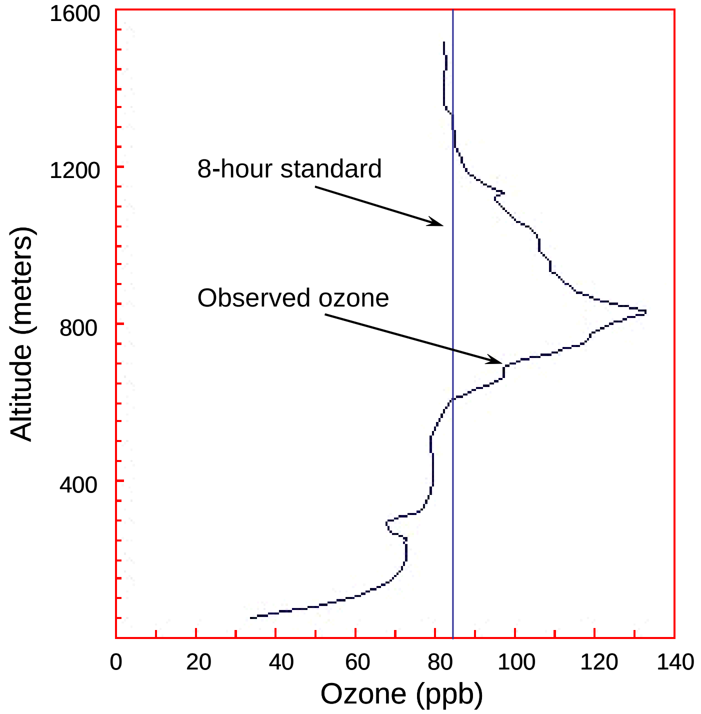
[2] NARSTO. *An Assessment of Tropospheric Ozone Pollution*. NARSTO, July 2000.

**Figure 2.1.4 Observed vertical ozone profile measured above Poughkeepsie, NY at about 4 a.m. EST on July 14, 1995**



Note: The figure includes a vertical line at 85 ppb for comparing aloft measurements with the 8-hour ozone NAAQS[3]. Elevated ozone levels aloft can be entrained in the nocturnal low level jet and transported several hundred kilometers downwind overnight. The next morning as the sun heats the Earth's surface, the nocturnal boundary layer begins to break up, and the ozone transported overnight mixes down to the surface where concentrations rise rapidly through the afternoon, partly from mixing and partly from ozone generated locally.

the Earth's surface, the nocturnal boundary layer begins to break up, and the ozone transported overnight mixes down to the surface where concentrations rise rapidly, partly from mixing and partly from ozone generated locally. By the afternoon, abundant sunshine combined with warm temperatures promotes additional photochemical production of ozone from local emissions. As a result, ozone concentrations reach their maximum levels through the combined effects of local and transported pollution.

Ozone moving over water is, like ozone aloft, isolated from destructive forces. When ozone gets transported into coastal regions by bay, lake, and sea breezes arising from afternoon temperature contrasts between the land and water, it can arrive highly concentrated.

During severe ozone episodes associated with high pressure systems, these multiple transport features are embedded within a large ozone reservoir arriving from source regions to the south and west of the OTR. Thus a severe ozone episode can contain elements of long range air pollution transport from outside the OTR, regional scale transport within the OTR from channeled flows in nocturnal low level jets, and local transport along coastal shores due to bay, lake, and sea breezes.

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[3] Observed ozone data from Zhang J. and S.T. Rao. "The role of vertical mixing in the temporal evolution of ground-level ozone concentrations." *J. Applied Meteor.* **38**, 1674-1691, 1999.

From this conceptual description of ozone formation and transport into and within the OTR, air quality planners need to develop an understanding of what it will take to clean the air in the OTR. Weather is always changing, so every ozone episode is unique in its specific details. The relative influences of the transport pathways and local emissions vary by hour and day during the course of an ozone episode and between episodes. The smaller scale weather patterns that affect pollution accumulation and its transport underscore the importance of local (in-state) controls for emissions of nitrogen oxides ($NO_X$) and volatile organic compounds (VOCs), the main precursors of ozone formation in the atmosphere. Larger synoptic scale weather patterns, and pollution patterns associated with them, support the need for $NO_X$ controls across the broader eastern United States. Studies and characterizations of nocturnal low level jets also support the need for local and regional controls on $NO_X$ and VOC sources as locally generated and transported pollution can both be entrained in nocturnal low level jets formed during nighttime hours. The presence of land, sea, mountain, and valley breezes indicate that there are unique aspects of pollution accumulation and transport that are area-specific and will warrant policy responses at the local and regional levels beyond a one-size-fits-all approach.

The mix of emission controls is also important. Regional ozone formation is primarily due to $NO_X$, but VOCs are also important because they influence how efficiently ozone is produced by $NO_X$, particularly within urban centers (see Figures 2.1.5 and 2.1.6). While reductions in anthropogenic VOCs will typically have less of an impact on the long-range transport of ozone, they can be effective in reducing ozone in urban areas where ozone production may be limited by the availability of VOCs. Therefore, a combination of localized VOC reductions in urban centers with additional $NO_X$ reductions across a larger region will help to reduce ozone and precursors in nonattainment areas as well as downwind transport across the entire region.

**Figure 2.1.5 2002 MANE-VU state VOC inventories in the OTR**

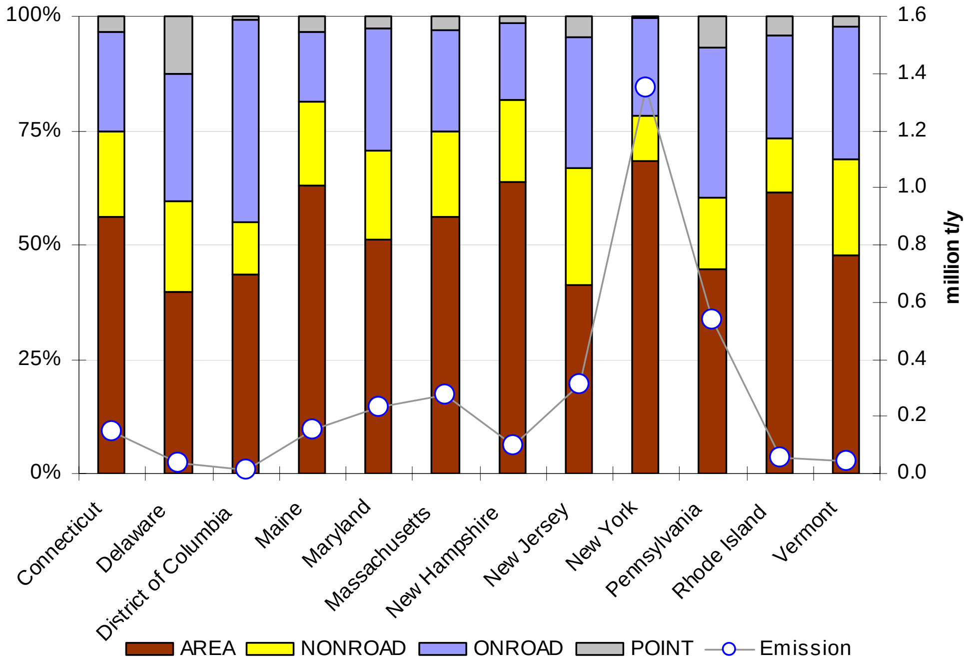

Figure key: Bars = Percentage fractions of four source categories; Circles = Annual emissions amount in $10^6$ tons per year. The Virginia portion of the Washington, DC metropolitan area is not shown in the figure.

**Figure 2.1.6 2002 MANE-VU state $NO_X$ inventories in the OTR**

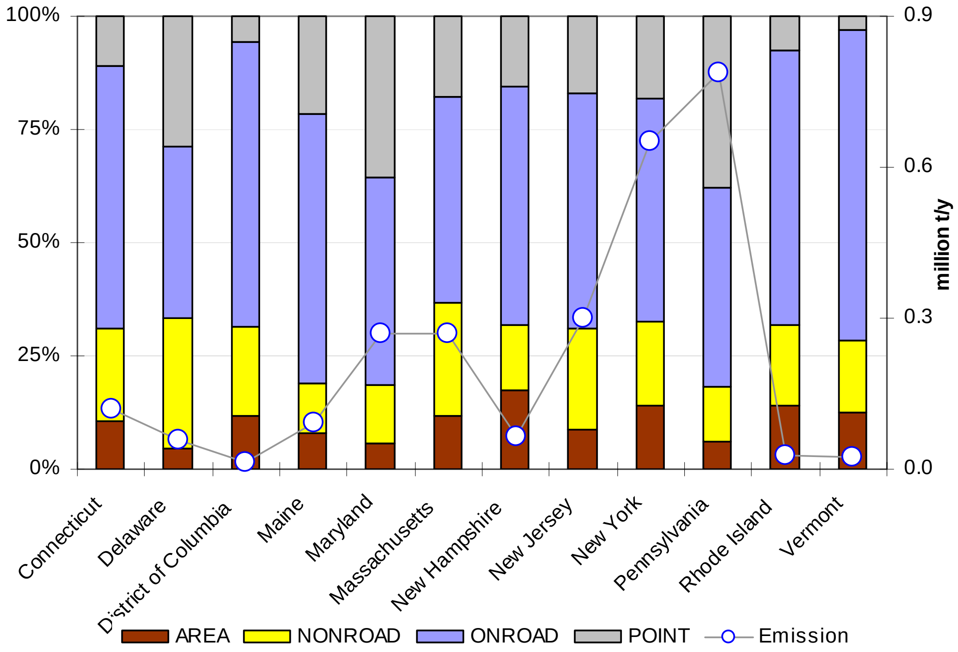

Figure key: Bars = Percentage fractions of four source categories; Circles = Annual emissions amount in $10^6$ tons per year. The Virginia portion of the Washington, DC metropolitan area is not shown in the figure.

The recognition that ground-level ozone in the eastern United States is a regional problem requiring a regional solution marks one of the greatest advances in air quality management in the United States. During the 1990s, air quality planners began developing and implementing coordinated regional and local control strategies for $NO_X$ and VOC emissions that went beyond the previous emphasis on urban-only measures. These measures have resulted in significant improvements in air quality across the OTR. Measured $NO_X$ emissions and ambient concentrations have dropped between 1997 and 2005, and the frequency and magnitude of ozone exceedances have declined within the OTR. To maintain the current momentum for improving air quality so that the OTR states can meet their attainment deadlines, there continues to be a need for more regional $NO_X$ reductions coupled with appropriate local $NO_X$ and VOC controls.

## 2.2 A Connecticut Perspective on the Regional Ozone Problem

Although all of the states in the OTR are affected to some degree by ozone transport, Connecticut's location in relation to upwind emissions sources and ozone-favorable meteorological regimes makes the state particularly vulnerable to levels of transport that at times exceed the 8-hour ozone NAAQS. In addition to NESCAUM's regional conceptual description summarized above (and NESCAUM's full report in Appendix 2A), Appendix 2B provides a more focused examination of the role that transport plays in Connecticut's 8-hour ozone problem. Highlights of that analysis are presented below.

### 2.2.1 Meteorological Regimes Producing High Ozone in Connecticut

Ozone exceedances in Connecticut can generally be classified into four categories based on spatial patterns of measured ozone and the contributing meteorological conditions. Typically, most exceedances occur on sunny summer days with inland maximum surface temperatures approaching or above 90°F, surface winds from the south and west (favorable for transport of pollutants from the Northeast Megalopolis) and aloft winds from the west-southwest to west-northwest (favorable for transport of pollutants from Midwest power plants). Figures 2.1.2 and 2.1.3 above illustrate some of the meteorological conditions and wind patterns associated with the unique characteristics for each of the four common transport regimes discussed below.

- **Inland-only Exceedances:** Ozone is transported aloft from the west and mixed down to the surface as daytime heating occurs. At times, transport from the southwest can also occur overnight at lower levels aloft due the formation of a nocturnal jet. Strong southerly surface winds during the day bring in clean maritime air from the Atlantic Ocean, resulting in relatively low ozone levels along the coast. The maritime front may not penetrate very far inland, allowing transported and local pollutants to contribute to inland exceedances.
- **Coastal-only Exceedances:** Strong westerly surface winds transport dirty air down Long Island Sound from source regions to the west (e.g., New York and New Jersey). The relatively cool waters of Long Island Sound confine the pollutants in the shallow and stable marine boundary layer. Afternoon heating over coastal land creates a sea breeze with a southerly component, resulting in ozone exceedances along the coast. Inland winds from the west prevent sea breeze penetration and can sometimes contribute to the formation of convergence zone that can further concentrate ozone along the coast.
- **Western Boundary-only Exceedances:** Southerly maritime surface flow invades the eastern two-thirds of Connecticut, keeping ozone levels in that portion of the state clean. The south-southwest urban winds out of New York City result in exceedances along Connecticut's western boundary. Winds aloft are often weak for this scenario.
- **Statewide Exceedances:** This is the classical worst-case pattern, with flow at the surface in the Northeast up the Interstate-95 corridor, transport at mid-levels also from the southwest via the low level jet and flow at upper levels from the west. All of these flows are from emission-rich upwind areas, serving to transport ozone precursors and previously formed ozone into Connecticut.

### 2.2.2 Modeling Evidence of Ozone Transport

Modeling conducted by the New Hampshire Department of Environmental Services (NHDES) for the OTR states and by EPA in support of the Clean Air Interstate Rule (CAIR) illustrates the overwhelming level of ozone transport affecting Connecticut.

- **NHDES CALGRID Modeling:** NHDES provided California Photochemical Grid Model (CALGRID) simulations to investigate the effects emissions from each state have on ozone levels in downwind states (i.e., "zero-our" runs). Although CALGRID is not considered to be a SIP-quality modeling tool and has a tendency to predict higher ozone levels than the SIP-quality CMAQ modeling system, CALGRID simulations are less resource-intensive than CMAQ analyses and can provide useful information on the relative contributions of source areas and the relative effectiveness of control strategies.

CALGRID zero-out runs indicate that upwind states have a much greater influence on ozone levels in Connecticut than in-state emissions. When anthropogenic emissions from New York, New Jersey and Pennsylvania are "zeroed-out", CALGRID modeled ozone levels in Connecticut improve by as much as 35 ppb, compared to an estimated maximum impact from Connecticut's in-state emissions of less than 15 ppb. Given how close Connecticut is to full attainment in 2009 according to the SIP-quality CMAQ modeling (see Section 8.4), additional regional emission reduction measures in upwind states, such as the high electric demand day (HEDD) initiative (see Section 8.5.5), would provide greater confidence regarding projected attainment.

- **EPA CAIR Modeling:** EPA's CAIR program is intended to reduce interstate transport of ozone using market-based incentives targeted at electric generating units (EGUs). As more fully described in Connecticut's recent SIP revision satisfying Section 110(a)(2)(D) requirements,[4] EPA's modeling analysis[5] for CAIR identified eight upwind states as contributing significantly to 8-hour ozone NAAQS nonattainment in Connecticut (i.e., NY, PA, NJ, OH, VA, MD/DC, WV, MA). The analysis showed that Connecticut is the only state subject to transport exceeding 90% of projected 2010 ozone levels, illustrating the unique and overwhelming influence upwind emissions have on Connecticut's prospects for achieving timely attainment. EPA's CAIR modeling estimates that almost two-thirds of the transport affecting Connecticut results from emissions from the three states of New York, Pennsylvania and New Jersey.

  Despite EPA's stated goals for the CAIR program, the modeling predicts that improvements due to CAIR will be inconsequential in Connecticut when compared to the overwhelming levels of transport from upwind areas that cannot be addressed by in-state controls. EPA's modeling predicts that emission reductions from CAIR in 2010 will reduce transported ozone to Connecticut's by well less than one percent of the total transport affecting the state. These results suggest that the levels of transport after CAIR implementation will remain large enough that the prospects for 2009 attainment may be in jeopardy without additional upwind emission reductions from such programs as the HEDD initiative being pursued by several Northeast states. Results also indicate that upwind states will continue to contribute significantly to any residual nonattainment in Connecticut in 2009, highlighting the need for EPA to ensure that the remaining significant contributions are properly addressed in the ozone attainment demonstrations submitted by states upwind of Connecticut.

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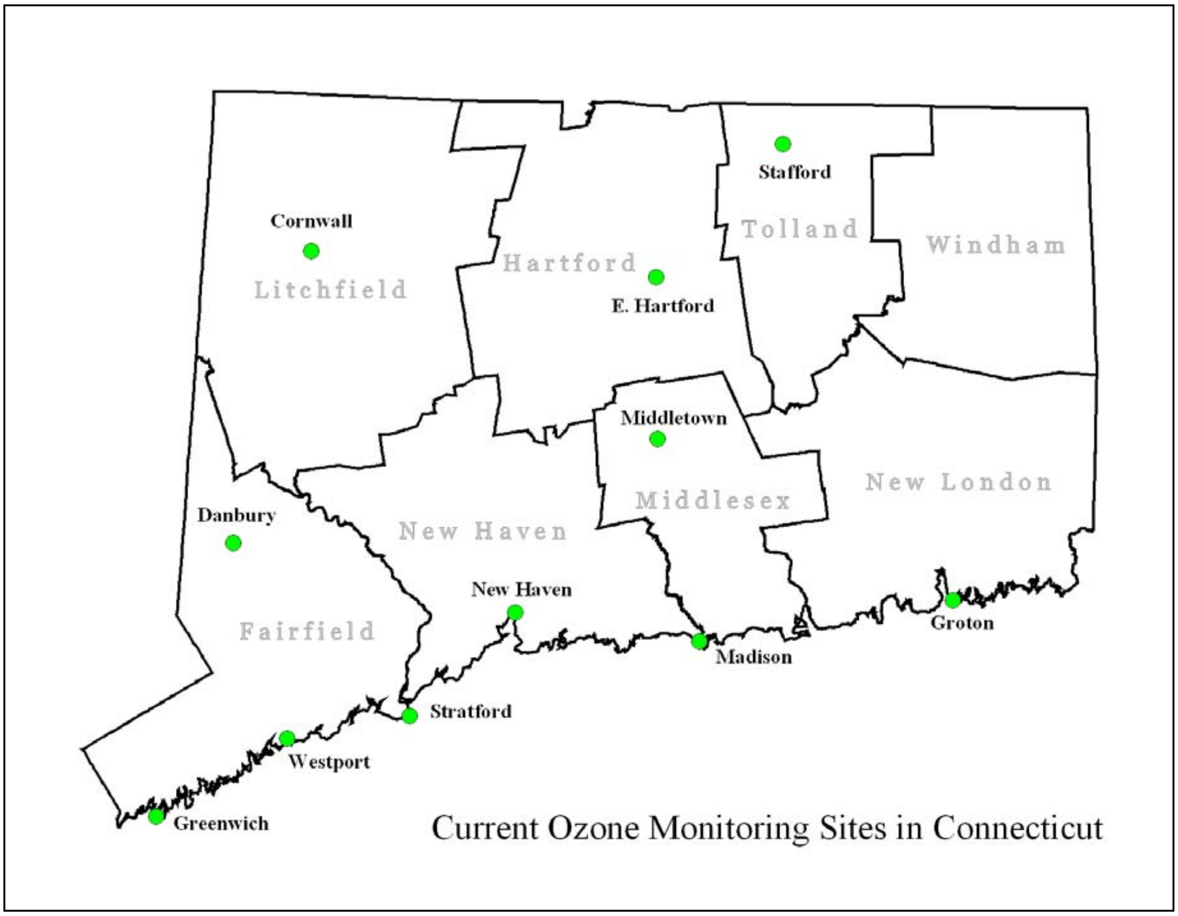
[4] "Revision to Connecticut's State Implementation Plan: Meeting the Interstate Air Pollution Transport Requirements of Clean Air Act Section 110(a)(2)(D)(i)"; Submitted to EPA on March 13, 2007; See: http://www.ct.gov/dep/lib/dep/air/regulations/proposed_and_reports/revsipsec110appendix.pdf.

[5] "Technical Support Document for the Final Clean Air Interstate Rule: Air Quality Modeling"; US EPA OAQPS; March 2005; See: http://www.epa.gov/cleanairinterstaterule/pdfs/finaltech02.pdf.

## 3.0 Ozone Air Quality Levels in Connecticut and Recent Trends

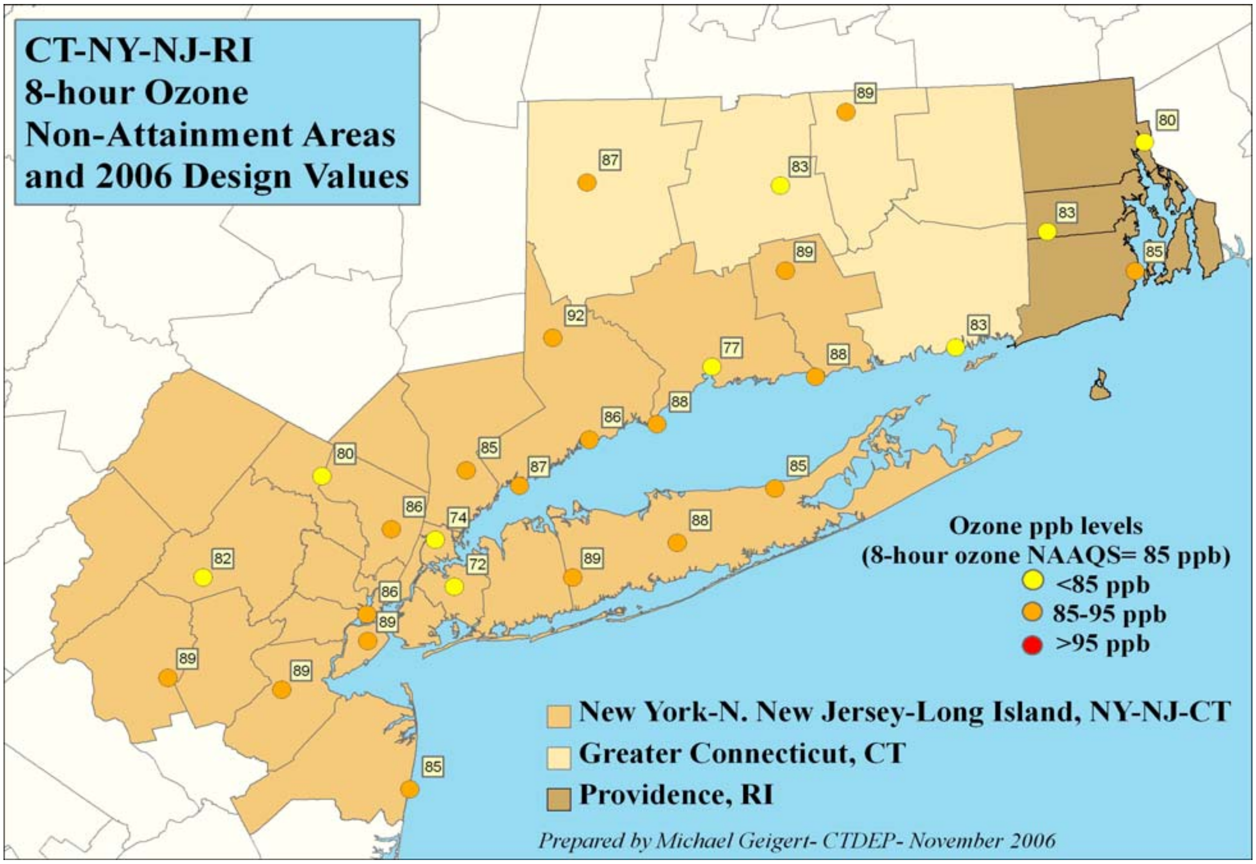
The CTDEP has been monitoring ambient ozone levels throughout the state since the early 1970s. The current network consists of the eleven sites depicted on the map in Figure 3.0.1. In addition to ozone monitoring, since 1994 Connecticut has operated up to four Photochemical Assessment Monitoring Stations (PAMS) to collect ambient concentrations of volatile organic compounds (VOCs), carbon monoxide (CO) and nitrogen oxides (NO and $NO_2$, which are referred to as $NO_X$).

**Figure 3.0.1: Connecticut Ozone Monitoring Sites in 2007**



The form of the 8-hour ozone standard is the three-year average of the fourth highest 8-hour ozone levels for each year. Compliance with the standard is achieved when this “design value” is less than 0.08 parts per million (which equates to 85 parts per billion, or ppb, using standard round-off convention). Figure 3.0.2 shows the 2006 design values and 8-hour ozone nonattainment area boundaries in Connecticut, New York, New Jersey and Rhode Island. Many locations throughout the area exceed the level of the standard and therefore continue to be considered nonattainment with respect to the 8-hour ozone NAAQS.

**Figure 3.0.2: 8-hour Ozone Nonattainment Areas in Connecticut, New York, New Jersey and Rhode Island and Associated 2006 Design Values**



## 3.1 8-Hour Ozone Trends

Ozone levels over the monitoring period of record have improved dramatically, corresponding to the large decreases in ozone precursor emissions from sources in Connecticut and from states upwind from Connecticut.[1]

### 3.1.1 Trends in Design Values

The trends in design values for each site in the Greater Connecticut and Southwest Connecticut portion of NY/NJ/CT nonattainment area are plotted in Figures 3.1.1.1 and 3.1.1.2 respectively**.** The Maximum design values in the Greater Connecticut non-attainment area have decreased by approximately 40% since the mid 1980s, from over 140 ppb to about 85 ppb in 2006. Similarly, the maximum design value in the Southwest Connecticut portion of NY/NJ/CT non-attainment area has decreased from over 155 ppb in 1983 to 90 ppb in 2006.[2]

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[1] Note that the ozone data set used in the analyses in this report does not include ozone levels recorded on July 9, 2002, which have been excluded due to the influence of a northern Quebec forest fire episode. Many other states in the Northeast have similarly flagged data during this episode as an exceptional event.

[2] Note: Five sites were operational in 1983 and seven sites in 2006.

**Figure 3.1.1.1: Greater Connecticut Ozone Non-Attainment Area**
**8-Hour Ozone Design Value Trends**

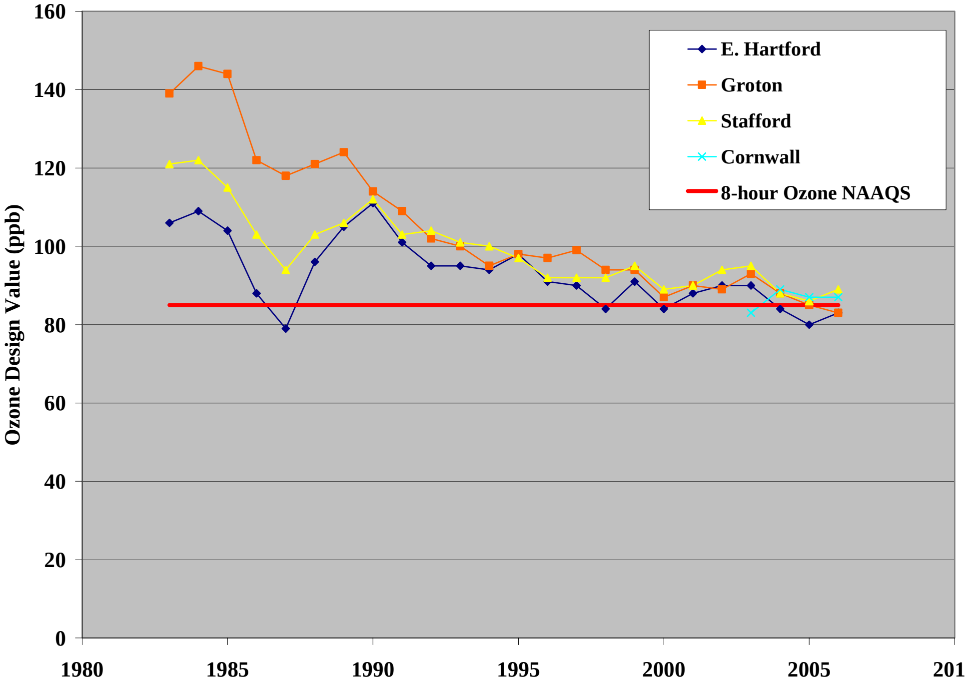
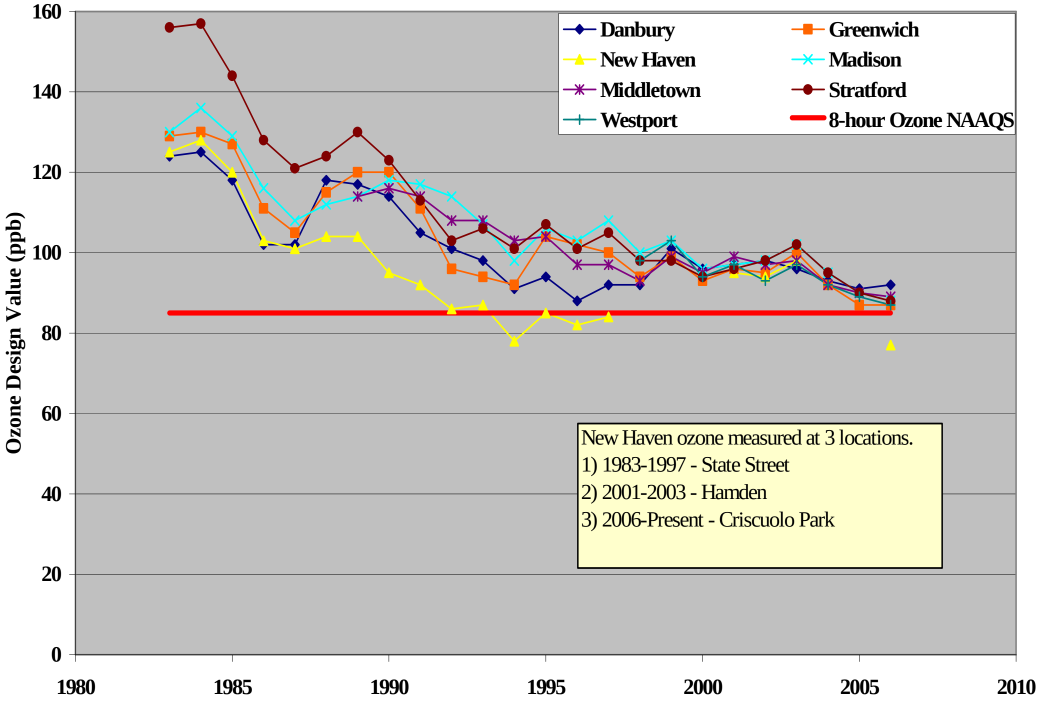


**Figure 3.1.1.2: Southwest Connecticut Portion of NY/NJ/CT Ozone Non-Attainment Area**
**8-Hour Ozone Design Value Trends**



New Haven ozone measured at 3 locations.
1) 1983-1997 - State Street
2) 2001-2003 - Hamden
3) 2006-Present - Criscuolo Park

### 3.1.2 Trends in Exceedance Days

An exceedance day for the 8-hour ozone NAAQS is defined as a day, measured from midnight to midnight, on which any one or more monitors in the state record an 8-hour ozone concentration greater than or equal to 85 ppb. The statewide total number of exceedance days measured in Connecticut from 1975 through 2006 is shown in Figure 3.1.2. The number of exceedance days has decreased dramatically from a high of 84 in 1983 to 13 in 2006.

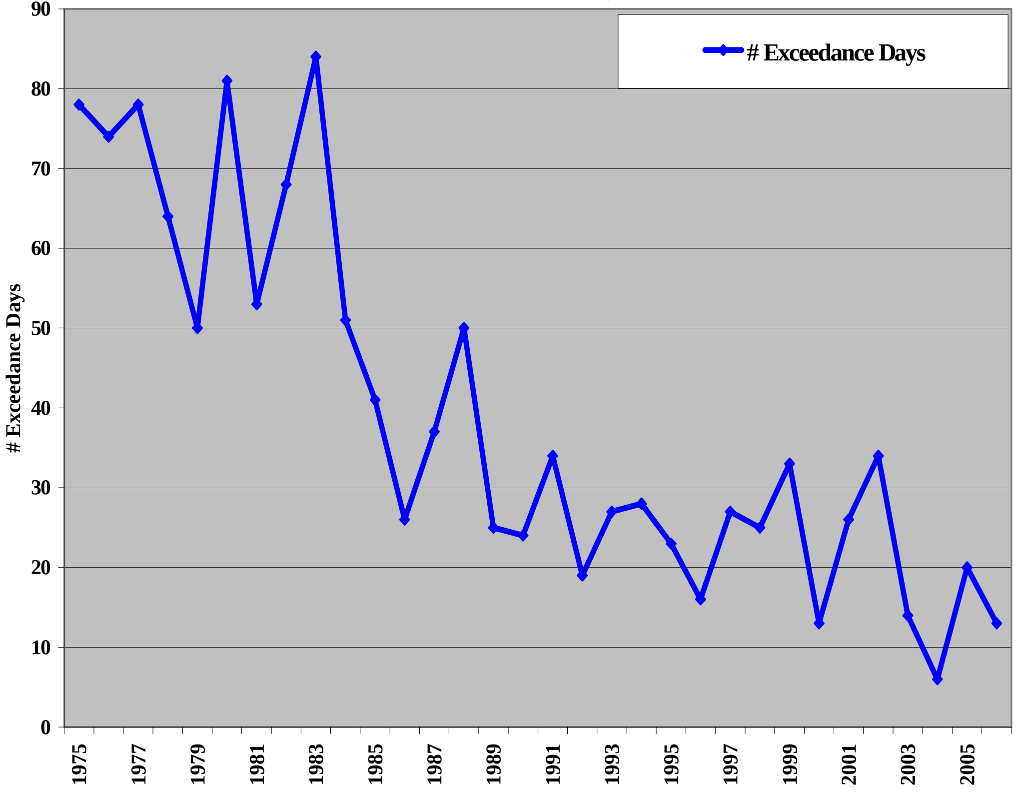
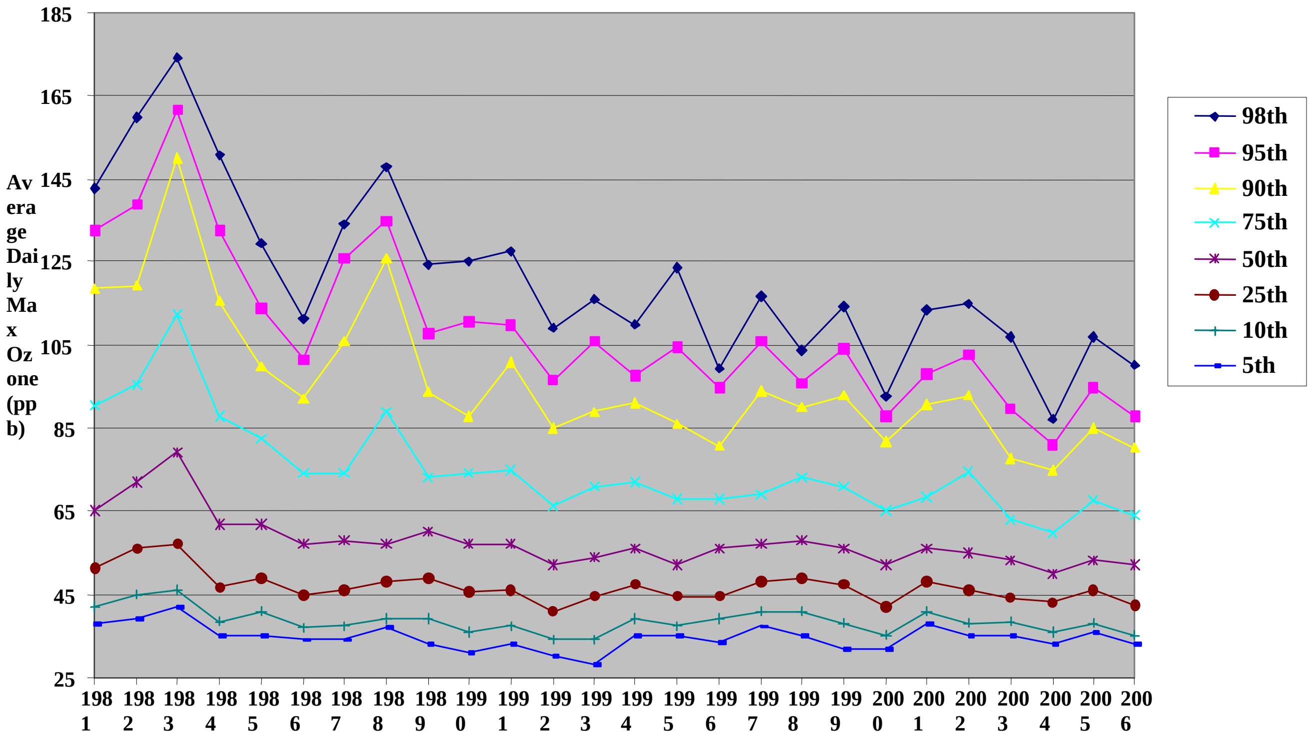


Figure 3.1.2: Trends in Connecticut 8-hr O3 Exceedance Days 1975-2006

### 3.1.3 Trends in 8-hour Ozone Percentiles

The trends addressed previously focused on the very highest ozone concentrations measured at Connecticut monitors. Another way of looking at long-term trends is to plot the full distribution of concentrations including the lowest to the highest percentiles measured during the ozone-monitoring season. Figure 3.1.3 displays such a distribution. It shows that the trend of median values (50th percentiles) and the highest percentiles of ozone levels are consistently downward for the last 25 years. For example, the 90th percentile 8-hr ozone levels were as high as 150 ppb in 1983 but were only 80 ppb in 2006. Meanwhile, the lowest percentiles (representing the lowest 5 and 10 % of ozone levels) do not show a very discernable downward trend.

**Figure 3.1.3: Connecticut**
**Average of Statewide Daily Maximum 8-Hour Ozone**
**Binned by Percentile for Each Year 1981 Through 2006**



### 3.1.4 Meteorological Influences on Ozone Levels

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

Meteorological data from Bradley International Airport (Windsor Locks, CT) were used to examine the year-to-year relationship between the frequencies of high ozone and high temperature days in Connecticut. Figure 3.1.4.1 shows the trend from 1981 through 2006 of average of statewide daily maximum 8-hour ozone levels binned by daily maximum temperature. It shows that, the highest ozone levels occur on the hottest days (days with maximum temperatures above 90 degrees Fahrenheit) and the trend of high ozone on the hottest days is downward. The trend of ozone on days with high temperatures below 80 degrees is fairly flat.

**Figure 3.1.4.1: Connecticut**
**Average of Statewide Daily Maximum 8-Hour Ozone**
**Binned by Temperature**

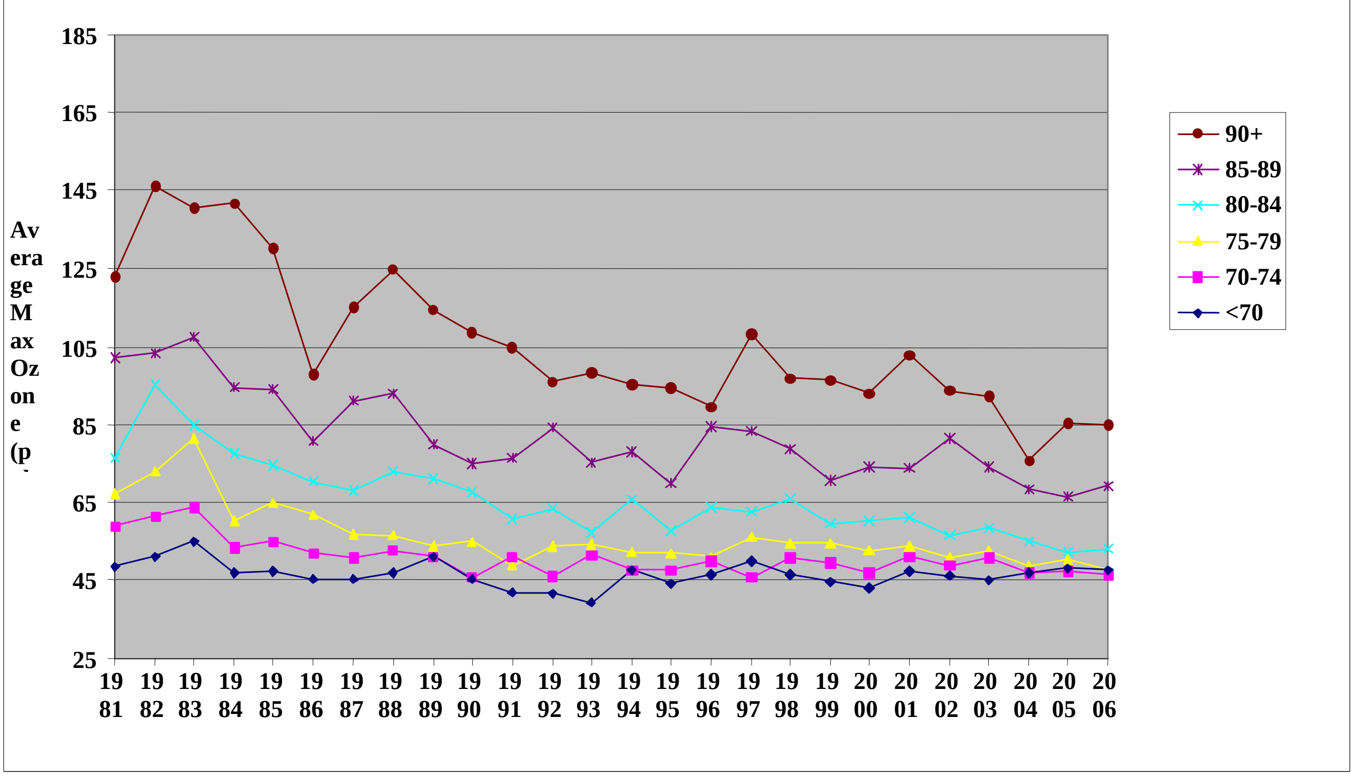
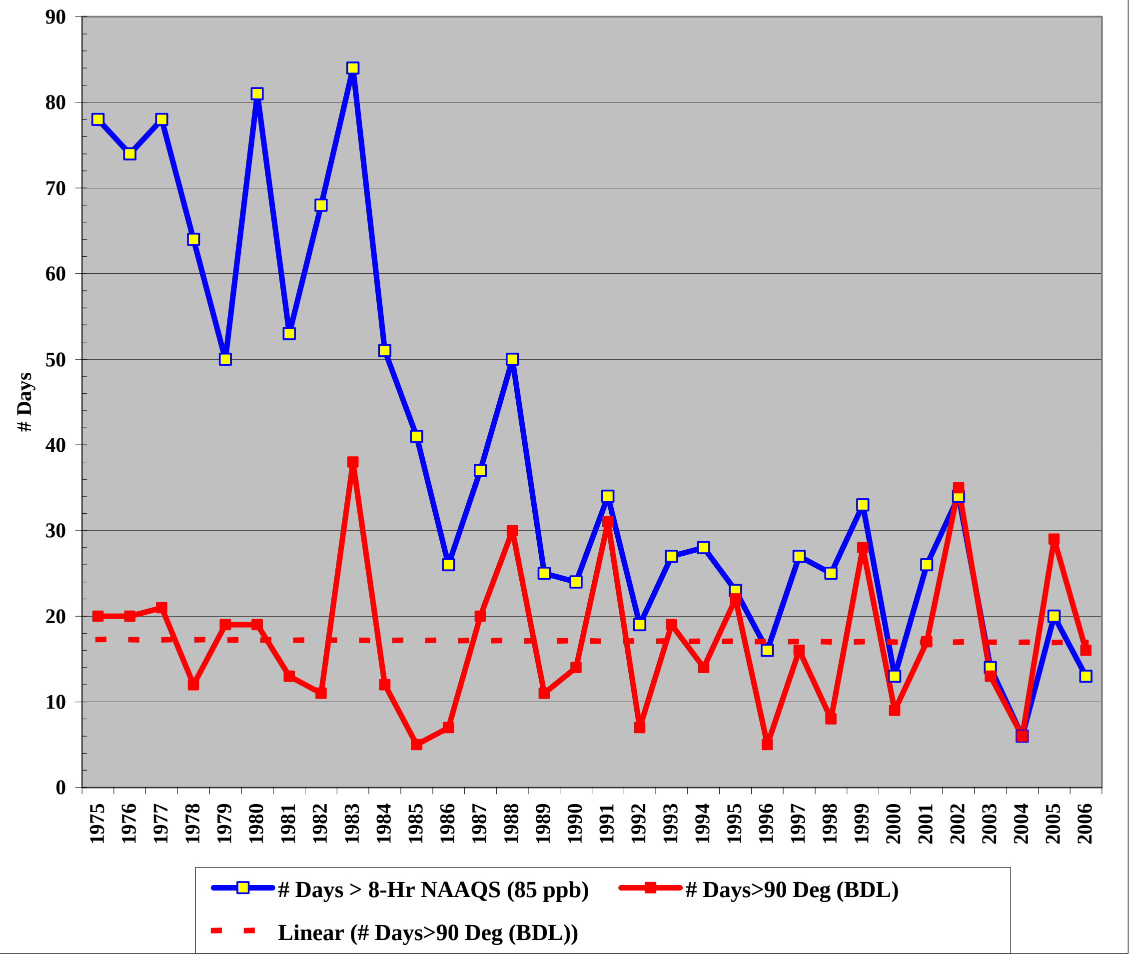


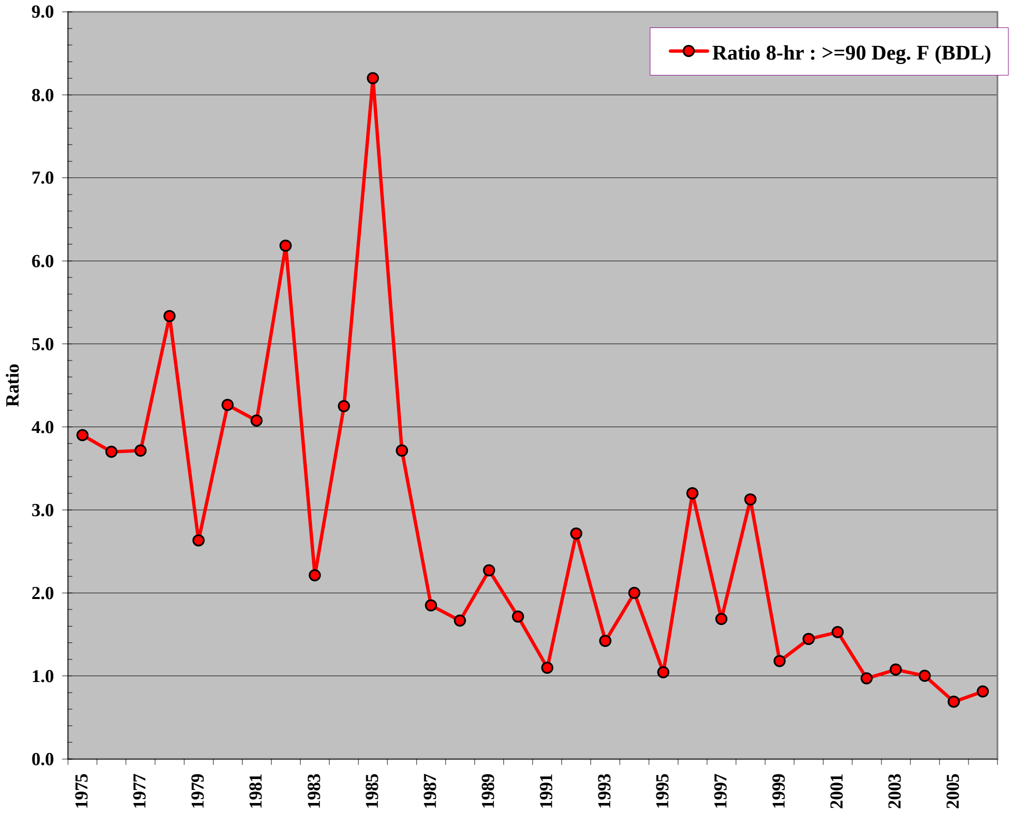
Figure 3.1.4.2 is a plot of the number of exceedance days in Connecticut for the period from 1975 through 2006 superimposed on the number of “hot” days, that is, days with maximum temperatures of 90˚F or above. Although the number of high ozone days tends to track up and down with the number of hot days, the frequency of high ozone days has decreased over time, even for years with similar numbers of hot days. Compared to the 20-year average of 17 hot days, the years 1983, 1988, 1991, 1999, 2002 and 2005 all were hot years with 28 to 38 days of 90˚F or higher temperatures. The number of exceedance days for those years, 84, 50, 34, 33, 34 and 12, respectively, exemplifies the declining trend.

**Figure 3.1.4.2: Connecticut 8-Hour Ozone Exceedance Days vs. "Hot" Days**



The decline in ozone exceedances after adjusting for temperature effects is shown more clearly in Figure 3.1.4.3**,** which depicts the ratio of exceedance days ("unhealthy" days) to the number of hot days for each ozone season from 1975 through 2006. There were 2.2 to 8 times more exceedance days than hot days during the first ten years of the period (1975 to 1985). Ratios subsequently decreased to levels closer to one exceedance day per each hot day through the early 1990s and have continued to decline to 1.1 or lower since 2002. In 2006, the ratio was 0.81, with 13 exceedance days versus 16 hot days during the ozone season.

**Figure 3.1.4.3: Connecticut Statewide 8-Hour Ozone Standard Ratio of "Unhealthy" to "Hot" Days through 2006**



## 3.2 VOC and $NO_X$ Trends

Ozone is formed when $NO_X$ and VOCs react in the presence of sunlight. Dozens of VOC species can be present in the atmosphere influencing the ozone formation process. Section 182(c)(1) of the CAA directed EPA to promulgate rules (40 CFR 58) that would require states to establish Photochemical Assessment Monitoring Stations (PAMS) as part of their monitoring networks in serious, severe or extreme ozone nonattainment areas. CTDEP established PAMS sites during the mid-1990s that are currently operating in Westport (Sherwood Island), New Haven and East Hartford (*see* Figure 3.0.1 for locations).

PAMS data collection includes ambient concentrations of 55 VOC species, CO, NO, $NO_2$, and other $NO_X$ species. The federal objectives of this program include providing a speciated ambient air database that is both representative and useful for ascertaining ambient profiles and distinguishing among various individual VOCs and characteristics of source emission impacts. In furtherance of these objectives, the Northeast States for Coordinated Air Use Management (NESCAUM) contracted with Sonoma Technology, Inc. in 2002 to collect, organize and validate data from 2000 for all the NESCAUM PAMS sites and evaluate control program effectiveness in the NESCAUM region.[3]

Figure 3.2.1 is a plot of the average monthly $NO_X$ concentrations from 1997 to 2005. $NO_X$ concentrations are at their highest levels in the winter months and lowest in the summer months. The trend in $NO_X$ concentrations during the ozone season (May to September) has been downward from 1997 to 2005.

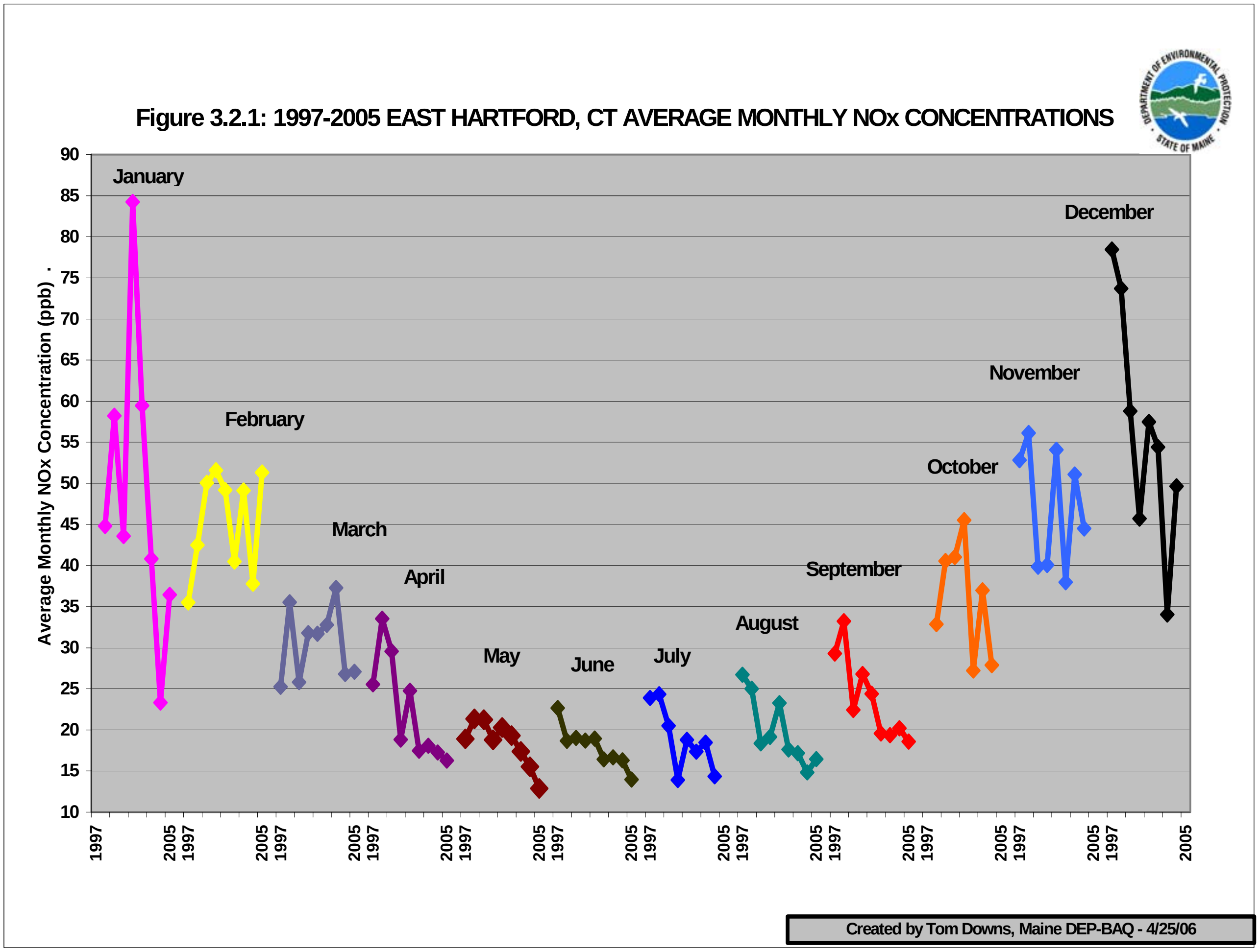


Figure 3.2.1: 1997-2005 EAST HARTFORD, CT AVERAGE MONTHLY NOx CONCENTRATIONS

Created by Tom Downs, Maine DEP-BAQ - 4/25/06

Figure 3.2.2 supplements the aforementioned analysis to include the trends of Total Non-Methane Organic Carbon (TNMOC) and $NO_X$ from the East Hartford site for the summer months of June, July and August from 1997 to 2006. Over the eight-year period covered in the analysis, the trend shows reductions in the average monthly concentration for both $NO_X$ and TNMOC.

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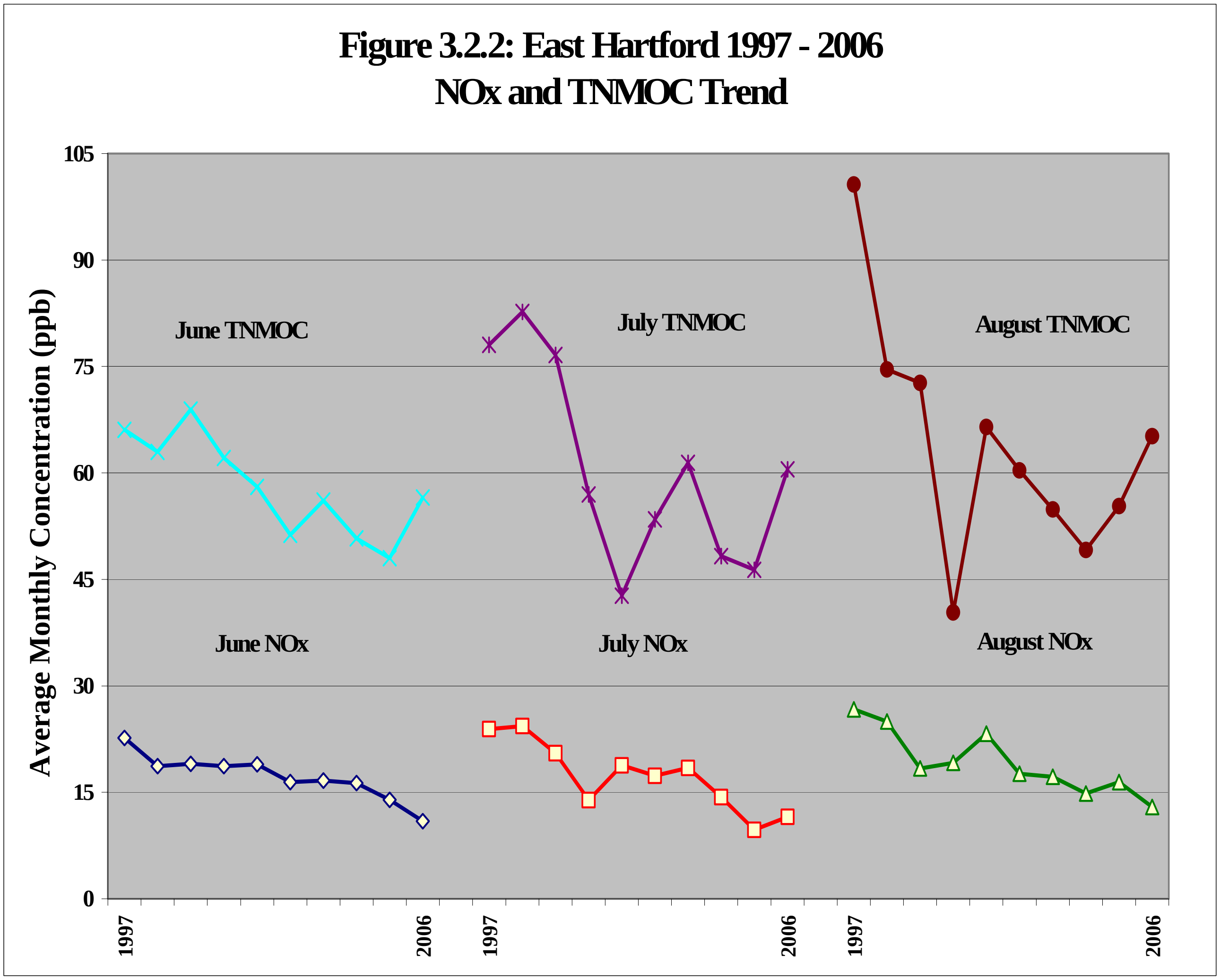
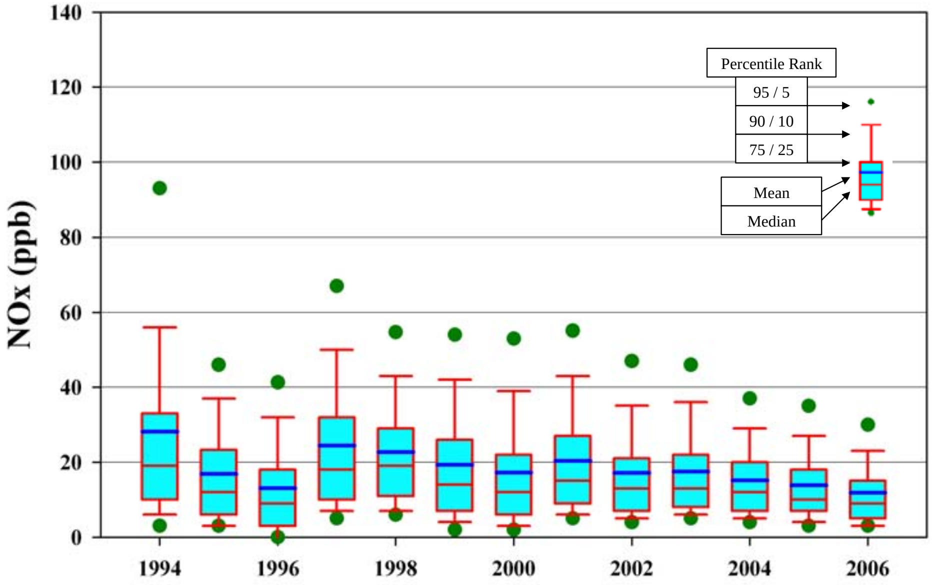
[3] The results of this effort may be obtained at: http://www.nescaum.org/projects/pams/part2/index.html.



Figures 3.2.3 to 3.2.6 show the trend in $NO_X$ and TNMOC measured at the Westport Sherwood Island and East Hartford McAuliffe Park monitoring locations where 11 and 13 years of ambient data have been collected, respectively. Over the course of data collection the concentrations of $NO_X$ and TNMOC at each site have trended downward. It should be noted that the East Hartford site was moved closer to Route 5, a rather busy thoroughfare, prior to data collection in 1997. As a consequence, $NO_X$ levels increased in 1997 compared to 1996 but the downward trend continued thereafter. The 95th percentile TNMOC levels for East Hartford increased in 2005 and 2006 while those for Westport showed a similar increase only in 2006.

## Figure 3.2.3: East Hartford McAuliffe Park
## Oxides of Nitrogen
## June to August 1994 - 2006 Trend



## Figure 3.2.4: Wesport Sherwood Island
## Oxides of Nitrogen
## June to August 1996 - 2006 Trend

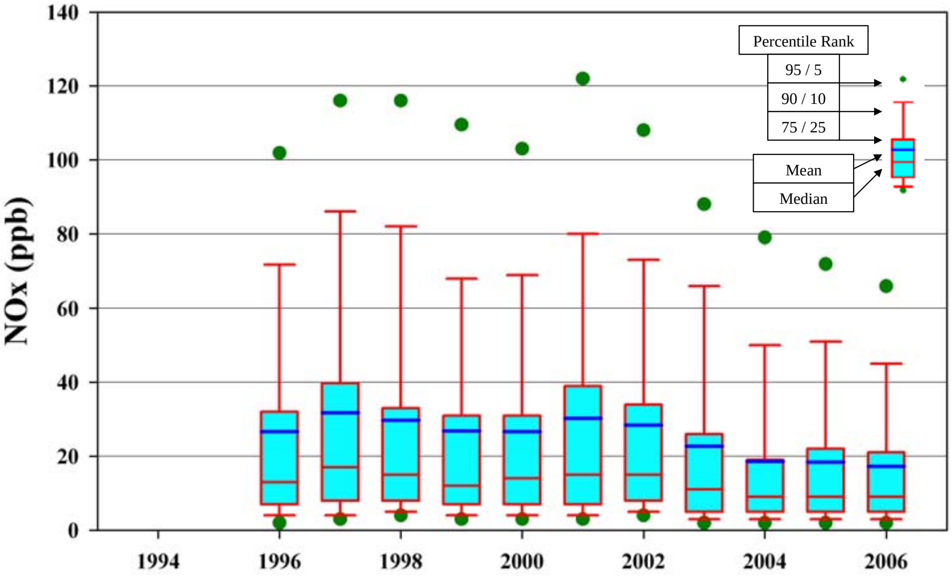


**Figure 3.2.5: East Hartford McAuliffe Park**
**Total Non-Methane Organic Carbon**
**June to August 1994 - 2006 Trend**

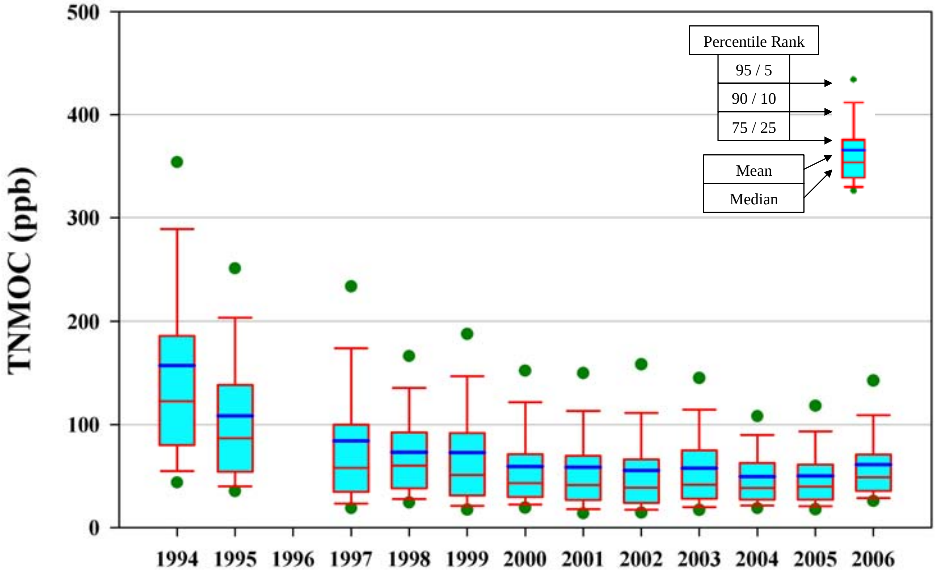
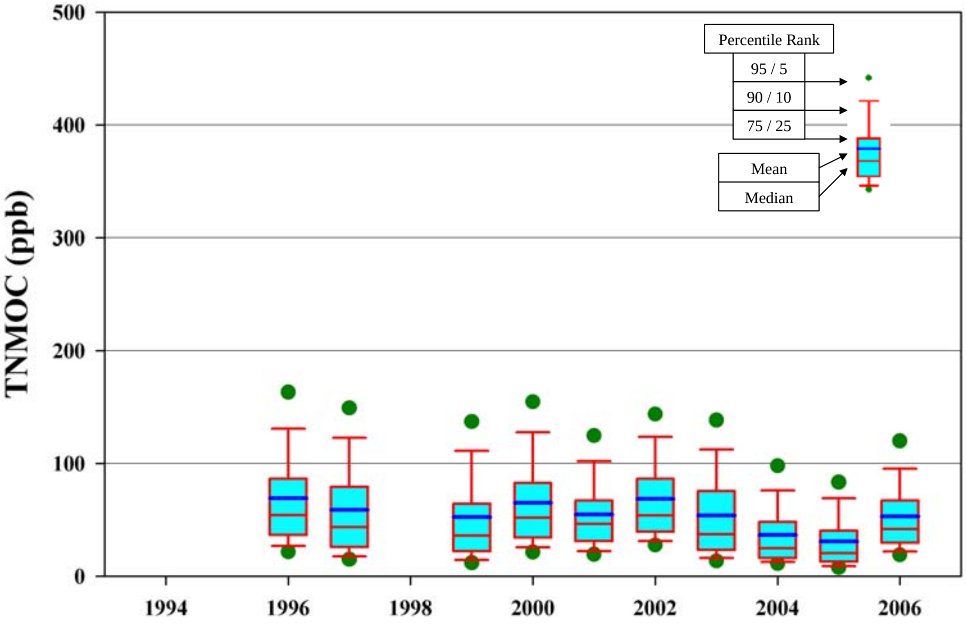
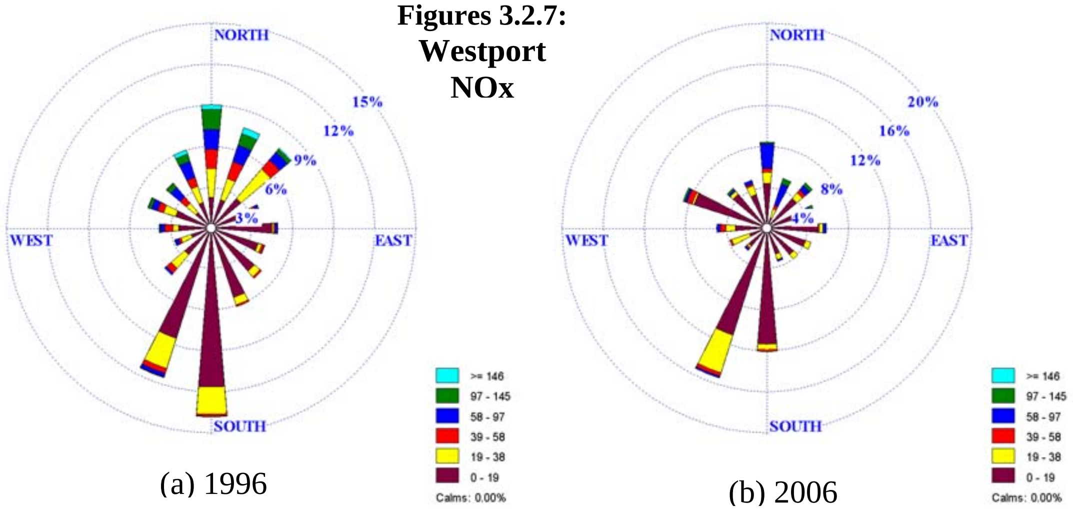


**Figure 3.2.6: Westport Sherwood Island**
**Total Non-Methane Organic Carbon**
**June to August 1996-2006 Trend**



Wind rose plots of $NO_X$ concentrations (ppb) as a function of wind direction from the Westport site in 1996 and 2006 are presented, respectively, in Figures 3.2.7 (a) and (b) below. The wind rose petals (bars) indicate the frequency that winds originated from specific directions and the color bands within each petal indicate the frequency of various $NO_X$ concentrations. The plots show the influence of local mobile source $NO_X$ emissions due to Interstate 95, from which the highest concentrations occur when the winds are from the Northwest to Northeast. Wind rose plots for TNMOC from the Westport site for 1996 and 2006 are presented in Figures 3.2.8 (a) and (b) below. The plots indicate that the TNMOC levels monitored in Westport are driven by dispersed, as opposed to directional-specific sources. Figures 3.2.7 and 3.2.8 also indicate that both NOx and TNMOC levels were lower in 2006 than in 1996, an indication that emission control programs are working to reduce ambient concentrations of ozone precursors.

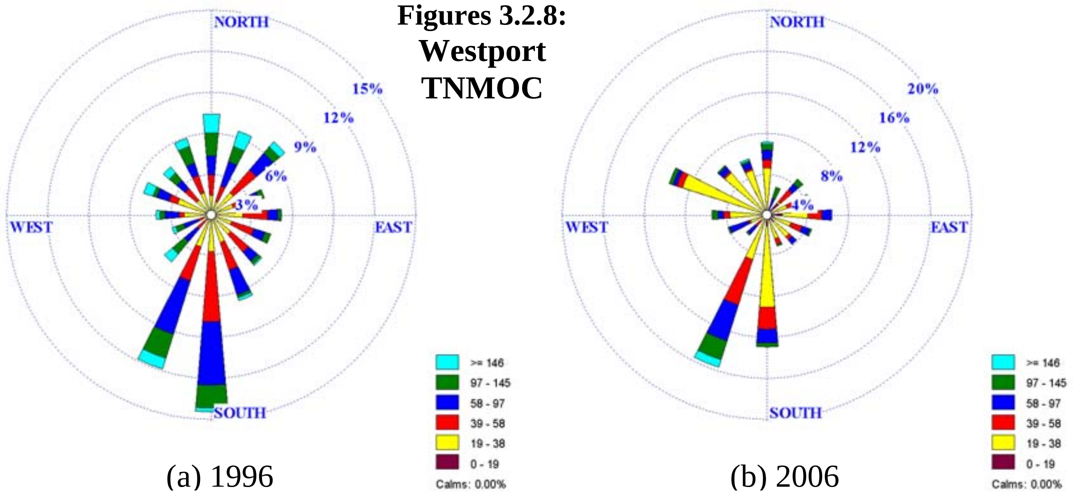
**Figures 3.2.7:**
**Westport**
**NOx**



(a) 1996

(b) 2006

**Figures 3.2.8:**
**Westport**
**TNMOC**



(a) 1996

(b) 2006

## 4.0 Base Year and Future Year Emission Estimates

CTDEP has adopted, or is currently pursuing adoption of, several regulations to provide in-state reductions of ozone precursor (i.e., VOC and $NO_X$) emissions. These in-state measures, along with national measures targeted at on-road and non-road emission sources, are expected to provide significant emission reductions through 2009 and beyond. This section documents the level of emissions in Connecticut in the baseline year of 2002, provides descriptions of the measures relied upon to meet CAA reasonable further progress (RFP) and attainment requirements, and summarizes estimates of projected future emissions resulting from these state and federal measures.

## 4.1 2002 Base Year Typical Summer Day Inventory

The development and refinement of Connecticut's 2002 base year inventory is described below.

### 4.1.1 CTDEP's 2002 Periodic Emissions Inventory

EPA's Phase 2 Ozone Implementation Rule[1] established 2002 as the baseline year for determining RFP compliance and recommended that states use 2002 as the baseline year for photochemical grid modeling. Section 182(a)(3) of the CAA requires states with moderate or above ozone nonattainment areas to prepare periodic emission inventories (PEIs) every three years, starting in 1990, estimating actual emissions from all sources.

As required, CTDEP has routinely prepared PEIs since 1990. The most recent version of the 2002 PEI was provided to EPA in December 2005. The 2002 PEI provides estimates of actual VOC and $NO_X$ emissions for each county in Connecticut, with sources grouped into the following general categories:

- Stationary Point Sources: Industrial or commercial operations that are either classified as major sources or have 2002 actual emissions of 10 tons or more per year (tpy) of VOC or $NO_X$ are included in the point source inventory. Examples include power plants, factories, large industrial and commercial boilers or other fuel burning equipment.
- Stationary Area Sources: Emission sources too small to be inventoried individually are classified as area sources. Examples include small industrial or commercial facilities such as gasoline stations, printing shops, dry cleaners, and auto refinishing shops.
- On-Road Mobile Sources: These include exhaust and evaporative emissions from cars, buses, motorcycles and trucks traveling on state and local roads.
- Non-Road Mobile Sources: Exhaust and evaporative emissions from mobile sources that are not generally traveling on state and local roads are designated non-road mobile sources. Examples include construction equipment such as backhoes and graders, recreational equipment such as all-terrain vehicles and off-road motorcycles, commercial and residential lawn and garden equipment such as lawn mowers and leaf blowers, industrial equipment such as forklifts and sweepers, airport equipment such as aircraft and ground support vehicles, and marine equipment such as commercial and recreational watercraft.

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[1] 70 FR 71612

The 2002 PEI (December 2005 version) contains full documentation of the procedures and data used to develop the 2002 emissions estimates. Summaries of VOC and $NO_X$ emission estimates are provided in Tables 4.1.1.1 and 4.1.1.2 for both of Connecticut's 8-hour ozone nonattainment areas. As described below, the December 2005 version of the PEI, with some modifications, will serve as the 2002 Base Year Inventory for determining compliance with 8-hour ozone reasonable further progress obligations.

### Table 4.1.1.1
### Summary of Connecticut's 2002 VOC Periodic Emissions Inventory*

**(tons / summer day)**

| Source Category | Greater CT | Southwest CT | State Total |
|---|---|---|---|
| Stationary Point | 4.6 | 11.3 | 15.9 |
| Stationary Area | 69.1 | 77.1 | 146.2 |
| On - Road Mobile | 45.8 | 47.3 | 93.1 |
| Non - Road Mobile | 37.2 | 57.7 | 94.9 |
| **Total Anthropogenic VOC** | **156.7** | **193.4** | **350.1** |
| Biogenic VOC | 268.6 | 125.6 | 394.2 |
| **Total VOC** | **425.3** | **318.9** | **744.2** |

*These estimates of actual 2002 emissions are from CTDEP's December 2005 version of the 2002 periodic emissions inventory. See Section 4.1.2 for a description of modifications made to the 2002 PEI estimates to ensure the 2002 Base Year Inventory (used for determining reasonable further progress) is based on the most recent emission estimation techniques.

### Table 4.1.1.2
### Summary of Connecticut's 2002 $NO_X$ Periodic Emissions Inventory*

**(tons / summer day)**

| Source Category | Greater CT | Southwest CT | State Total |
|---|---|---|---|
| Stationary Point | 19.0 | 37.8 | 56.8 |
| Stationary Area | 6.4 | 7.2 | 13.6 |
| On - Road Mobile | 90.7 | 100.3 | 191.0 |
| Non - Road Mobile | 31.9 | 51.6 | 83.5 |
| **Total Anthropogenic $NO_X$** | **148.0** | **196.9** | **344.9** |
| Biogenic $NO_X$ | 1.3 | 0.7 | 2.0 |
| **Total $NO_X$** | **149.3** | **197.6** | **346.9** |

*These estimates of actual 2002 emissions are from CTDEP's December 2005 version of the 2002 periodic emissions inventory. See Section 4.1.2 for a description of modifications made to the 2002 PEI estimates to ensure the 2002 Base Year Inventory (used for determining reasonable further progress) is based on the most recent emission estimation techniques.

### 4.1.2 Updates to the 2002 PEI to Determine 2002 Base Year Emissions

Subsequent to the preparation of the 2002 PEI, updated emission estimation techniques became available for a few source categories. These included a new release of EPA's NONROAD model used for estimating emissions from most non-road emission sources, updates to traffic-related parameters used as inputs to EPA's MOBILE model, and new procedures to account for evaporative VOC emissions resulting from storage and use of portable fuel containers (i.e., gasoline cans) and from the manufacture and use of adhesives and sealants. As described below, emission estimates from the December 2005 version of the 2002 PEI were updated to incorporate each of these new procedures.

#### Updated Non-Road Emission Estimates for 2002

Emissions from the non-road sector were updated using NONROAD2005,[2] EPA's most recent release of the NONROAD emissions model. The new version of the model incorporates all of EPA's non-road engine emission and fuel standards finalized through the end of 2005.[3] As with previous versions of the model, NONROAD2005 calculates past, present and future emission estimates for all non-road equipment categories except commercial marine, locomotives, and aircraft. Emissions for those three categories remain unchanged from the 2002 PEI provided to EPA in December 2005. Table 4.1.2.1 lists the local inputs used in the NONROAD2005 runs for 2002. Complete input data files are included in Appendix 4A.

**Table 4.1.2.1: Local Inputs to EPA's NONROAD2005 Model**

| | | | |
|---|---|---|---|
| **Gasoline RVP (psi)** | 6.86 | **Minimum Temperature (F)**<br>**Greater Connecticut:**<br>**Southwest Connecticut:** | <br>67.7<br>66.5 |
| **Gasoline Oxygen Weight %** | 2.1 | **Maximum Temperature (F)**<br>**Greater Connecticut:**<br>**Southwest Connecticut:** | <br>95.5<br>91.6 |
| **Gasoline Sulfur %** | 0.0106 | **Average Temperature (F)**<br>**Greater Connecticut:**<br>**Southwest Connecticut:** | <br>86.2<br>83.2 |
| **Diesel Sulfur %** | 0.2318 | **Year** | 2002 |
| **Marine Diesel Sulfur %** | 0.2637 | **Season** | Summer |
| **CNG/LPG Sulfur %** | 0.003 | **Day Type** | Typical Weekday |
| **Stage II Control %** | 0.0 | **Sources** | All |

Overall, for Connecticut, EPA's new version of the model projects non-road VOC emissions to be about 29% higher and non-road $NO_X$ emissions to be about 17% lower than estimates produced by the April 2004 draft NONROAD model used in the December 2005 version of the 2002 PEI.

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[2] The NONROAD2005 model includes the following modules: 1) Core Model version 2005a (February 2006); 2) Graphical User Interface version 2005.1.0 (June 2006); 3) Reporting Utility version 2005c (March 2006); and 4) Data File updates (February 2006).

[3] See Section 4.2.1 for a summary of federal rulemakings for non-road engines.

## Updated On-Road Emission Estimates for 2002

The December 2005 version of the 2002 PEI was based on the best estimates of 2002 traffic data available from the Connecticut Department of Transportation (CTDOT) at that time (i.e., CTDOT's Series 27 traffic estimates). Subsequently, CTDOT produced refined estimates of traffic data for 2002 that serve as the basis for their most recent projections of future year traffic levels (i.e., Series 28D). In order to incorporate CTDOT's more recent data, CTDEP updated the MOBILE6.2[4] model runs using the Series 28D traffic estimates, which are summarized in Table 4.1.2.2 for each of Connecticut's nonattainment areas. More detailed listings of model inputs that differ from the December 2005 version of the 2002 PEI are included in Appendix 4A.

### Table 4.1.2.2
### CTDOT Series 28D Vehicle Miles Traveled Estimates for 2002
**(Average Daily Summer Traffic)**

| Area | Average Summer Day Traffic (Vehicle Miles Traveled) |
|---|---|
| Greater Connecticut | 44,425,646 |
| Southwest Connecticut | 48,419,485 |
| **State Total** | **92,845,131** |

Inclusion of the revised 2002 traffic data from CTDOT makes very little difference in emission estimates. On a statewide basis, the updated estimates of on-road VOC and $NO_X$ emissions differ by 0.3% and 0.5%, respectively, compared to the on-road estimates in the December 2005 version of the 2002 PEI.

## Portable Fuel Container Emission Estimates for 2002

The December 2005 version of the 2002 PEI does not include most of the evaporative VOC emissions that occur from the storage and use of portable fuel containers (PFCs, a.k.a. gasoline cans). PFC's have five different emission modes: permeation and diurnal (associated with storage), transport-spillage (associated with filling and transporting the PFC), equipment refueling spillage and refueling-vapor displacement (associated with equipment refueling). Although the emissions resulting from equipment refueling are accounted for by the EPA's NONROAD2005 model and included in the non-road portion of the inventory, the emissions associated with PFC transport- spillage and storage were not included in the December 2005 version of the 2002 PEI or in PEI's prepared for previous years (i.e., 1990, 1993, 1996 or 1999).

To address this issue for the 2002 base year inventory used in RFP calculations, the December 2005 version of the 2002 PEI has been modified to more fully account for PFC evaporative VOC emissions using a methodology developed by the California's Air Resource Board (CARB).[5] The CARB method is currently being used by CTDEP's Inventory Group to prepare a draft

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[4] "User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model"; EPA420-R-03-010; August 2003; See http://www.epa.gov/omswww/m6.htm.

[5] Notice of Public Meeting to Consider the Approval of California's Portable Gasoline-Container Emissions Inventory, California Air Resources Board, Sacramento, CA, September 1999.

version of the 2005 PEI. As described below, estimates of 2002 PFC emissions were developed from the draft 2005 PEI PFC results by using 2002 activity factors and control levels.

The CARB methodology calculates PFC emission estimates based on the storage condition of the gasoline can (open or closed), the material of construction (metal or plastic) and the type of usage (residential or commercial). A gas can is considered open when it is stored with an open breathing hole or an uncapped nozzle. A closed system exists when the breathing hole is closed, and the nozzle is capped. The permeation rate of gasoline vapors is dependent on the material of construction. Emissions are calculated separately for residential and commercial use because of differing usage profiles.

Appendix 4B contains the PFC section from CTDEP's draft 2005 PEI, documenting procedures and calculations used to determine PFC emissions for 2005. The following adjustments were made to the draft 2005 calculations to develop estimates of PFC emissions in 2002:

- Exclusion of PFC Controls Implemented in 2004
  Connecticut's PFC regulation initially became effective on May 1, 2004.[6] The PFC emission calculations in the draft 2005 PEI include the effect of that regulation, accounting for a reduction in VOC emissions of 6.82 percent. Calculations for 2002 PFC emissions were adjusted upwards by excluding the effects of the 2004 regulations.

- Removal of Growth in Activity Levels Between 2002 and 2005
  As documented in Section 4.3.1, growth in activity levels for the gasoline-marketing sector is based on actual gasoline usage data for Connecticut for the period from 1996 through 2005. Based on activity data tracked by the Federal Highway Administration, Connecticut's gasoline usage in 2002 was 5.4% less than in 2005.[7] PFC emission estimates for 2002 were adjusted accordingly.[8]

After removing both the 2004 controls and the activity growth occurring between 2002 and 2005, the resulting PFC VOC emissions for 2002 are estimated to be 4.0 tons/day in the Greater Connecticut nonattainment area and 4.7 tons/day in Southwest Connecticut portion of the NY/NJ/CT nonattainment area.

## Adhesives and Sealants Emission Estimates for 2002

The December 2005 version of the 2002 PEI does not include area source VOC emission estimates for the manufacture and industrial/commercial use of adhesives, sealants, adhesive primers and sealant primers. VOC emissions from this category result from evaporation of solvents during transfer, drying, surface preparation and cleanup operations. Examples of industrial and commercial operations using these products are upholstery shops, wood product manufacturers, building contractors, floor covering installers and roof repairers.

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[6] RCSA Section 22a-174-43.

[7] FHWA's annual Highway Statistics documents (Table MF-21). See http://www.fhwa.dot.gov/policy/ohpi/qffuel.htm.

[8] Appendix 4E includes documentation of how 2002 PFC emissions were determined from 2005 estimates.

To address this issue for the 2002 base year inventory used in RFP calculations, the December 2005 version of the 2002 PEI was modified to include area source adhesive and sealant emission estimates from the MANE-VU 2002 inventory, estimated to be 2.4 tons/day in both the Greater Connecticut and Southwest Connecticut areas.[9]

### 4.1.3 Summary of Resulting 2002 Base Year Inventory

The adjustments described above were made to the December 2005 version of the 2002 PEI emission estimates to account for recent updates to emission calculation methods and inputs. The resulting updated 2002 emission estimates, which will be used as the 2002 Base Year Inventory for demonstrating reasonable further progress compliance, are summarized in Tables 4.1.3.1 and 4.1.3.2 and in Figures 4.1.3.1 and 4.1.3.2.

On a statewide basis in 2002, biogenic sources contributed 50% of the total summer day VOC emissions, with the bulk of the remaining emissions accounted for by stationary area sources (20%), non-road mobile sources (16%) and on-road mobile sources (12%). For statewide $NO_X$ emissions in 2002, the largest contributing category was on-road mobile sources (57%), with large contributions from the non-road mobile (21%) and stationary point (17%) source sectors as well. A more complete source category breakdown of 2002 base year emissions is included in Appendix 4C.

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[9] "Technical Support Document for 2002 MANE-VU SIP Modeling Inventories – Version 3"; MANE-VU; April 2007; See http://www.marama.org/visibility/EmissionsInventory/index.htm and ftp://marama.org/2002 Version 3/Documentation/ (use UserID: mane-vu and Password: exchange)

### Table 4.1.3.1
### Summary of Connecticut's 2002 Base Year VOC Inventory[*]
**(tons / summer day)**

| Source Category | Greater CT | Southwest CT | State Total |
|---|---|---|---|
| Stationary Point | 4.6 | 11.3 | 15.8 |
| Stationary Area | 75.5 | 84.1 | 159.7 |
| On - Road Mobile | 45.1 | 48.3 | 93.4 |
| Non - Road Mobile | 56.2 | 66.0 | 122.2 |
| **Total Anthropogenic VOC** | **181.4** | **209.7** | **391.1** |
| Biogenic VOC | 268.6 | 125.6 | 394.2 |
| **Total VOC** | **450.0** | **335.3** | **785.3** |

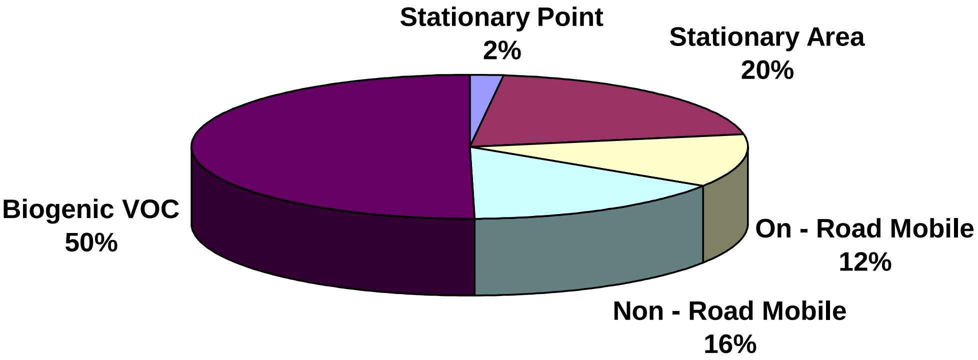
*As described in the text, the 2002 Base Year VOC Inventory is an updated version of CTDEP's December 2005 version of the 2002 periodic emissions inventory. Updates include incorporation of emission estimates from EPA's most recent version of the NONROAD model, more recent traffic information input to the MOBILE6.2 model, and inclusion of evaporative VOC emissions from portable fuel containers (i.e., gasoline cans).

### Table 4.1.3.2
### Summary of Connecticut's 2002 Base Year $NO_X$ Inventory[*]
**(tons / summer day)**

| Source Category | Greater CT | Southwest CT | State Total |
|---|---|---|---|
| Stationary Point | 19.0 | 37.7 | 56.8 |
| Stationary Area | 6.4 | 7.2 | 13.5 |
| On - Road Mobile | 89.3 | 102.7 | 192.0 |
| Non - Road Mobile | 30.8 | 38.7 | 69.5 |
| **Total Anthropogenic $NO_X$** | **145.5** | **186.3** | **331.8** |
| Biogenic $NO_X$ | 1.3 | 0.7 | 1.9 |
| **Total $NO_X$** | **146.8** | **187.0** | **333.7** |

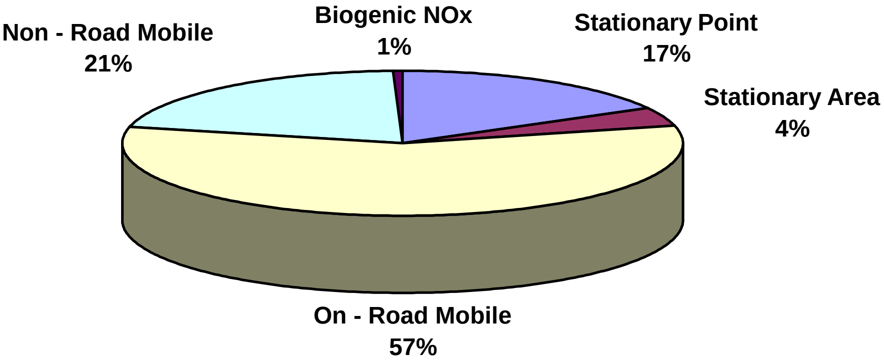
*As described in the text, the 2002 Base Year $NO_X$ Inventory is an updated version of CTDEP's December 2005 version of the 2002 periodic emissions inventory. Updates include incorporation of emission estimates from EPA's most recent version of the NONROAD model and more recent traffic information input to the MOBILE6.2 model.

### Figure 4.1.3.1: Connecticut's 2002 Base Year VOC Inventory (State Total = 785 tons / summer day)



As described in the text, the 2002 Base Year VOC Inventory is an updated version of CTDEP's December 2005 version of the 2002 periodic emissions inventory. Updates include incorporation of emission estimates from EPA's most recent version of the NONROAD model, more recent traffic information input to the MOBILE6.2 model, and inclusion of evaporative VOC emissions from portable fuel containers (i.e., gasoline cans).

### Figure 4.1.3.2: Connecticut's 2002 Base Year NOx Inventory (State Total = 334 tons / summer day)



As described in the text, the 2002 Base Year $NO_X$ Inventory is an updated version of CTDEP's December 2005 version of the 2002 periodic emissions inventory. Updates include incorporation of emission estimates from EPA's most recent version of the NONROAD model and more recent traffic information input to the MOBILE6.2 model.

## 4.2 Post-2002 Control Measures Included in Future Year Projections

CTDEP has implemented all emission control programs mandated by the 1990 CAA, and is currently pursuing completion of adoption of additional measures necessary to meet RFP requirements and to demonstrate a reasonable probability of attaining the 8-hour ozone NAAQS, as expeditiously as practicable. Section 4.2.1 describes mobile source control programs. Section 4.2 describes twelve new stationary and area source control measures CTDEP has recently adopted or is pursuing adoption. Section 4.3 includes a discussion of the level of emission reductions resulting from the post-2002 control measures described in this section.

Many of the measures identified in this section came out of a regional planning activities coordinated by the Ozone Transport Commission (OTC). These regional planning activities focused on the identification of potential emission control measures and preparation of materials for 1-hour and 8-hour ozone attainment plans being developed by the OTC member states. The materials included model rules to regulate products, activities and stationary sources to reduce ozone precursor emissions. Model rules were prepared in 2001-2002 to serve 1-hour ozone NAAQS purposes and in 2005-2006 to serve as templates for creating additional reductions for 8-hour ozone NAAQS purposes. Additional information regarding the process of identifying control measures suitable for 8-hour ozone NAAQS planning is included in Section 6.0.

### 4.2.1 On-Road and Non-Road Mobile Sources and Fuels

There are various federal measures that reduce ozone precursors through more stringent emission standards for vehicles, engines and equipment; changes to fuel type and quality; and influences on human behavior associated with vehicle use. Such federal control measures, along with state counterparts, provide emissions reductions through 2007 and beyond.

#### 4.2.1.1 On-Road Mobile Sources

The Post-1999 Rate of Progress (ROP) Plan (CTDEP, 2001) included a list of control strategies resulting in emission reductions during the period from 2000 to 2007. This list has been expanded to include all post-2002 control programs resulting in emission reductions incorporated into this attainment demonstration. The following table, Table 4.2.1.1, includes the relevant control programs for on-road mobile sources. A brief summary of each strategy is provided in the following paragraphs. All the post-2002 control programs for on-road sources are summarized in Table 4.2.1.1. Explanation of the listed measures that impact ozone attainment follows. More detail concerning the emission reduction calculations is provided in sections 4.3 and 7.0.

**Reformulated Gasoline**

The federal reformulated gasoline (RFG) program is mandated by CAA Section 211. Its primary purpose is to reduce motor vehicle emissions of smog-forming pollutants such as VOCs and $NO_X$ as well as certain toxic or hazardous air pollutant emissions. The lower volatility of RFG

**Table 4.2.1.1: On-Road Mobile Sources Control Strategies**

| Control Strategy | Pollutant | | Federal Program | State Program | Rule Approval Date[1] | Initial Year of Implementation[2] |
|---|---|---|---|---|---|---|
| | VOC | $NO_X$ | | | | |
| Reformulated Gasoline - Phase I[3] | ● | ● | ● | | 12/23/1991[4] | 1995 |
| Reformulated Gasoline - Phase II[3] | ● | ● | ● | | 2/16/1994[4] | 2000 |
| Tier 1 Motor Vehicle Controls | ● | ● | ● | | 6/5/1991 | 1994 |
| National Low Emission Vehicle Program | ● | ● | ● | | 3/02/1998[5] | 1998 (in CT) |
| Tier 2 Motor Vehicle Controls/Low Sulfur Gasoline | ● | ● | ● | | 2/10/2000 | 2004-2008 |
| On-board Refueling Vapor Recovery | ● | | ● | | 4/6/1994 | 1997-2005 |
| Heavy-Duty Diesel Vehicle Controls and Fuels | ● | ● | ● | | 10/6/2000 | 2004-2005 |
| 2007 Highway Rule | ● | ● | ● | | 1/18/2001 | 2006-2007 |
| California Low Emission Vehicle Phase 2 (CALEV2) | ● | ● | ● | ● | [6] | 2007 |
| Enhanced I/M (ASM 2525 phase-in standards) | ● | ● | | ● | 3/10/1999 | 2000 |
| Enhanced I/M (ASM 2525 final standards) | ● | ● | | ● | 10/27/2000 | 2004 |
| OBD-II Enhanced I/M | ● | ● | | ● | [7] | 2004 |
| Highway Motorcycle Exhaust Emission Standards | ● | ● | ● | | 1/15/2004 | 2006-2010 |
| Mobile Source Air Toxics Rule | ● | ● | ● | | 3/29/2001 | 2002 |
| Control of Hazardous Air Pollutants | ● | ● | ● | | 2/26/2007 | 2009-2015 |
| Renewable Fuel Standard Program[8] | ● | ● | ● | | 5/01/2007 | 2006,2007-2012 |

[1] Unless otherwise noted, this is the date of Federal Register publication of either a final federal rule or EPA's approval of a state SIP submittal, as appropriate for the indicated control strategy.

[2] A range of implementation years is listed for some strategies due to phase-in of standards. In addition, all listed mobile source strategies (except enhanced I/M and reformulated gasoline) result in increased levels of emission reductions through and beyond 2007 due to the gradual turnover of the affected fleets.

[3] Reformulated gasoline requirements also result in a reduction in evaporative VOC emissions throughout the gasoline distribution system.

[4] Promulgated statewide under 40 CFR 80.70. Approved for 15% rate-of-progress on 03/10/99.

[5] EPA determined that the NLEV program was in place on 03/02/98. As a result, rules published on 06/06/97 and 01/07/98 went into effect.

[6] Regulation adopted 12/03/04. Not submitted to EPA as of the date of this submission. Emission calculations do not take credit for the CALEV2 program.

[7] Amendment to incorporate OBD-II adopted 08/25/04. CTDEP submitted the OBD-II SIP revision to EPA on December 20, 2007. Emission calculations reflect the inclusion of the OBD-II component in the I/M program.

[8] Renewable fuels may be blended into conventional gasoline or diesel fuel. Eventually, emission impacts may be witnessed in the non-road category, in addition to the on-road emission impacts.

also results in reduced evaporation of VOC as the gasoline makes its way through the gasoline distribution. The CAA required the federal RFG program to be implemented in two phases. Phase I was implemented in 1995 and Phase II went into effect in 2000. Phase II RFG performance standards require a minimum emission reduction of 27% for VOC and 7% for $NO_X$ (as well as at least a 22% reduction in toxics) relative to conventional gasoline.

## Light-Duty Motor Vehicle Emission Standards

Federal emission standards for on-road vehicles have become increasingly more stringent since the Clean Air Act was amended in 1990. In June of 1991, EPA published a final rule establishing "Tier 1" emission standards to supplement previous federal standards (i.e., "Tier 0" standards established prior to the 1990 CAA Amendments) for light-duty vehicles and trucks.[10] The final rule implemented the mandates of CAA sections 202(g) and 202(h), setting both certification and useful life standards for emissions of $NO_X$ and VOC (as well as carbon monoxide and particulate matter), phased-in over model years from 1994 through 1996.[11]

Light-duty vehicle emission standards were reduced in 1998 through the National Low Emission Vehicle (NLEV) Program, a voluntary agreement reached between 23 vehicle manufacturers and 9 northeastern states, including Connecticut.[12] The NLEV Program required the phase-in of lower emitting vehicles, beginning with model year 1999 in the Northeast, and with model year 2001 throughout the remainder of the country.

More recently, EPA adopted final rules requiring more protective emission standards for all new passenger vehicles, including cars, sport utility vehicles (SUVs), minivans, vans, and pick-up trucks. These "Tier 2" standards, published on February 10, 2000,[13] marked the first time that the largest passenger vehicles were subject to the same emission standards as cars. Manufacturers of new vehicles weighing less than 6000 pounds have a phase-in period between 2004 and 2007. Manufacturers of heavier passenger vehicles are provided a longer phase-in period, from 2004 through 2009.

The Tier 2 standards result in cars that are 77 percent cleaner and light-duty trucks that are up to 95 percent cleaner than Tier 1 models. On a national level, EPA estimates that the Tier 2 standards will reduce $NO_X$ emissions from passenger vehicles by over 70% by 2030. Additional reductions of VOC (and particulate matter) emissions will also be realized.

## On-Board Refueling Vapor Recovery for Motor Vehicles

CAA Section 202 (a)(6) contains provisions requiring passenger cars to capture refueling emissions. In 1994, EPA published regulations, which require that vehicles meet refueling emission standards.[14] On-board Refueling Vapor Recovery (ORVR) began to be phased in on light-duty cars in model year 1998 (cars on the road in calendar year 1997). By 2005, all 2006

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[10] 56 FR 25724, June 5, 1991.
[11] See http://www.epa.gov/otaq/stds-ld.htm.
[12] See http://www.epa.gov/oms/regs/ld-hwy/lev-nlev/subpt-r.pdf.
[13] 65 FR 6698; see also http://www.epa.gov/otaq/regs/ld-hwy/tier-2/index.htm.
[14] 59 FR 16262, April 6, 1994.

model year light-duty cars and trucks up to 8,500 pounds (lbs) gross vehicle weight rating (GVWR) were equipped with ORVR systems.

## Heavy-Duty Motor Vehicle Emission Standards

In addition to more stringent light-duty vehicle standards, EPA has also finalized rules requiring emission reductions from on-road vehicles equipped with heavy-duty engines. In October of 2000, EPA published final rules affirming more stringent $NO_X$ and hydrocarbon (HC) emission standards for heavy-duty diesel engines and vehicles (starting with vehicle model year 2004) and establishing tighter $NO_X$ and HC standards for heavy-duty gasoline engines and vehicles (starting with vehicle model year 2005).[15] Standards vary by GVWR and fuel-type, and require new test procedures and diagnostic systems to ensure that in-use emissions are properly controlled.[16] The October 2000 final rule also requires that heavy-duty vehicles (HDVs), up to 10,000 lbs GVWR, be equipped with ORVR systems. The ORVR systems for HDVs began to be equipped on model year 2004 vehicles and were fully phased in on HDVs by model year 2006.

On January 18, 2001 EPA published a final rule, referred to as the "2007 Heavy-Duty Highway Rule."[17] The 2007 Heavy-Duty Highway Rule serves as a second phase to the heavy-duty motor vehicle emission standards implemented for heavy-duty vehicles starting with model year 2004. The 2007 Highway Rule required additional, significant reductions of $NO_X$ and HC (as well as particulate matter) emissions from heavy-duty engines and vehicles, beginning with vehicle model year 2007. This rule also requires lowering the sulfur content of diesel fuel to 15 ppm from previous levels of 500 ppm, beginning in 2006. The 15 ppm sulfur fuel enables the proper operability of advanced pollution control technology for cars, trucks and buses so that engine manufacturers can meet the 2007 emission standards.

## California Low Emission Vehicle Phase 2 (CALEV2)

The State of Connecticut has revised the Regulations of Connecticut State Agencies (R.C.S.A.) section 22a-174-36b, concerning the second phase of the California Low Emission Vehicle Program. The State of Connecticut will be implementing the light-duty motor vehicle emission standards of the State of California applicable to motor vehicles of model year 2008 and later. California's revision of their Low Emission Vehicle (LEV) standards also includes adoption of green house gas emission standards for passenger cars, light-duty trucks and medium duty passenger vehicles commencing with 2009 and subsequent model year vehicles. Further information on the status of the California rulemaking proceeding, including a final statement of reasons issues by the California Air Resources Board (CARB), can be found at the CARB website.[18] Note that emission calculations in this attainment demonstration do not take credit for the CALEV2 program.

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[15] 65 FR 59895, October 6, 2000.

[16] See http://www.epa.gov/otaq/regs/hd-hwy/2000frm/f00026.pdf.

[17] 66 FR 5001, January 18, 2001, see EPA summary at http://www.epa.gov/otaq/highway-diesel/index.htm.

[18] See www.arb.ca.gov/regact/grnhsgas/grnhsgas.htm.

**Enhanced Inspection and Maintenance Program**

CAA Section 182(c)(3) requires Connecticut to adopt an enhanced vehicle emission inspection and maintenance (I/M) program throughout most of the state. In response to this requirement, Connecticut began statewide testing of vehicles in January 1998 subjecting vehicles to Acceleration Simulation Mode (ASM 2525) testing, a tailpipe emission test conducted on a treadmill simulating travel at 25 miles per hour at a 25% load factor. The ASM 2525 test replaced the previous single-speed idle test, which began implementation in 1983.

Since 2003, Connecticut has operated a decentralized I/M testing infrastructure. As part of the decentralized infrastructure, Connecticut has implemented an On-Board Diagnostics-II (OBD-II) test on all 1996 and newer vehicles having a GVWR of 8,500 lbs or less.

EPA published final approval of Connecticut's enhanced inspection and maintenance program on October 27, 2000.[19] This final rule approves Connecticut's enhanced inspection and maintenance program to use the ASM 2525 testing protocol. Connecticut's contract with its current I/M vendor has been in place since 2003. The contract requires the vendor to operate an enhanced I/M program, which consists of OBD-II testing in addition to ASM 2525 testing. The CTDEP filed a SIP revision with EPA on December 20, 2007 to incorporate these changes to the I/M program. Emission calculations in this attainment demonstration account for the I/M program revisions.

**Highway Motorcycle Exhaust Emission Standards**

In 2004, EPA published a final rule to implement improved exhaust emission standards on new highway motorcycles.[20] The new exhaust emission standards apply to all 2006 model year and beyond motorcycles. The biggest of new motorcycles, 280 cubic centimeters (cc) displacement and above, will be subject to more stringent HC and $NO_X$ emission standards beginning with model year 2010, in addition to the emission standards that were required in model year 2006. Prior to this final rule, the exhaust emission standards that applied to motorcycles had not been updated in over 20 years. Thus, a model year 2005 motorcycle produces more harmful emissions per mile than even the largest of passenger cars of the same age. This rule marks the first time that exhaust emissions from motorcycles with engines of less than 50cc displacement (scooters and mopeds) will be regulated.

### 4.2.1.2 Non-Road Mobile Sources

Non-road engines are used in a variety of applications such as construction equipment, outdoor power equipment, farm equipment, lawn and garden equipment, marine vessels, locomotives, and aircraft. Prior to the mid-1990's, emissions from these engines were largely unregulated. EPA has since issued several rules regulating emissions from new non-road engines.[21]

As listed in Table 4.2.1.2 and described below, non-road mobile source controls contained in this

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[19] 65 FR 64357.

[20] 69 FR 2398, January 15, 2004.

[21] See http://www.epa.gov/otaq/nonroad.htm.

attainment demonstration include the adoption of several different standards for compression-ignition engines, spark-ignition engines, marine diesel engines, locomotives and aircraft; as well as relevant changes to the fuel for powering engines in the non-road source category.

## Non-Road Compression Ignition (Diesel) Engines

EPA rules have established four tiers of emission standards for new non-road diesel engines. EPA's first non-road regulations were finalized in 1994,[22] when (Tier 1) emission standards were issued for most large, greater than 50 horsepower (hp), land-based non-road compression-ignition (CI, or diesel) engines used in applications such as agricultural and construction equipment, which were phased in between 1996 and 2000.

In 1998, EPA subsequently promulgated Tier 1 standards for smaller (< 50 hp) diesel engines, including marine propulsion and auxiliary engines, which required phase-in between 1999 and 2000.[23] At the same time, EPA also issued more stringent Tier 2 emission standards for all non-road diesel engine sizes to be phased in from 2001 to 2006 and Tier 3 standards requiring additional reductions from new diesel engines between 50 and 750 hp to be phased in from 2006 to 2008.

EPA’s final rules to reduce emissions from non-road diesel engines were published in 2004. These integrated new diesel engine emission standards (Tier 4 standards) and finalized fuel requirements that will decrease the allowable levels of sulfur in non-road diesel fuel.[24] This rule is also known as the Clean Air Non-road Diesel Rule.

The Clean Air Non-road Diesel Tier 4 Final Rule sets new emission standards for diesel engines used in most construction, agricultural, industrial, and airport equipment. The standards will take effect for new engines beginning in 2008 and be fully phased in for most engines by 2014. Larger engines (greater than 750 hp) have one year of additional flexibility to meet the Tier 4 emission standards. These emission standards do not apply to diesel engines used in locomotives and marine vessels. However, fuel requirements for these categories are covered in this rule.

Decreasing the sulfur levels in non-road diesel fuel will prevent damage to emission-control systems used to meet the new Tier 4 engine exhaust emission standards. The Non-road Diesel Rule will reduce current sulfur levels in two steps. First, current sulfur levels of about 3,000 ppm will be limited to a maximum of 500 ppm in 2007. This limit also covers fuels used in locomotive and marine applications (though not to the marine residual fuel used by very large engines on ocean-going vessels). The second step consists of reducing fuel sulfur levels in non-road diesel fuel to 15 ppm in 2010 (except for locomotive and marine diesel fuel which will be reduced to 15 ppm in 2012).

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[22] 59 FR 31306.

[23] 63 FR 56968.

[24] 69 FR 38958, June 29, 2004.

**TABLE 4.2.1.2: Non-Road Mobile Sources Control Strategies**

| Non-Road Engine Category | Date of Final Rule | Implementation Phase-In Period |
|---|---|---|
| ***Compression Ignition (diesel) Engines*** | | |
| **Tier 1: Land-Based Diesel Engines > 50 hp** | **06/17/1994 (59 FR 31306)** | **1996-2000** |
| **Tier 1: Small Diesel Engines < 50 hp** | **10/23/1998 (63 FR 56968)** | **1999-2000** |
| **Tier 2: Diesel Engines (all sizes)** | **10/23/1998 (63 FR 56968)** | **2001-2006** |
| **Tier 3: Diesel Engines 50 - 750 hp** | **10/23/1998 (63 FR 56968)** | **2006-2008** |
| **Tier 4: All Diesel Engines (Except locomotive and marine vessels)** | **06/29/2004 (69 FR 38958)** | **2008-2015** |
| ***Spark-Ignition (e.g., gasoline) Engines*** | | |
| **Phase 1: SI Engines < 25 hp (except marine & recreational)** | **07/03/1995 (60 FR 34581)** | **1997** |
| **Phase 2: Non-Handheld SI Engines < 25 hp** | **03/30/1999 (64 FR 15208)** | **2001-2007** |
| **Phase 2: Handheld SI < 25 hp** | **04/25/2000 (65 FR 24268)** | **2002-2007** |
| **Gasoline SI Marine Engines (outboard & personal watercraft)** | **10/04/1996 (61 FR 52088)** | **1998-2000** |
| **Large Spark-Ignition Engines >19 kW (or >25 hp)** | **11/08/2002 (67 FR 68242)** | **2004/2007** |
| **Recreational Land-Based Spark-Ignition Engines** | **11/08/2002 (67 FR 68242)** | **2006-2012** |
| ***Marine Diesel Engines*** | | |
| **MARPOL: New/Old Engines on Vessels Constructed Starting 1/1/2000** | **09/27/1997 MARPOL (Annex VI of International Convention on Prevention of Pollution from Ships)** | **2000** |
| **Commercial Marine Diesel Engines[1] (US-flagged vessels)** | **12/29/1999 (64 FR 73300)** | **2004/2007** |
| **Recreational Marine Diesel Engines >37 kW (or >50 hp)** | **11/08/2002 (67 FR 68242)** | **2006-2009** |
| **Marine Diesel Engines (US-flagged vessels) >30 liters/cylinder** | **02/28/2003 (68 FR 9746)** | **2004** |
| ***Locomotives*** | | |
| **New & Remanufactured Locomotives and Locomotive Engines[2]** | **04/16/1998 (63 FR 18978)** | **(see note 2)<br>Tier 0: 1973-2001<br>Tier 1: 2002-2004<br>Tier 2: 2005 +** |
| ***Non-Road Diesel Fuel*** | **06/29/2004 (69 FR 38958)** | **2007/2010** |
| ***Aircrafts*** | | |
| **Control of Air Pollution From Aircraft and Aircraft Engines 1** | **05/08/1997 (62 FR 25356)** | **1997** |
| **Control of Air Pollution From Aircraft and Aircraft Engines 2** | **11/17/2005 (70 FR 69664)** | **2005** |
| ***Future Control Measures*** | | |
| **Proposed Locomotive & Marine Diesel Rule** | **04/03/2007[3] (72 FR 15938)** | **2008-2015** |
| **Proposed Spark-Ignition Engines, Equipment, and Vessels Rule** | **05/18/2007[3] (72 FR 28098)** | **2009, 2011-2012** |

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

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

[3] This is a proposed rule, not yet finalized.

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

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

EPA subsequently issued more stringent Phase 2 emission standards for both small non-handheld engines (e.g., lawn mowers, generator sets, air compressors) and small handheld engines (e.g., leaf blowers, chain saws, augers) in 1999[26] and 2000,[27] respectively. Phase 2 standards are to be phased-in from 2001 to 2007 for non-handheld engines and from 2002 to 2007 for handheld engines.

EPA finalized emission standards for new gasoline spark-ignition marine engines in 1996[28] to be phased-in between 1998 and 2000. These engines, typically based on simple two-stroke technology, are used for outboard engines, personal watercraft, and jet boats.

On November 8, 2002, EPA published a final rule which includes new engine emission standards for large spark-ignition engines rated over 19 kilowatts (kW), or >25 hp.[29] Large spark-ignition engines are used in a variety of commercial and industrial applications, including forklifts, electric generators, airport baggage transport vehicles, and a variety of farm and construction applications. Most large spark-ignition engines are fueled with liquefied petroleum gas, with others operating on gasoline or natural gas. The standards were implemented in two tiers: Tier 1 standards started in 2004 and Tier 2 standards scheduled to start in 2007. In addition to exhaust-emission controls, manufacturers of large spark-ignition engines must take steps, starting in 2007, to reduce evaporative emissions, such as using pressurized fuel tanks. Tier 2 engines must also have engine diagnostic capabilities that alert the operator to mal-functions in the engine’s emission-control system, ensuring that engine emissions are controlled during normal operating conditions.

EPA’s 2002 rulemaking also includes exhaust emission standards for non-road recreational spark-ignition engines and vehicles.[30] These recreational land-based engines are found in snowmobiles, off-highway motorcycles, and all-terrain-vehicles (ATVs). These standards are being phased-in between 2006 and 2007, except for snowmobiles, which have until 2009 to be fully phased-in. In addition, snowmobiles will have to meet more stringent standards that will be in effect in 2010 and 2012.

Plastic fuel tanks and rubber hoses available on recreational vehicles will also be regulated for permeation, to minimize the fuel lost through the component walls. The permeation standards for fuel tanks and fuel hoses on recreational vehicles become effective in 2008.

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[25] 60 FR 34581.

[26] 64 FR 15208.

[27] 65 FR 24268.

[28] 61 FR 52088.

[29] 67 FR 68242, November 8, 2002.

[30] Ibid.

## Marine Diesel Engines

Marine diesel engines include small auxiliary and propulsion engines, medium-sized propulsion engines on coastal and harbor vessels, and very large propulsion engines on ocean-going vessels. Both new and modified marine diesel engines rated above 175 hp must adhere to international standards (i.e., MARPOL convention) if vessel construction or engine modification commences on or after January 1, 2000. Furthermore, U.S.-flagged commercial vessels with new marine diesel engines rated over 37 kW (or >50 hp, with displacements up to 30 liters per cylinder) produced after 2003 (after 2006 for very large engines) must comply with EPA standards issued in 1999.[31]

EPA published a final rule in 2002 that includes new engine emission standards for recreational marine diesel engines.[32] These are marine diesel engines rated over 37 kW, or >50 hp, which are used in yachts, cruisers, and other types of pleasure craft. The standards are phased-in, beginning in 2006, depending on the size of the engine. By 2009, emission standards will be in effect on all recreational, marine diesel engines.

On February 28, 2003, EPA finalized emission standards for exhaust emission from U.S.-flagged vessels with new marine diesel engines rated over 37 kW with displacements over 30 liters per cylinder (also known as Category 3 Marine Diesel Engines).[33] This marks the first time that emissions from very large marine diesel engines have been regulated. These diesel engines are used primarily for propulsion power on ocean-going vessels such as container ships, tankers, bulk carriers, and cruise ships. Most Category 3 marine diesel engines are used for propulsion on vessels engaged in international trade. The standards were implemented in two tiers: Tier 1 standards, which match internationally negotiated standards, took effect in 2004; and Tier 2 standards will be established in a future rulemaking.

## Locomotives

EPA's final rule establishing emission standards for new and remanufactured locomotives and locomotive engines was published in 1998.[34] Three sets of standards were adopted, with applicability of the standards tied to the date a locomotive is first manufactured (i.e., 1973 through 2001, 2002 to 2004, and 2005 and later).

## Aircraft

Control of air pollution from aircraft and aircraft engines was covered in a final rule published by EPA in 1997.[35] This rule adopts the international aircraft emissions standards of the United Nations International Civil Aviation Organization (ICAO), which had been in place since 1986 and amended in 1993. This rule brings the U.S. aircraft standards into alignment with the international standards and applies to newly manufactured and newly certified commercial

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[31] 64 FR 73300.

[32] 67 FR 68242, November 8, 2002.

[33] 68 FR 9746, February 28, 2003.

[34] 63 FR 18978, April 16, 1998.

[35] 62 FR 25356, May 8, 1997.

aircraft gas turbine engines with rated thrust greater than 26.7 kilonewtons. ICAO adopted revised standards in 1999 for implementation beginning in 2004. In November of 2005, EPA finalized the adoption of the revised ICAO standards, to once again bring U.S. aircraft standards into alignment with international standards.[36]

## Future Control Measures

Two new sets of proposed regulations, published in 2007, may have minimal impact on the 2009 attainment date because they only begin to take effect in 2008. However, they will help to ensure that Southwest Connecticut comes into attainment by 2012.

On April 3, 2007, EPA published a proposed rule to implement more stringent emission standards for locomotives and marine diesel engines.[37] This proposed rule would reduce emissions from these engines through a three-part program. The first part involves tightening emission standards for existing locomotives when they are remanufactured. These standards are effective as soon as certified remanufacture systems are available (as early as 2008). The new remanufacturing standards would not apply to the existing fleets of locomotives owned by very small railroads, such as those that comprise the bulk of the fleet in Connecticut. The second part includes setting near term engine-out (Tier 3) emission standards for new locomotives and marine diesel engines to be phased-in starting in 2009. The third part of the program entails setting longer-term (Tier 4) emission standards for newly-built locomotives and marine diesel engines that reflect the application of high-efficiency emission control technology. The Tier 4 emission standards would begin to be phased-in starting in 2014 for marine diesel engines and 2015 for locomotives (these standards are enabled due to the availability of diesel fuel capped at 15 ppm sulfur content in 2012). All new marine diesel engines with displacements less than 30 liters per cylinder (Category 1 and Category 2 engines greater than 50 hp) installed U.S.-flagged vessels are covered in this rulemaking. This proposal also includes provisions to eliminate emissions from unnecessary locomotive idling as well as requesting comments to reduce emissions from existing marine diesel engines when they are remanufactured.

On May 18, 2007, EPA published a rule proposing exhaust emission standards for marine spark-ignition engines (more stringent than those finalized on October 4, 1996[38]) and small land-based non-road spark-ignition engines.[39] The proposed rule also includes new evaporative emission standards for equipment and vessels using these engines. The marine spark-ignition engines and vessels affected by these standards (effective starting with the 2009 model year) include outboard engines and personal watercraft, as well as sterndrive and inboard engines, which are being regulated for the first time. The small non-road spark-ignition engines and equipment affected by these standards (effective starting with the 2011 and 2012 model years) are those rated below 25 hp (19 kW) used in household and commercial applications, including lawn and garden equipment, utility vehicles, generators, and a variety of other construction, farm, and industrial equipment.

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[36] 70 FR 69664, November 11, 2005.

[37] 72 FR 15938, April 3, 2007.

[38] 61 FR 52088, October 4, 1996.

[39] 72 FR 28098, May 18, 2007.

### 4.2.2 Connecticut's Control of Stationary and Area Sources

Given federal efforts to address emissions from mobile sources, Connecticut has focused its post-2002 reduction strategy on stationary and area sources of VOC and $NO_X$. All twelve measures identified in Sections 4.2.2.1 through 4.2.2.3 create emissions reductions after the 2002 baseline emissions inventory year and, therefore, are creditable towards 8-hour ozone NAAQS RFP and attainment efforts. The date on which each rule became or is anticipated to become effective in Connecticut is identified in Table 4.2.2, along with the date on which the requirements apply to the regulated activities to create emissions reductions. See Section 4.3 for a discussion of the level of emission reductions resulting from the post-2002 control measures described in this section. The twelve control measures include four measures that were adopted and approved for 1-hour ozone attainment yet that have effective dates after the 2002 baseline year (Section 4.2.2.1); seven measures adopted in coordination with other states in the OTC region to assist in 8-hour ozone attainment (Section 4.2.2.2) and a regulation to satisfy Connecticut's obligations under the Clean Air Interstate Rule (Section 4.2.2.3).

#### 4.2.2.1 One-Hour Ozone Control Measures With Post-2002 Effective Dates

The following four control measures were adopted to meet EPA's 1-hour ozone attainment requirements, but are creditable for the 8-hour attainment demonstration because they were implemented after the 2002 baseline year.

**VOC Reductions from Automotive Refinishing Operations**

In 2001, the OTC states endorsed a model rule to reduce VOC emissions from automotive refinishing operations. The model rule includes VOC limits for paints used in the industry, which are consistent with Federal limits for mobile equipment refinishing materials; it also establishes requirements for using improved transfer efficiency application equipment and enclosed spray gun cleaning.

On March 15, 2002, Connecticut adopted regulatory requirements in R.C.S.A. section 22a-174-3b(d) based on the OTC model rule, which, at EPA's request, were amended on April 4, 2006 to clarify the applicability requirements and operating practices. The emissions reductions associated with the requirements for automotive refinishing operations were approved for one-hour ozone attainment on August 31, 2006.[40]

**VOC Reductions from Stage II Vapor Recovery at Gasoline Pumps**

A May 10, 2004 amendment to R.C.S.A. section 22a-174-30 resulted in VOC emission reductions by requiring the use of "pressure-vacuum vent caps" on gasoline pumps that are subject to the Stage II vapor control regulation. The amendment also requires the use of a two-point closed system for the transfer of gasoline from a gasoline tanker truck to an underground storage tank, improves Stage II system maintenance, clarifies testing requirements and increases testing frequency. The amended requirements apply as of May 10, 2005. The

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[40] 71 FR 51761.

## Table 4.2.2 Connecticut's Post-2002 Control Measures Included in Future Year Projections

| Control Measure | Pollutant | Section of the Regulations of Connecticut State Agencies | Status of Regulation Adoption | Date Requirements Apply to Create Emissions Reductions |
|---|---|---|---|---|
| **VOC Content Limits for Consumer Products** | VOC | 22a-174-40 | Adoption completed July 26, 2007 | January 1, 2009 |
| **Design Improvements for Portable Fuel Containers (1) and (2)** | VOC | 22a-174-43 | Initial rule adopted May 10, 2004; amendment adopted January 29, 2007 | 1) Initial rule: May 1, 2004<br>2) Amendment: July 1, 2007 |
| **VOC Content Limits for Architectural and Industrial Maintenance (AIM) Coatings** | VOC | 22a-174-41 | Adoption completed July 26, 2007 | May 1, 2008 |
| **Restrictions on Asphalt in Paving Operations** | VOC | 22a-174-20(k) | Public hearing held May 1, 2007 | May 1, 2008 (anticipated) |
| **Restrictions on the Manufacture and Use of Adhesives and Sealants** | VOC | 22a-174-44 | Public hearing held October 16, 2007 | January 1, 2009 (anticipated) |
| **Automotive refinishing operations** | VOC | 22a-174-3b(d) | Adoption of amendment completed on April 4, 2006 | April 4, 2006 |
| **Stage II Vapor Recovery – Gasoline Service Station Pressure Vent Valves** | VOC | 22a-174-30 | Adoption of amendment completed on May 10, 2004 | May 10, 2005 |
| **Reduced Vapor Pressure Limitation for Solvent Cleaning** | VOC | 22a-174-20(*l*) | Adoption completed July 26, 2007 | May 1, 2008 |
| **Standards for Municipal Waste Combustion** | $NO_X$ | 22a-174-38 | Adoption of amendment completed October 26, 2000 | May 1, 2003 |
| **$NO_X$ Reductions from Industrial, Commercial and Institutional (ICI) Boilers** | $NO_X$ | 22a-174-22 | Public hearing held October 19, 2006 | May 1, 2009 (anticipated) |
| **CAIR $NO_X$ Ozone Season Trading Program** | $NO_X$ | 22a-174-22c | Adoption completed September 4, 2007 | May 1, 2009 |

emissions reductions associated with the May 10, 2004 amendment were approved for 1-hour ozone attainment purposes on August 31, 2006.[41]

### VOC Reductions from Portable Fuel Container Spillage Control

R.C.S.A. section 22a-174-43 (Section 43), which was adopted on May 10, 2004, reduces emissions of VOCs by requiring the sale of portable fuel containers (PFCs) designed to minimize spillage and fugitive evaporative emissions. This regulation is based on an OTC model rule that requires manufacturers of particular PFCs to reformulate to meet VOC limits. The 2004 regulation and the associated emissions reductions were approved for 1-hour ozone NAAQS attainment on August 31, 2006.[42]

### Municipal Waste Combustor (MWC) $NO_X$ Reductions

Connecticut has six facilities that burn municipal waste to create electricity. These six facilities account for approximately thirty percent of the actual annual $NO_X$ emissions from the major $NO_X$ emitters in the state and are regulated by RCSA section 22a-174-38 (Section 38). Section 38 became effective on June 28, 1999 and included $NO_X$ emission limits that were equivalent to the emission limits established in the federal emissions guidelines for MWCs. An October 26, 2000 amendment to Section 38 reduced the $NO_X$ emission limits below the 1999 levels beginning May 1, 2003. EPA approved the amended regulation and associated emissions reductions for 2007 1-hour ozone NAAQS attainment on December 6, 2001.[43]

### 4.2.2.2 Measures Adopted for 8-Hour Ozone Standard Attainment

Although currently mandated controls, including those identified in Sections 4.2.1 and 4.2.2.1, will achieve significant emission reductions over the next five to ten years, additional emission reductions beyond current requirements will be necessary for timely attainment and maintenance of the 8-hour ozone NAAQS. To address this need, Connecticut has adopted or is in pursuing adoption of seven additional control measures to influence Connecticut’s nonattainment status towards attainment. These seven measures, all of which are based on OTC model rules, are described here.

### Additional VOC Reductions from Portable Fuel Container Spillage Control

An amendment to Section 43 became effective on January 29, 2007. The amended version of R.C.S.A. section 22a-174-43 increases the effectiveness of the 2004 rule by simplifying PFC design requirements and minimizing the potential for misuse by expanding the definitions to include kerosene cans and utility jugs. The amendment also incorporates California’s new PFC certification program, which begins July 1, 2007. Once implemented, the CARB certification process streamlines the regulatory requirements for manufacturers and simplifies compliance determinations for PFCs to meet the regulatory requirements. Amended R.C.S.A. section 22a-174-43 is consistent with a 2006 OTC model rule for portable fuel containers.

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[41] 71 FR 51761.

[42] 71 FR 51761.

[43] 66 FR 63311

## VOC Content Limits for Consumer Products

Most states in the OTR have adopted regulations based on a 2001 OTC Model Rule for Consumer Products. That OTC Model Rule was, in turn, based on consumer product requirements in California. Connecticut opted not to adopt a regulation for 1-hour ozone NAAQS attainment purposes based on that initial OTC model rule.

The OTC states were prompted to revisit the 2001 OTC model rule for consumer products in 2005 when California amended its consumer products program to create additional VOC reductions by reducing the VOC content limits for certain products and specifying new VOC content limits for additional products. This led to the creation of a 2006 OTC model rule for consumer products.

CTDEP has adopted regulation, R.C.S.A. section 22a-174-40, consistent with the 2006 OTC model rule for consumer products. The new Connecticut regulation will apply to anyone who sells, supplies, offers for sale or manufactures for sale regulated products sold on or after January 1, 2009.

## VOC Content Limits for Architectural & Industrial Maintenance (AIM) Coatings

New R.C.S.A. section 22a-174-41 (Section 41) will limit VOC emissions from AIM coatings through VOC content limits developed in 2001 by the OTC as part of a model rule. Section 41 will apply to anyone who sells, supplies, offers for sale or manufactures for sale in the State of Connecticut any AIM coating for use in the State of Connecticut and to any person who applies or solicits the application of any AIM coating within the State of Connecticut on or after the implementation date of May 1, 2008.

## Additional VOC Reductions from Solvent Cleaning (Metal Degreasing)

In 2001, solvent cleaning was identified by the OTC as a control measure for which many states in the region could achieve further VOC emission reductions by implementing measures to go beyond applicable federal control technique guideline (CTG) requirements. A model rule was developed that includes hardware and operating requirements and alternative compliance options for vapor cleaning machines used to clean metal parts. These requirements are based on the Federal maximum achievable control technology (MACT) standard for chlorinated solvent vapor degreasers. The OTC Model Rule for Solvent Cleaning establishes a limitation on the vapor pressure of solvents used in cold cleaning and additional operating practices to further limit VOC emissions from metal cleaning.

The Department has recently amended pre-existing requirements for solvent cleaning in R.C.S.A. section 22a-174-20(*l*) to include the vapor pressure limitation for solvents used in cold cleaning plus additional operating requirements recommended by the OTC Model Rule. Compliance with the new vapor pressure limitation will be required as of May 1, 2008.

## VOC Reductions from Asphalt Paving

Connecticut is pursuing adoption of an amendment to the current Connecticut regulation for asphalt paving, R.C.S.A. section 22a-174-20(k). The existing rule, based on a 1977 CTG, restricts the use of cutback asphalt during the ozone season to that which emits, under test conditions, less than five percent of the total solvent contained in the asphalt. The existing rule also provides exemptions for specific uses such as penetrating prime coats and long-term storage. The proposed amendment removes exemptions and requires more stringent VOC content limits for cutback and emulsified asphalt. The amended regulation would be consistent with Delaware's emissions limitations for asphalt paving and a 2006 OTC model rule applicable to asphalt paving. The amended requirements are anticipated to apply beginning May 1, 2008.

## VOC Reductions from Adhesives and Sealants

CTDEP is pursuing adoption of a new section of the air quality regulations, R.C.S.A. section 22a-174-44 (Section 44), to limit emissions of VOCs from adhesives, sealants and primers. Section 44 will achieve VOC reductions through two basic components: sale and manufacture restrictions that limit the VOC content of specified adhesives, sealants and primers sold in the state; and use restrictions that apply primarily to commercial/industrial operations. By reducing the availability of higher VOC content adhesives and sealants within the state, the sales prohibition is also intended to address adhesive and sealant usage at area sources. In addition to the VOC content limits and use requirements, Section 44 will include requirements for cleanup and preparation solvents and a compliance alternative in the form of add-on air pollution control equipment.

CTDEP held a public hearing on a proposed adhesive and sealant regulation on October 16, 2007. The proposed regulation is based on an OTC model rule, which is, in turn, based on a reasonably available control technology determination prepared by the CARB in 1998.

Presently, the air quality regulations only cover the use of adhesives in very limited circumstances; the requirements of this proposal apply to more activities, regulate more materials and are more prescriptive than the limited requirements in Connecticut's current regulations. The new regulation is anticipated to apply as of January 1, 2009.

## $NO_X$ Reductions from ICI Boilers

Any facility in Connecticut that has the potential to emit at least fifty tons per year of $NO_X$ is regulated by R.C.S.A. section 22a-174-22 (Section 22). Section 22 also applies to sources in the southwestern part of the State, the "severe" area, that have the potential to emit at least twenty-five tons per year of $NO_X$. Therefore, all major $NO_X$ RACT sources under the 8-hour ozone NAAQS (i.e. those with potential emissions of at least 100 tpy) are regulated by this section. Section 22 was approved as part of Connecticut's 1-hour ozone attainment demonstration.

Based on 2001 and 2006 OTC model rules, CTDEP proposed for public hearing on October 19, 2006 an amended version of Section 22 that includes more stringent emission and control requirements such that all major $NO_X$ sources will meet or exceed RACT.

### 4.2.2.3 The Clean Air Interstate Rule (CAIR) Nitrogen Oxides ($NO_X$) Ozone Season Trading Program

Effective May 1, 2009, a new regulation will replace the market-based emissions cap-and-trade program of R.C.S.A. section 22a-174-22b, Connecticut's Post-2002 $NO_X$ Budget Program, with a similar program to reduce emissions of $NO_X$ and reduce the regional transport of ozone. All the sources that now participate in the trading program of R.C.S.A. section 22a-174-22b will be subject to the CAIR trading program. With the transition to the new program, the ozone season budget will be reduced from 4,466 tons in 2008 to 2,691 tons beginning in 2009. As a result of the decreased ozone season budgets in Connecticut and in states throughout the region, $NO_X$ emissions levels are expected to continue to decline beyond the emissions reductions achieved in the $NO_X$ SIP Call trading program. On April 28, 2006 EPA finalized its CAIR Federal Implementation Plan (FIP).[44] EPA published approval of CTDEP's CAIR regulation on January 24, 2008, indicating that a separate rulemaking will be issued withdrawing the FIP.

## 4.3 Future Year Emission Projections

EPA's Phase 2 Ozone Implementation Rule[45] for the 8-hour NAAQS requires states such as Connecticut, with moderate nonattainment areas, to achieve a 15 % reduction in ozone precursor emissions between 2002 and 2008. The rule also requires submittal of attainment year (i.e., 2009) inventories incorporating the effects of adopted control measures. Continued emission reductions beyond the statutory attainment date are also needed as contingency measures and to maintain attainment once it is achieved. In response to these requirements, CTDEP has prepared projected future year inventories for 2008, 2009 and 2012. Emissions projections were developed from the 2002 Base Year Inventory (see Section 4.1) by applying appropriate growth factors and post-2002 control levels to each source category.

The following subsections describe the selection of growth factors for each source category, estimated reductions from post-2002 controls, and resulting future year emission projections for 2008, 2009 and 2012.

### 4.3.1 Growth Factors

Growth factors for most industrial-related stationary point and area source categories were developed using statewide employment projections obtained from the Connecticut Department of Labor (CTDOL)[46]. CTDOL sector-specific employment estimates for 2004 and employment forecasts out to 2014 were used to derive linearly interpolated employment growth estimates for 2008, 2009 and 2012. For reference purposes, CTDOL projects that total employment in

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[44] 71 FR 25328.

[45] 70 FR 71612.

[46] "Connecticut's Industries and Occupations: Forecast 2014"; Connecticut Department of Labor; Summer 2006; See http://www.ctdol.state.ct.us/lmi/misc/forecast2014.pdf.

Connecticut will increase by 8.5% between 2002 and 2012. However, total manufacturing employment, more directly related to stationary source emissions, is projected to decrease by 5.3% over the same period. Detailed CTDOL employment projections by industry category, and resultant 2002 through 2012 growth factors, are included in Appendix 4D.

Growth factors for gasoline storage and marketing activities were estimated by extrapolating statewide gasoline consumption data from the 1996 through 2005 period out through 2012. Based on these data, obtained from the Federal Highway Administration's (FHWA) "Highway Statistics Series"[47], gasoline consumption is projected to increase by 1.9% annually between 2002 and 2012. A summary of the FHWA's data is included in Appendix 4D.

Statewide forecasted population growth, obtained from the United States Census Bureau[48], was used to project future year emissions for the following categories: architectural coatings, dry cleaning, consumer/commercial solvent usage, publicly owned treatment works, residential fuel combustion, wood stoves, structural fires and open burning. Statewide population is projected to increase by 3.0% in 2008, 3.4% in 2009 and 4.5% in 2012 from an estimated 2002 population of 3,445,579. The Census Bureau's data are summarized in Appendix 4D.

Statewide forecasts of growth in vehicle miles traveled (VMT), provided by CTDOT, were used to project future year emissions for the following categories: on-road vehicles, traffic markings, cutback asphalt paving and asphalt paving. CTDOT forecasts[49] that summer season average daily traffic (ADT) will increase by 7.5% in 2008, 8.6% in 2009 and 11.8% in 2012 from 2002 VMT levels of 92,845,131. A summary of CTDOT's projected VMT is provided in Appendix 4D.

Default growth factors included in EPA's NONROAD2005 model were used to project future emissions for most non-road source categories. The NONROAD2005 model incorporates national growth projections based on a time series analysis of historical non-road engine populations from 1989 through 1996, segregated by market sector and fuel type[50]. As described above, CTDOL employment projections were used to derive growth factors for aircraft, locomotive and commercial marine engines, which are not considered by the NONROAD2005 model.

Connecticut's $NO_X$ Budget Program and regulation to implement EPA's Clean Air Interstate Rule (CAIR) (both described in Section 4.2) establish a decreasing cap on $NO_X$ emissions from electric generating units (EGU) and other large fuel combustion units. As a result, emissions growth for the EGU sector is limited to VOC emissions. Growth in EGU VOC emissions was approximated by assuming that the annual growth in seasonal heat input (i.e., 1.43%) for $NO_X$ Budget sources between 2002 and 2006 would continue at the same pace through 2012.

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[47] FHWA Highway Statistic Series; Tables MF-2; See http://www.fhwa.dot.gov/policy/ohpi/qffuel.htm.

[48] US Census Bureau; See link to "File 1" at http://www.census.gov/population/www/projections/projectionsagesex.html.

[49] Based on CTDOT's Series 28D estimates.

[50] Further information on EPA's development of non-road equipment population growth can be found in the technical report "Nonroad Engine Growth Estimates"; EPA420—P-04-008; April 2004; NR-008c; See: http://www.epa.gov/omswww/models/nonrdmdl/nonrdmdl2004/420p04008.pdf.

Consistent with CTDEP's recently updated Solid Waste Management Plan[51], no growth in emissions is projected for municipal waste combustion or landfills. Connecticut's resource recovery facilities (RRF) are operating at or near capacity, with no current plans to expand RRF or landfill capacity. The new plan lays out a strategy to address potential growth in waste generation through increased source reduction, reuse, recycling, and composting.

Categories assumed to have no growth in emissions relative to 2002 also include forest fires and biogenic emission sources.

### 4.3.2 Post-2002 Emission Reductions

Numerous federal and state control measures have been or will be adopted and incorporated into this ozone SIP, providing significant post-2002 emission reductions to meet CAA requirements for reasonable further progress and timely attainment of the 8-hour ozone NAAQS. Section 4.2 provides a description of each of the control measures, including regulation adoption and implementation schedules. Table 4.3.2 provides a summary of estimated emission reductions expected in 2008, 2009 and 2012 from each of the measures. The following paragraphs briefly outline how reductions were determined; more detailed calculations are provided in Appendix 4E.

#### On-Road Mobile Source Control Programs

As described in Section 4.2.1.1, EPA has adopted a number of increasingly more stringent fuel and new engine standards over the last several years for passenger vehicles, motorcycles, buses and heavy-duty trucks. As the fleet of light-duty and heavy-duty vehicles gradually turns over, emissions will continue to decrease significantly. In addition, in 2005, Connecticut upgraded the vehicle emission inspection and maintenance (I/M) program to include testing of the on-board diagnostic (OBDII) systems included in light duty vehicles manufactured since the late 1990's. CTDEP applied the EPA's MOBILE6.2 model to estimate the impacts of these programs in 2008, 2009 and 2012, accounting for growth in vehicle miles traveled and CTDOT's planned improvements to the roadway and transit networks. Projected reductions from 2002 emission levels, after accounting for growth, are summarized in Table 4.3.2. More detailed summaries of on-road mobile source emission estimates for 2008, 2009, and 2012 are included in Appendix 4E. MOBILE6.2 model input files are contained in Appendix 4A.

#### Federal Non-Road Mobile Source Control Programs

Section 4.2.1.2 also describes federal requirements for increasingly more stringent fuel and new engine standards for a variety of land-based and water-based non-road engines. Many of the federal non-road regulations are being phased in; therefore, in combination with gradual fleet turnover, emission reductions from this sector will continue to occur through 2012 and beyond. The EPA's NONROAD2005 model was used to determine emission reductions expected from the federal program. Estimated reductions compared to 2002 emission levels, accounting for growth, are included in Table 4.3.2. More detailed summaries of non-road mobile source

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[51] Connecticut's "Solid Waste Management Plan" was approved by CTDEP Commissioner Gina McCarthy on December 20, 2006; see http://www.ct.gov/dep/cwp/view.asp?a=2718&q=325482&depNav_GID=1646#SWMP.

## Table 4.3.2: Estimated Statewide Emission Reductions From Post-2002 Ozone Control Strategies

**(tons/day)**

| | 2008 | | 2009 | | 2012 | |
|---|---|---|---|---|---|---|
| Control Strategy | VOC | $NO_X$ | VOC | $NO_X$ | VOC | $NO_X$ |
| Federal **On-Road** Control Programs (see: http://www.epa.gov/omswww/url-fr.htm) and Connecticut's **On-Board Diagnostic** Inspection & Maintenance Program (RCSA 22a-174-27) | 35.3 | 77.2 | 39.7 | 88.2 | 53.0 | 119.0 |
| Federal **Non-Road** Control Programs (see: http://www.epa.gov/nonroad-diesel/regulations.htm) | 25.9 | 7.8 | 29.4 | 10.1 | 35.4 | 17.0 |
| VOC Content Limits for **Consumer Products** (RCSA 22a-174-40) | 0.0 | n/a | 6.6 | n/a | 6.7 | n/a |
| Design Improvements for **Portable Fuel Containers** (RCSA 22a-174-43) | 1.9 | n/a | 3.0 | n/a | 6.0 | n/a |
| VOC Content Limits for Architectural and Industrial Maintenance **(AIM) Coatings** (RCSA 22a-174-41) | 6.6 | n/a | 6.6 | n/a | 6.7 | n/a |
| Restrictions on **Asphalt in Paving** Operations (RCSA 22a-174-20(k)) | 0.0 | n/a | 3.9 | n/a | 4.1 | n/a |
| Restrictions on the Manufacture and Use of **Adhesives and Sealants** (RCSA 22a-174-44) | 0.0 | n/a | 4.2 | n/a | 4.7 | n/a |
| **Automotive Refinishing** Operations[1] (RCSA 22a-174-3b(d)) | 0.0 | n/a | 0.0 | n/a | 0.0 | n/a |
| Pressure-Vacuum **Gas Station Vent Valves** (RCSA 22a-174-30) | 0.7 | n/a | 0.8 | n/a | 0.8 | n/a |
| Reduced Vapor Pressure Limitation for **Solvent Cleaning** (RCSA 22a-174-20(*l*)) | 9.6 | n/a | 9.5 | n/a | 9.4 | n/a |
| Standards for **Municipal Waste Combustion** (RCSA 22a-174-38) | n/a | 1.0 | n/a | 1.0 | n/a | 1.0 |
| $NO_X$ Reductions from **ICI Boilers** (RCSA 22a-174-22) | n/a | 0.0 | n/a | 3.1 | n/a | 3.1 |
| **CAIR** $NO_X$ Ozone Season Trading Program (RCSA 22a-174-22c) | n/a | n/a | n/a | 1.7 | n/a | 1.7 |
| **Total Post-2002 Estimated Statewide Emission Reductions[2]** | **80.0** | **86.0** | **103.7** | **104.1** | **126.8** | **141.8** |

n/a – not applicable

[1] Although CTDEP's original automobile refinishing regulation was adopted in 2002, many refinishing shops began using high volume-low pressure spray guns (or equivalent) in prior years. As a result, CTDEP has conservatively assumed that no additional VOC reductions occur in the post-2002 period.

[2] Reductions are relative to emission levels without the post-2002 controls. For comparison purposes, 2002 statewide anthropogenic emissions are estimated as 391.1 tons/day of VOC and 331.8 tons/day of $NO_X$.

emission estimates for 2008, 2009, and 2012 are included in Appendix 4E. NONROAD2005 model input files are contained in Appendix 4A.

## Consumer Products

Consumer and commercial products are those items sold to retail customers for personal, household or automotive use, along with products marketed by wholesale distributors for use in commercial or institutional settings such as beauty shops, schools and hospitals. VOC emissions from these products are the result of the evaporation of propellant and organic solvents during use. Emission estimates for 2002 include the effects of EPA's federal consumer and commercial products rule, was adopted in 1998 under the authority of CAA section 183(e). The federal rule limits the VOC content of 24 product categories representing about 48% of the consumer and commercial products inventory nationwide.

CTDEP worked with other OTC states to develop model rules for consumer products in 2001 and 2006. OTC's 2001 model rule, which is similar to rules developed by the California Air Resources Board (CARB) in the late 1990's, expands the number of covered consumer and commercial product categories to a total of 80, and requires more stringent limits than the federal rule. The 2001 OTC model rule provides VOC reductions from the total consumer product inventory that are 14.2% greater than the national rule reductions[52]. The 2006 OTC model rule regulates 14 new product categories, based on recent CARB rule updates through July 2005, providing an additional 2% overall reduction in emissions[53] compared to the 2001 OTC model rule (i.e., 15.9% reduction overall, relative to emission levels after the federal rule).

As described in Section 4.2.3, CTDEP has recently adopted a state regulation consistent with the requirements of both OTC model rules. The rule, which is scheduled to be implemented in January 2009, is expected to produce the emission reductions summarized in Table 4.3.2. A more complete summary of emission reduction calculations is included in Appendix 4E.

## Portable Fuel Containers

Future year emission reductions, which are expected to result from Connecticut's January 2007 revision to the portable fuel container regulation, were determined using the CARB procedures referred to in Section 4.1.2. As documented in Section 4.3.1, annual growth of 1.9% in gasoline usage was assumed. Based on a 10-year turnover to fully compliant fuel containers, the combination of Connecticut's original 2004 rule and the January 2007 revision is estimated to achieve a 19.5% reduction in VOC emissions by 2008, 30.2% by 2009 and a 58.1% reduction by 2012. In 2018, when all fuel containers are compliant, reductions are expected to reach 85.3% from uncontrolled levels. Corresponding reductions in tons/day are listed in Table 4.3.2. A more detailed documentation of emissions reduction calculations is included in Appendix 4E.

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[52] "Control Measure Development Support Analysis of Ozone Transport Commission Model Rules"; OTC & E.H. Pechan & Associates, Inc.; March 31, 2001; See http://www.otcair.org/document.asp?Fview=Report#.

[53] "Identification of Candidate Control Measures: Final Technical Support Document"; OTC & MACTEC; February 28, 2007; See http://www.otcair.org/document.asp?fview=Report.

## AIM Coatings

As described in Section 4.2.3, CTDEP has recently adopted a regulation to implement the requirements of the OTC 2001 model rule[54] for architectural and industrial maintenance (AIM) coatings. The regulation requires manufacturers to reformulate coatings to meet the specified VOC content limits initially developed by CARB, providing a 31% VOC reduction beyond the levels achieved by the national rule implemented by EPA in 1998. Connecticut's regulation, which is scheduled to be implemented in May 2008, is expected to produce the emission reductions summarized in Table 4.3.2. A more complete summary of emission reduction calculations is included in Appendix 4E.

## Asphalt Paving Operations

Asphalt paving is used to pave, seal and repair surfaces such as roads, parking lots, driveways, walkways and airport runways. There are three general categories of asphalt paving: cutback, emulsified and emulsified. Hot mix asphalt plants are regulated and permitted by CTDEP at the time they are built or modified. Hot mix asphalt, the most commonly used paving asphalt, produces minimal VOC emissions because its organic components have high molecular weights and low vapor pressures. Cutback asphalt, typically prepared by blending asphalt cement with a diluent that can contain 25 to 45 percent petroleum distillate, produces the highest level of VOC emissions. Emulsified asphalt, typically prepared by blending asphalt cement with water and an emulsifying agent, is a lower emitting alternative to cutback asphalt.

CTDEP is currently in the process of modifying its existing regulation to implement the recommendations of OTC's 2006 model rule.[55]. The draft rule eliminates the use of cutback asphalt during the ozone season and limits the VOC content of emulsified asphalt. Emission reductions expected to result from the revised regulation are summarized in Table 4.3.2, with more complete documentation of emission reduction calculations provided in Appendix 4E.

## Adhesives and Sealants

Adhesives and sealants are used in product manufacturing, packaging and construction and in the installation of metal, wood, plastic and other materials. Adhesives are used to bond two surfaces together. Sealants are materials with adhesive properties that are used to fill, seal or weatherproof gaps or joints between two surfaces. VOC emissions from this category result from solvent evaporation during surface preparation, transfer, drying and cleanup activities, largely from building construction, floor covering installations and roof repair operations.

As described in Section 4.2.3, CTDEP is currently pursuing the adoption of a new regulation implementing the requirements of the OTC 2006 model rule for adhesives and sealants;[56] with implementation currently scheduled to begin in 2009. The OTC model rule, based on a rule

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[54] "Control Measure Development Support Analysis of Ozone Transport Commission Model Rules"; OTC & E.H. Pechan & Associates, Inc.; March 31, 2001; See http://www.otcair.org/document.asp?Fview=Report#.
[55] "Identification of Candidate Control Measures: Final Technical Support Document"; OTC & MACTEC; February 28, 2007; See http://www.otcair.org/document.asp?fview=Report.
[56] Ibid.

developed by CARB in 1998, is estimated to provide a VOC emission reduction of 64.4% from unregulated industrial/commercial adhesive and sealants. Connecticut's expected emission reductions from the revised regulation are summarized in Table 4.3.2, with more complete documentation of emission reduction calculations provided in Appendix 4E.

## Automotive Refinishing

Connecticut adopted a regulation in 2002 requiring improved transfer efficiency of paint sprays used in automotive refinishing operations, with subsequent modifications to the regulation occurring as recently as 2006. Although CTDEP's original automobile refinishing regulation became effective in 2002, many refinishing shops began using high volume-low pressure spray guns (or equivalent) in prior years. As a result, CTDEP has conservatively assumed that no additional VOC reductions occur in the post-2002 period.

## Gasoline Station Pressure-Vacuum Vent Valves

Prior to the May 2004 amendment to CTDEP's Stage II gasoline refueling regulation, pressure-vacuum (PV) vent valves were only required at Stage II gasoline stations equipped with vacuum assist dispensing nozzles. The amended regulation required all gasoline stations with Stage II systems to install PV vent valves by May 2005. As a result, over 96% of all gasoline sold in Connecticut is now dispensed at stations equipped with PV vent valves to limit the amount of gasoline vapors escaping from underground storage tanks. Following the procedures used in CTDEP's December 2005 version of the 2002 periodic inventory, and accounting for estimated growth in gasoline sales, the regulation results in nearly one ton per day of VOC emission reductions (see Table 4.3.2). Documentation of emission reduction calculations is included in Appendix 4E.

## Solvent Cleaning

As described in Section 4.2.3, CTDEP has recently revised a regulation to implement the major requirements of the OTC 2001 model rule for solvent cleaning operations[57]. The revised regulation, scheduled for implementation in May 2008, includes vapor pressure limitations for cold cleaning solvents and additional operating requirements recommended by the OTC model rule. Emission reductions expected in Connecticut from the revised regulation are summarized in Table 4.3.2, with more complete documentation of emission reduction calculations provided in Appendix 4E.

## Municipal Waste Combustion

Connecticut's MWC $NO_X$ regulation[58] (RCSA 22a-174-38) was implemented in two phases, as described in Section 4.2.2. The emission limits for Phase 1 were implemented in 1999 and are reflected in the 2002 Base Year Inventory. Phase 2 of the regulation required further emission

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[57] "Control Measure Development Support Analysis of Ozone Transport Commission Model Rules"; OTC & E.H. Pechan & Associates, Inc.; March 31, 2001; See http://www.otcair.org/document.asp?Fview=Report#. (hereinafter referred to as Pechan.)

[58] RCSA 22a-174-38.

reductions, with implementation in 2003. The Phase 2 portion of the regulation results in post-2002 $NO_X$ emission reductions of one ton per day, as listed in Table 4.3.2. A more complete summary of emission reduction calculations is included in Appendix 4E.

**Industrial/Commercial/Institutional Boilers**

As described in Section 4.2.2, CTDEP is currently pursuing a regulatory revision to incorporate many of the recommendations of OTC's 2001[59] and 2006[60] model rules for industrial, commercial and institutional (ICI) boilers. As of this writing, $NO_X$ emission limits for the final version of that regulation are yet to be determined. In recognition of this uncertainty, CTDEP has conservatively calculated the emission reductions listed in Table 4.3.2 by applying both an 80% rule effectiveness and 80% rule penetration to the reductions achievable with the OTC 2006 model rule. More detailed calculations are included in Appendix 4E.

**CAIR Ozone Season $NO_X$ Trading Program**

Connecticut's CAIR regulation, scheduled for implementation in 2009, will establish a revised statewide $NO_X$ budget of 2,691 tons per ozone season for electric generating units and large industrial boilers. When compared to 2002 actual emission levels for covered sources (i.e., 2,948 tons during the 2002 ozone season), the new budget is estimated to provide 1.7 tons/day of $NO_X$ reductions starting in 2009.

### 4.3.3 Emission Projections for 2008, 2009, and 2012

Future year emission projections were developed from the 2002 Base Year Inventory, applying the growth factors described in Section 4.3.1 and the emission reductions described in Section 4.3.2. Resulting emission projections for 2008, 2009 and 2012 are depicted in Tables 4.4.1 and 4.4.2 for each of Connecticut's 8-hour nonattainment areas and Figures 4.4.1 and 4.4.2 for all of Connecticut.

Both VOC and $NO_X$ emissions are projected to decrease dramatically in Connecticut over the 10-year period from 2002 to 2012 due to federal and state control programs. Statewide anthropogenic VOC emissions are projected to decrease 19% by 2008, 25% by 2009 and 30% by 2012, after accounting for growth. Statewide $NO_X$ emission reductions are projected to be even greater, with estimated reductions of 25% by 2008, 31% by 2009 and 42% by 2012.

## 4.4 Additional Reductions Not Included In Emission Projections

The emission reductions discussed in this section, and depicted in Tables 4.4.1 and 4.4.2 and Figures 4.4.1 and 4.4.2, result from the control strategies relied upon to comply with RFP and modeled attainment requirements. Several other programs are in place, or are being pursued, that would provide additional, significant emission reductions, increasing the probability of achieving attainment in the 2009 timeframe. These strategies, examples of which include

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[59] Pechan.

[60] "Identification of Candidate Control Measures: Final Technical Support Document"; OTC & MACTEC; February 28, 2007; See http://www.otcair.org/document.asp?fview=Report.

energy efficiency and demand side management of electricity demand, a high electricity demand day (HEDD) initiative, additional proposed federal non-road standards and telecommuting incentives, are described as part of the weight-of-evidence discussion later in this document (see Section 8.5.5).

### Table 4.4.1
**Summary of Greater Connecticut's Projected Emission Trends 2002 –2012**
**(tons / summer day)**

| | **2002** | | **2008** | | **2009** | | **2012** | |
|---|---|---|---|---|---|---|---|---|
| **Greater Connecticut** | **VOC** | **NOx** | **VOC** | **NOx** | **VOC** | **NOx** | **VOC** | **NOx** |
| Stationary Point | 4.6 | 19.0 | 4.6 | 18.8 | 4.6 | 17.9 | 4.6 | 18.1 |
| Stationary Area | 75.5 | 6.4 | 69.5 | 6.5 | 61.6 | 5.6 | 61.0 | 5.7 |
| On-Road Mobile | 45.1 | 89.3 | 28.5 | 54.3 | 26.3 | 49.2 | 19.8 | 34.8 |
| Non-Road Mobile | 56.2 | 30.8 | 46.7 | 27.4 | 45.2 | 26.4 | 42.3 | 23.3 |
| **Total Anthropogenic** | **181.4** | **145.5** | **149.3** | **107.0** | **137.8** | **99.1** | **127.7** | **81.9** |
| Biogenic | 268.6 | 1.3 | 268.6 | 1.3 | 268.6 | 1.3 | 268.6 | 1.3 |
| **Total Emissions** | **450.0** | **146.8** | **417.9** | **108.2** | **406.4** | **100.4** | **396.3** | **83.2** |

### Table 4.4.2
**Summary of Southwest Connecticut's Projected Emission Trends 2002 –2012**
**(tons / summer day)**

| | **2002** | | **2008** | | **2009** | | **2012** | |
|---|---|---|---|---|---|---|---|---|
| **Southwest Connecticut** | **VOC** | **NOx** | **VOC** | **NOx** | **VOC** | **NOx** | **VOC** | **NOx** |
| Stationary Point | 11.3 | 37.7 | 11.8 | 38.3 | 11.8 | 35.6 | 12.1 | 35.9 |
| Stationary Area | 84.1 | 7.2 | 76.6 | 7.4 | 69.4 | 6.6 | 68.6 | 6.7 |
| On-Road Mobile | 48.3 | 102.7 | 29.7 | 60.5 | 27.4 | 54.6 | 20.6 | 38.2 |
| Non-Road Mobile | 66.0 | 38.7 | 49.5 | 34.3 | 47.6 | 33.0 | 44.5 | 29.2 |
| **Total Anthropogenic** | **209.7** | **186.3** | **167.6** | **140.5** | **156.2** | **129.8** | **145.8** | **109.9** |
| Biogenic | 125.6 | 0.7 | 125.6 | 0.7 | 125.6 | 0.7 | 125.6 | 0.7 |
| **Total Emissions** | **335.3** | **187.0** | **293.2** | **141.2** | **281.8** | **130.4** | **271.4** | **110.6** |

**Figure 4.4.1: Projected Anthropogenic VOC Emission Trends for Connecticut**

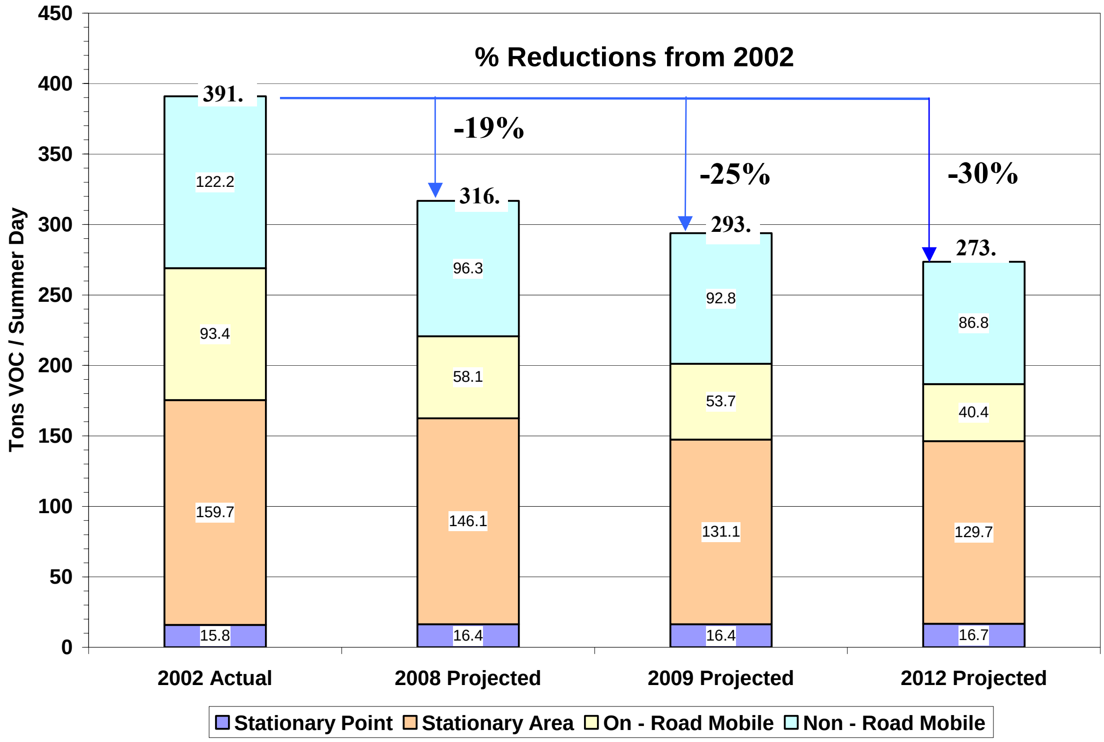
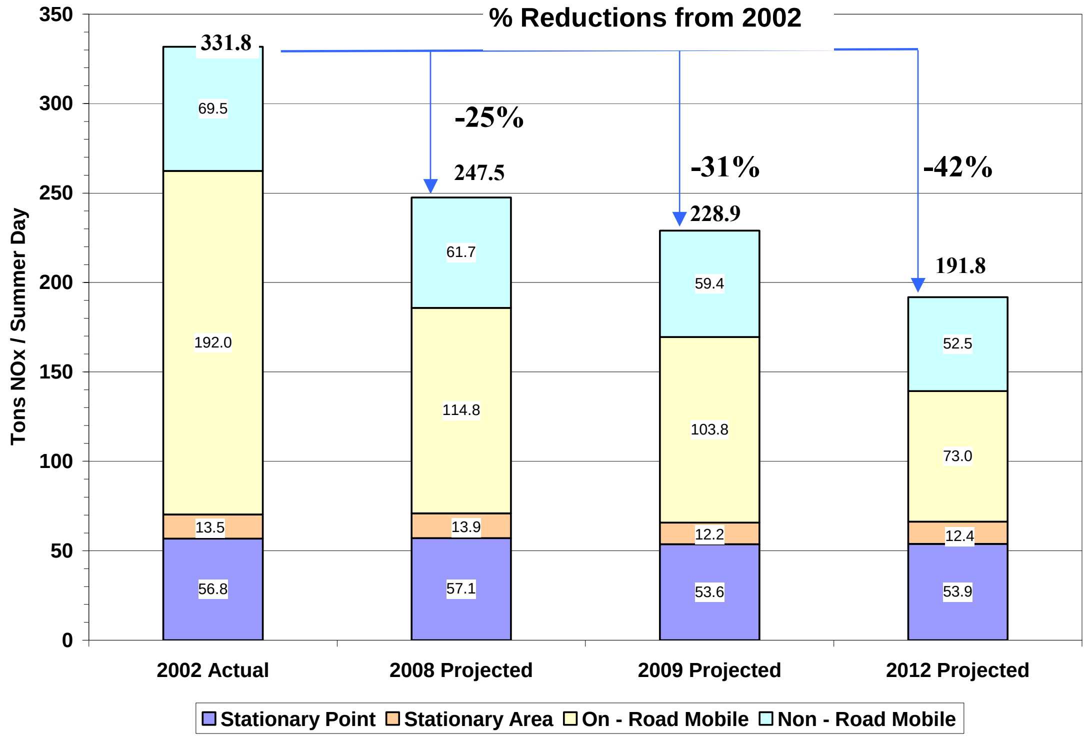


**Figure 4.4.2: Projected Anthropogenic NOx Emission Trends for Connecticut**



## 5.0 Meeting Reasonable Further Progress Requirements

The Phase 2 Ozone Implementation Rule[1] includes EPA's interpretation of the CAA requirement that nonattainment areas demonstrate reasonable further progress (RFP) towards attaining the ozone NAAQS. For moderate 8-hour ozone nonattainment areas, such as Greater Connecticut and Southwest Connecticut, with attainment dates at least five years after designation, the rule requires a demonstration that areas will achieve at least a 15% emission reduction between 2002 and 2008. The 15% reduction requirement can be satisfied with any combination of VOC and $NO_X$ reductions. Additional reductions are also required to achieve attainment beyond 2008.

In order to demonstrate RFP, a region must show that its projected emissions, termed controlled inventories, of $NO_X$ and VOC will be less than or equal to the target levels set for the end of the RFP period, or "milestone year." For the 2002-2008 RFP period, the "target inventories" of emissions are the maximum quantity of anthropogenic emissions permissible during the 2008 milestone year. This section describes the methodology and calculations used to establish the 2008 target inventories for both the Greater Connecticut and Southwest Connecticut areas. It also demonstrates that both areas will meet RFP requirements because projected $NO_X$ and VOC emissions will be less than the calculated target levels.

## 5.1 Methodology and Calculations for Determining Emission Target Levels

Procedures for determining emissions levels for the 2008 RFP targets are specified by EPA in Appendix A to the Preamble of the Phase 2 rule[2]. EPA provided additional guidance in a memorandum issued in August 2006[3]. The following methodology description and calculations comport with those procedures.

## 5.2 Calculation of 2008 Target Levels

EPA's RFP methodology specifies the steps involved in calculating 2008 emission target levels that satisfy the 15% RFP emission reduction requirement.

### Step 1: Develop 2002 Base Year RFP Inventory

The 2002 RFP inventory is comprised of all anthropogenic sources of VOC and $NO_X$ for a typical ozone season weekday in 2002, including all control programs in place at that time. The 2002 baseline RFP inventory, which is identical to the 2002 Base Year Inventory presented in Section 4.1.3, is summarized in Tables 5.2.1 and 5.2.2 for each of Connecticut's nonattainment areas.

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[1] 70 FR 71612.

[2] 70 FR 71696.

[3] "8-Hour Ozone National Ambient Air Quality Standards (NAAQS) Implementation – Reasonable Further Progress (RFP)"; Memorandum from William T. Harnett (EPA OAQPS) to Regional Air Division Directors; August 15, 2006; See: http://www.epa.gov/air/ozonepollution/SIPToolkit/documents/rfp_20060815.pdf.

## Table 5.2.1
## Greater Connecticut's 2002 Reasonable Further Progress Inventory
**(tons / summer day)**

| Source Category | VOC | $NO_X$ |
|---|---|---|
| Stationary Point | 4.6 | 19.0 |
| Stationary Area | 75.5 | 6.4 |
| On - Road Mobile | 45.1 | 89.3 |
| Non - Road Mobile | 56.2 | 30.8 |
| **Total Anthropogenic** | **181.4** | **145.5** |

## Table 5.2.2
## Southwest Connecticut's 2002 Reasonable Further Progress Inventory
**(tons / summer day)**

| Source Category | VOC | $NO_X$ |
|---|---|---|
| Stationary Point | 11.3 | 37.7 |
| Stationary Area | 84.1 | 7.2 |
| On - Road Mobile | 48.3 | 102.7 |
| Non - Road Mobile | 66.0 | 38.7 |
| **Total Anthropogenic** | **209.7** | **186.3** |

### Step 2: Develop 2002 and 2008 Adjusted RFP Inventories

The CAA prohibits the use of emission reductions from some control measures that could otherwise contribute towards meeting the 15% RFP requirements. The reductions needed to satisfy RFP must be calculated from an emissions baseline that excludes the effect of the reductions in ozone precursors resulting from the following on-road mobile source control programs:

1) Federal Motor Vehicle Control Program (FMVCP) tailpipe and evaporative standards applicable as of January 1, 1990; and
2) Federal regulations limiting the Reid Vapor Pressure (RVP) of gasoline in ozone nonattainment areas applicable as of June 15, 1990.

Therefore, the 2002 baseline must be adjusted by subtracting the VOC and $NO_X$ reductions that result from these two programs between 2002 and 2008.

In order to calculate the non-creditable emission reductions, adjusted on-road mobile source sector inventories must be developed for both 2002 and 2008. EPA's RFP methodology specifies that these inventories be developed using the same set of MOBILE6.2 inputs, except for the model run year (i.e., 2002 and 2008). Required inputs are summarized as follows:

1) 1990 Inspection and Maintenance Program;
2) Gasoline RVP = 9.0 pounds per square inch;
3) No post-1990 CAA measures;
4) 2002 vehicle activity inputs;
5) 2002 vehicle miles traveled; and
6) Model run year of either 2002 or 2008.

The MOBILE6.2 input files are included in Appendix 5A. The resulting 2002 and 2008 adjusted RFP inventories are summarized in Tables 5.2.3 and 5.2.4 for the Greater Connecticut and Southwest Connecticut areas, respectively. Note that the 2002 and 2008 adjusted RFP inventories are identical for all source categories except for on-road mobile sources.

**<u>Step 3: Calculate Non-creditable Emission Reductions</u>**

The post-1990 emission reductions that are not creditable for RFP purposes are simply the difference between the 2002 and 2008 adjusted RFP inventories. These non-creditable VOC and $NO_X$ reductions are included in the last column of Tables 5.2.3 and 5.2.4.

## Table 5.2.3
## Greater Connecticut 2002 and 2008 Adjusted RFP Inventories and Non-Creditable Reductions

**(tons / summer day)**

| | VOC | | | $NO_X$ | | |
|---|---|---|---|---|---|---|
| **Source Category** | **2002** | **2008** | **Non Creditable** | **2002** | **2008** | **Non Creditable** |
| Stationary Point | 4.6 | 4.6 | 0.0 | 19.0 | 19.0 | 0.0 |
| Stationary Area | 75.5 | 75.5 | 0.0 | 6.4 | 6.4 | 0.0 |
| On–Road Mobile | 76.1 | 71.8 | 4.3 | 106.4 | 97.2 | 9.3 |
| Non-Road Mobile | 56.2 | 56.2 | 0.0 | 30.8 | 30.8 | 0.0 |
| **Total** | 209.9 | 205.7 | **4.3** | 162.6 | 153.4 | **9.3** |

## Table 5.2.4
## Southwest Connecticut 2002 and 2008 Adjusted RFP Inventories and Non-Creditable Reductions

**(tons / summer day)**

| | VOC | | | $NO_X$ | | |
|---|---|---|---|---|---|---|
| **Source Category** | **2002** | **2008** | **Non Creditable** | **2002** | **2008** | **Non Creditable** |
| Stationary Point | 11.3 | 11.3 | 0.0 | 11.3 | 11.3 | 0.0 |
| Stationary Area | 84.1 | 84.1 | 0.0 | 81.8 | 81.8 | 0.0 |
| On–Road Mobile | 80.2 | 75.7 | 4.5 | 121.7 | 110.0 | 11.7 |
| Non-Road Mobile | 66.0 | 66.0 | 0.0 | 66.0 | 66.0 | 0.0 |
| **Total** | 239.2 | 234.7 | **4.5** | 280.7 | 269.0 | **11.7** |

### Step 4: Calculate 2008 Emission Target Levels

EPA's RFP methodology specifies that the required 15% RFP reduction can come from any combination of VOC and $NO_X$ reductions occurring between 2002 and 2008, the total of which meets or exceeds the 15% requirement. CTDEP has elected to establish 2008 emission target levels based on a 10% reduction in VOC emissions and a 5% reduction in $NO_X$ emissions. Expressed in equation form, corresponding VOC and $NO_X$ 2008 target levels are:

**2008 VOC RFP Target Level** = (2002 RFP Base Year VOC Emissions – Non-creditable emission reductions between 2002 and 2008) * (100% - 10% VOC reduction)

**2008 NOx RFP Target Level** = (2002 RFP Base Year $NO_X$ Emissions – Non-creditable emission reductions between 2002 and 2008) * (100% - 5% VOC reduction)

Tables 5.2.5 and 5.2.6 show the calculations and resulting 2008 VOC and $NO_X$ RFP target emission levels for Greater Connecticut and Southwest Connecticut, respectively.

## Table 5.2.5:
## Greater Connecticut
## Calculation of 2008 Target Levels
**(tons / summer day)**

| Step-By-Step Description | VOC | $NO_X$ |
|---|---|---|
| 2002 RFP Inventory (a) | 181.4 | 145.5 |
| Non-creditable emissions reduction (b) | 4.3 | 9.3 |
| 2002 Adjusted Base Year Inventory (c) = (a-b) | 177.1 | 136.3 |
| Selected % Reduction (d) | 10% | 5% |
| Required RFP Reduction (e) = (c * d) | 17.7 | 6.8 |
| **2008 Target Level (f) = (c – e)** | **159.4** | **129.5** |

## Table 5.2.6
## Southwest Connecticut
## Calculation of 2008 Target Levels
**(tons / summer day)**

| Step-By-Step Description | VOC | $NO_X$ |
|---|---|---|
| 2002 RFP Inventory (a) | 209.7 | 186.3 |
| Non-creditable emissions reduction (b) | 4.5 | 11.7 |
| 2002 Adjusted Base Year Inventory (c) = (a-b) | 205.2 | 174.6 |
| Selected % Reduction (d) | 10% | 5% |
| Required RFP Reduction (e) = (c * d) | 20.5 | 8.7 |
| **2008 Target Level (f) = (c – e)** | **184.6** | **165.9** |

### 5.3 Compliance with 2008 RFP Requirements

In order to comply with RFP requirements, projected emissions of VOC and $NO_X$ must be less than or equal to the target emission levels calculated for the 2008 milestone year. Tables 5.3.1

and 5.3.2 compare 2008 projected emission levels (from Section 4.3.3) to calculated target levels (determined in Section 5.2) for the Greater Connecticut and Southwest Connecticut areas, respectively.

Projected 2008 emissions in both areas are significantly less than the required RFP target levels corresponding to a total of 15% reduction in VOC and/or $NO_X$ emissions. For Greater Connecticut, the combined reduction of VOC and $NO_X$ emissions is projected to be 37.2%, more than double the required 15% reduction. Similarly for Southwest Connecticut, the projected combined VOC and $NO_X$ reduction of 37.8% is also more than double the RFP requirement for 2008.

### Table 5.3.1
### Greater Connecticut
### Demonstration of Reasonable Further Progress
### Comparison of 2008 Projected and Target Level Emissions

**(tons / summer day)**

| Description | Anthropogenic VOC | Anthropogenic $NO_X$ |
|---|---|---|
| 2008 Reasonable Further Progress Target Levels (Portion of Required 15% VOC+ $NO_X$ RFP) | 159.4<br>(10%) | 129.5<br>(5%) |
| 2008 Projected Emissions (% Reduction Projected to be Achieved) | 149.3<br>(15.7%) | 107.0<br>(21.5%) |
| Combined VOC + $NO_X$ Reduction | 37.2% | |
| Excess Reduction Beyond 15% Requirement | 22.2% | |

### Table 5.3.2
### Southwest Connecticut
### Demonstration of Reasonable Further Progress
### Comparison of 2008 Projected and Target Level Emissions

**(tons / summer day)**

| Description | Anthropogenic VOC | Anthropogenic $NO_X$ |
|---|---|---|
| 2008 Reasonable Further Progress Target Levels (Portion of Required 15% VOC+ $NO_X$ RFP) | 184.6<br>(10%) | 165.9<br>(5%) |
| 2008 Projected Emissions (% Reduction Projected to be Achieved) | 167.6<br>(18.3%) | 140.5<br>(19.5%) |
| Combined VOC + $NO_X$ Reduction | 37.8% | |
| Excess Reduction Beyond 15% Requirement | 22.8% | |

## 5.4 RFP Contingency Requirements

Under CAA section 172(c)(9), 8-hour ozone nonattainment areas are required to include contingency measures in the SIP, to be implemented without further action by the State or by EPA, in the event the area fails to meet RFP requirements. The contingency measures for the 2008 RFP demonstration must be sufficient to provide any combination of VOC and/or $NO_X$ emission reductions, the total of which will be equivalent to 3% of the 2002 adjusted base year inventory. A minimum of 0.3% VOC reduction must be included.

As depicted in Tables 5.3.1 and 5.3.2, control programs that have been adopted in each of Connecticut's 8-hour ozone nonattainment areas are projected to provide combined VOC and $NO_X$ reductions that exceed the RFP requirement by more than 20% relative to the 2002 adjusted base year inventory. This surplus of emission reductions in 2008 more than covers the additional 3% reduction required by the RFP contingency requirement. Furthermore, the excess VOC reductions of 5.7% in Greater Connecticut and 8.3% in Southwest Connecticut (see Tables 5.3.1 and 5.3.2) are sufficient to cover the requirement that at least 0.3% of the contingency come from VOC reductions. As summarized previously in Table 4.3.2, a significant portion of projected emission reductions through 2008 result from federal new engine and fuel standards for on-road and non-road mobile sources. Those reductions are projected to increase substantially in the years beyond 2008, ensuring continued improvement in ozone air quality.

## 6.0 Reasonably Available Control Measures (RACM) Analysis

This section provides an analysis and summary of the many control measures applied to reduce in-state emissions of ozone precursors. Because atmospheric transport overwhelms the ability of Connecticut to advance its 8-hour ozone attainment date solely using in-state strategies, Connecticut's attainment demonstration relies heavily on emission reductions from upwind states to increase the probability of attainment of the 8-hour NAAQS by June 15, 2010. While none of the potential measures discussed meet the criteria to be considered RACM because they cannot advance our attainment date, CTDEP has pursued in-state emissions reductions in acknowledgement of the importance of actions in individual states in the region and super-region to better position all States for attainment by the designated attainment date.

## 6.1 RACM Requirements

In accordance with CAA Section 172(c)(1), the "Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard" (the Implementation Rule)[1] requires a state to apply all reasonably available control measures (RACM) that will assist the state in timely attainment of the ozone standard. A RACM analysis traditionally focuses on area, mobile and non-major point sources, and the measures that are considered RACM are those readily implemented measures that are economically and technologically feasible and that contribute to the advancement of attainment in a manner that is "as expeditious as practicable." RACM requires an area-specific analysis, in which the State considers the application of RACM for any source of VOCs or $NO_X$ within the state borders. The plan to implement these RACM is due June 15, 2007, and is therefore included here with this demonstration of attainment.

A subset of RACM is the reasonably available control technology (RACT) requirements. EPA has defined RACT as the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.[2] Unlike RACM, RACT is limited to sources for which EPA has developed Control Technique Guidelines (CTGs) and the major non-CTG sources. As the analytical work for implementing the CTGs is readily available, and because the RACT sources are, *a priori*, a significant focus for implementing control strategies, EPA expects requirements limiting emissions from RACT sources to be addressed more immediately than the other control options. Connecticut submitted its RACT state implementation plan (SIP) to EPA on December 8, 2006. In recognition of Connecticut's longstanding efforts to improve air quality with respect to ozone and its precursor emissions, that SIP submittal included measures that went beyond RACT.

This section provides an analysis of whether of not RACM exist for potential transportation control measures (TCM) for on-road mobile sources and for non-TCM potential control measures for point, area, off-road and on-road categories. Just as it did in the RACM analysis associated with the 1-hour ozone NAAQS attainment demonstration, and for the same reasons, Connecticut concludes, in this analysis, that no potentially available control measures adopted in this state could be considered adequate to advance the attainment date.

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[1] 70 FR 71612; November 29, 2005.

[2] 44 FR 53762; September 17, 1979.

## 6.2 Summary of CT Reasonably Available Control Technology (RACT) Analysis

Section 182 of the CAA sets forth two separate RACT requirements for ozone non-attainment areas. The first requirement, the RACT "fix-up", calls for the state to correct RACT rules for which EPA identified deficiencies before the CAA was amended in 1990. Connecticut has no such deficiencies to correct. The second requirement calls for the state to implement RACT controls on all major VOC and $NO_X$ emission sources and on all sources and source categories covered by an EPA-published CTG, the presumptive norm establishing RACT for the covered sources. EPA has also documented alternative control techniques (ACTs) to serve as guidance for controls of VOC and $NO_X$ emissions from stationary sources. The ACTs describe control techniques and their cost effectiveness, but unlike the CTGs, they do not define RACT. A complete list of the CTGs and ACTs can be found at EPA's website.[3]

Connecticut submitted a SIP revision to EPA on December 8, 2006 demonstrating that RACT requirements adopted for attainment of the 1-hour ozone NAAQS are sufficient to satisfy RACT for the 8-hour ozone NAAQS. That submission is available on the CTDEP web site.[4] In addition, CTDEP has made progress updating, sometimes exceeding, requirements for some of the RACT and major non-CTG sources to achieve emissions reductions no later than May 1, 2009, as required by the attainment date.

The CTDEP frequently negotiates RACT requirements with individual sources and issues RACT orders. These orders are then submitted to EPA on a case-by-case basis for approval and inclusion into the SIP. Approved RACT orders and other SIP approvals for Connecticut are identified in the U.S. Code of Federal Regulations at 40CFR52.370(c).

### CTG Category Sources

For sources for which a CTG has been published, RACT is considered met if a state imposes controls equivalent to the CTG for that source or source category. CTDEP has addressed the majority of the CTG source categories and requirements through three sections of the Regulations of Connecticut State Agencies (R.C.S.A.): 22a-174-20 (Section 20); 22a-174-30 (Section 30) and 22a-174-32 (Section 32). Connecticut demonstrated through its RACT SIP that these regulations are consistent with the CTGs, and therefore meet the RACT requirements. However, Connecticut concluded that two of these categories are appropriate to update. Both the metal degreasing CTG, Section 20(l), and the asphalt paving CTG, Section 20(k), are in the process of being amended. The Department expects the amendments to be implemented by May 1, 2008.

### Major Non-CTG Sources of NOx and VOC.

The state was required to conduct a RACT analysis for each major stationary source of VOC and for each major stationary source of $NO_X$. The guidance in the Implementation Rule gives states the discretion either to conduct individual source-specific RACT determinations or to perform

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[3] See: http://www.epa.gov/ttn/naaqs/ozone/ctg_act/index.htm.

[4] See: http://www.ct.gov/dep/lib/dep/air/ozone/ozoneplanningefforts/commcoverltr.pdf.

RACT determinations or certifications collectively for groups of sources. Therefore, emissions averaging or controls applied throughout a group of sources may have been used to show that a particular source group meets RACT. In general, all major sources of $NO_X$ are regulated under Section 22, while stationary sources of VOC are regulated by Sections 20 and 32. Section 32 explicitly regulates major sources of VOC for the purpose of implementing RACT, and allows the Department to conduct individual RACT analyses for sources.

## 6.3 RACM Analysis for Other Stationary/Area Sources: A Regional Process

The 1990 CAA amendments recognized the significant role of interstate transport of $NO_X$ and VOCs in influencing the ability of a downwind state to attain the ozone NAAQS. As part of that recognition, the United States Congress established the Ozone Transport Commission (OTC) to help coordinate control plans for reducing ground-level ozone in the Northeast and Mid-Atlantic states.

As a member of the OTC, Connecticut has worked jointly with the other eleven member states and the District of Columbia to assess the nature and magnitude of the ozone problem in the region, evaluate potential new control approaches and recommend regional control measures to ensure attainment and maintenance of the ozone NAAQS. This regional approach recognizes that all states benefit from coordinated attainment planning efforts to reduce ozone precursors. Connecticut has been an active participant in this regional effort to assess potential attainment measures including RACM/RACT for the 8-hour ozone NAAQS.

The OTC staff and member states formed several workgroups to identify and evaluate candidate control measures. Initially, the workgroups compiled and reviewed a list of over 1,000 candidate control measures. These control measures were identified through published sources such as EPA’s Control Technique Guidelines, STAPPA/ALAPCO “Menu of Options” documents, the AirControlNET database, emission control initiatives in other states including California, state/regional consultations, and stakeholder input. The workgroups developed a preliminary list of approximately fifty candidate control measures to be considered for more detailed analysis with respect to the potential for emissions reductions, cost effectiveness, and ease of implementation. These measures were anticipated to be most effective in reducing ozone air quality levels in the Northeastern and Mid-Atlantic States.

Based on the analyses presented by the OTC workgroups, the OTC Commissioners made recommendations to pursue emission reductions from a shortened list of categories. Details of the OTC regional model rules and control measures identified in Table 4.3.2 of the RACT SIP can be found in the OTC technical support document provided as Appendix 6B. Connecticut has already adopted, or is in the process of adopting several of these control measures as part of its 8-hour ozone attainment plan. Those measures for which rule adoption is now proceeding are identified in Table 4.3.2. Table 4.3.2 also indicates those control measures with no applicability to Connecticut or for which development at the regional level continues.

Several measures are available that could provide creditable levels and emissions reductions (see, for example, Section 4.2.2), however, none of these measures, implemented by Connecticut alone, will be sufficient to advance attainment by one year or more. Nonetheless, Connecticut is pursuing these measures jointly with the OTC in efforts to develop effective controls on the regional level. The 2007 OTC control measures Technical Support Document summarizes the process used to identify and evaluate candidate control measures (see Appendix 6B).

## 6.4 RACM Analysis for Mobile Sources

The CTDEP 8-hour ozone attainment demonstration includes a RACM analysis to review potential control measures for on-road mobile sources.

This RACM analysis consists of an evaluation of transportation control measures (TCMs) and their contribution to transportation and air quality planning in Connecticut. It is customary that the statewide transportation planning process in Connecticut includes the identification, evaluation, selection, and implementation of appropriate TCMs. The Connecticut Department of Transportation (CTDOT) produces annual updates to the Statewide Transportation Improvement Program (STIP), documenting projects to be funded under federal transportation programs for a three-year period.

One of the federal funding sources for the STIP is the Federal Highway Administration's Congestion Mitigation and Air Quality (FHWA CMAQ)[5] Program. Funds are used for projects that reduce emissions from vehicles, improve traffic congestion, and/or improve air quality. Some examples of projects eligible for FHWA CMAQ funding are:

- Programs for improved public transit;
- Restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high-occupancy vehicles (HOV);
- Employer-based transportation management plans, including incentives;
- Traffic flow improvement programs that achieve emission reductions;
- Fringe and transportation corridor parking facilities serving multiple-occupancy vehicle programs or transit service;
- Programs for the provision of all forms of high-occupancy, shared-ride services;
- Sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place.
- Programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of cyclists, in both public and private areas; and
- Employer-sponsored programs to permit flexible work schedules.

CTDOT produces annual FHWA CMAQ reports consisting of details of transportation projects and programs that are considered TCMs and will benefit air quality in Connecticut. The most recent report, "CMAQ2007-10" dated March 2007, consists of a summary of emission benefits achieved in 2007, including a few projects that have construction completion dates in the near future beyond 2007. The following table, Table 6.4.1, was compiled from CTDOT's 2007 emission summary report for the most significant FHWA CMAQ projects and programs.

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[5] This program is conventionally referred to as the CMAQ program, however, in this document, where it is not clearly linked to CTDOT, it is referred to as FHWA CMAQ to distinguish it from EPA's Community Multi-scale Air Quality Program, also known as CMAQ, referenced elsewhere in this document.

## Table 6.4.1: CMAQ2007-10 Emission Summary Report Table

| State Project Number | Project Description | Geographic Area | Total Emission Benefit (kg/d) | | |
|---|---|---|---|---|---|
| | | | VOC | $NO_X$ | $PM_{2.5}$ |
| **TRANSIT** | | | | | |
| **Bus Improvements** | | | | | |
| 0170-T763 | Purchase 7 diesel/electric hybrid buses. Assumption that 3 hybrids will operate in the NY/NJ/CT PM2.5 non-attainment area is reflected in $PM_{2.5}$ benefit calculations. | Statewide | 0.22 | 2.00 | 0.04 |
| 0171-0305 | New Britain-Hartford busway that will serve 8 other towns: Berlin, Bristol, Farmington, Newington, Plainville, Southington, West Hartford, and Wethersfield. Project to be complete in 2011. | District 1 | 9.40 | 19.90 | n/a |
| 0301-0060 | New railroad station in Fairfield, potential access from I-95 and Route 1. | Fairfield | 7.69 | 6.95 | 0.21 |
| **Railroad Station Improvements** | | | | | |
| 0138-0226 | Expand current railroad parking capacity by 400 additional spaces. | Stratford | 8.38 | 7.57 | 0.23 |
| 0161-0136 | Expand parking capacity. | Wilton | 1.95 | 1.74 | 0.10 |
| 0310-0039 | Construct station parking lot, 141 spaces. | Guilford | 3.07 | 2.91 | 0.09 |
| **SHARED RIDE** | | | | | |
| **Main Regional Rideshare Program** | | | | | |
| Various Projects | Programs to encourage van or carpooling. Projects include: 0170-2709, 0170-T714, 0170-2706, 0170-2708, 0170-TX15, 0170-2711, 0170-2707, and 0170-2710. | Statewide | 897.39 | 737.22 | 7.34 |
| **TRAFFIC FLOW IMPROVEMENTS** | | | | | |
| **Signal System Upgrades** | | | | | |
| 0155-0160<br>0155-0161 | Traffic signal adjustments and additions. | Statewide | 2.73 | 2.73 | n/a |
| **Incident Management System Design & Construction** | | | | | |
| 0063-0563 | Improve the Travel Information Gateway for managing traffic congestion on I-84. | Hartford | 30.70 | 15.05 | n/a |
| **DEMAND MANAGEMENT** | | | | | |
| Various Projects | Employee Commute Option program to include Telecommuting, Transportation Days and Travel Demand Management Offices (to promote carpooling, vanpooling and public transportation). Projects include: 0170-2713, 0170-2712, 0063-0634, 0092-0600, 0135-0296, 0015-0325, 0034-0326, 0094-0221, and 0151-0306. | Statewide | 192.10 | 386.01 | 5.47 |
| **EXPERIMENTAL PILOT PROJECTS** | | | | | |
| **Alternate Fuel Vehicles** | | | | | |
| 0170-2734<br>0170-2735 | Purchase of four alternate fuel vehicles. | Statewide | 1.35 | 7.63 | n/a |
| **TOTAL of all projects** | | | **1154.98** | **1189.71** | **13.48** |
| **TOTAL (tons/day)** | | | **1.24** | **1.31** | **0.01** |

The following table, Table 6.4.2, was compiled from projects appearing in CTDOT's CMAQ emission summary reports from 2002 to 2006. These projects have provided emission benefits throughout the years leading up to Connecticut's attainment demonstration. These projects have either been completed, resulting in significant air quality improvements, or are no longer funded through FHWA CMAQ resources.

**Table 6.4.2: CMAQ 2002 – 2006 Emission Summary Report Table**

| State Project Number | Project Description | Geographic Area | Total Emission Benefit (kg/d) | | | CMAQ Report Year |
|---|---|---|---|---|---|---|
| | | | VOC | $NO_X$ | $PM_{2.5}$ | |
| **TRANSIT** | | | | | | |
| **Rail Freight Facilities** | | | | | | |
| 0092-0586 | Advancement of the railroad track installation on Waterfront Street and associated utility relocations. | New Haven | 0.46 | 18.44 | 0.16 | 2005-09 |
| **TRAFFIC FLOW IMPROVEMENTS** | | | | | | |
| **Signal System Upgrades** | | | | | | |
| Various Projects | Upgrade signal control equipment to a closed loop system. Projects include: 0046-0120, 0048-0180, 0048-0181, 0063-0567, and 0128-0141 | Statewide | 4.58 | 4.58 | n/a | 2005-09 |
| Various Projects | Upgrade signal control equipment to a closed loop system. Projects include: 0007-0178, 0033-0122, 0051-0255, 0051-0256, 0155-0153, 0155-0154, and 0155-0155 | | 16.85 | 0.85 | n/a | 2002 |
| **Incident Management System Design & Construction** | | | | | | |
| 0014-0170 | Construct incident management system on I-95 from exit 56 vicinity to exit 64 vicinity. | Branford | 6.11 | 3.00 | 0.00 | 2005-09 |
| 0131-0184 | Construct incident management system on I-84 in Central Connecticut Region. | Southington | 3.91 | 1.92 | n/a | 2005-09 |
| 0151-0278 | Construct incident management system on I-84 in the Waterbury area. | Waterbury | 1.03 | 0.50 | 0.001 | 2005-09 |
| 0151-0286 | Construct incident management system on CT 8. | Waterbury | 2.19 | 1.08 | 0.002 | 2005-09 |
| 0034-H044 | Construct incident management system on I-84 in the Danbury area. | Danbury | 6.00 | 0.18 | n/a | 2002 |
| 0092-0524 | Construct incident management system on I-91 in New Haven from I-95 interchange to exit 8. | New Haven | 1.70 | 0.05 | n/a | 2002 |
| **TOTAL of all projects** | | | **42.83** | **30.60** | **0.17** | |
| **TOTAL (tons/day)** | | | **0.0472** | **0.0337** | **0.0002** | |

In addition to all the projects included in Tables 6.4.1 and 6.4.2, there are numerous other TCMs that receive FHWA CMAQ program funding that will result in emission reductions. Those not listed in this RACM analysis will lead to emission benefits that have yet to be quantified. A list, as of March 30, 2007, of all planned TCM projects from the 2007 STIP is included as Appendix 6A.

In conclusion, the State of Connecticut continues to implement all of the major TCMs included in the STIP. While the addition of new TCMs to the STIP could marginally reduce VMT, the level of emission reductions would be minimal compared to the level of emission reductions needed to advance the attainment date for the NY/NJ/CT ozone nonattainment area. Therefore, since inclusion of TCMs in the SIP would not advance the attainment date, they are not considered RACM. However, the State of Connecticut will continue to advocate that cost-effective TCMs be implemented through Connecticut’s STIP as a means to further reduce emissions.

## 7.0 Transportation Conformity Process and Motor Vehicle Emission Budgets

The CAA requires states to submit State Implementation Plans (SIPs) to the United States Environmental Protection Agency (EPA) within three years after nonattainment designations to demonstrate how they will improve air quality and attain the relevant national ambient air quality standards (NAAQS).

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

Transportation conformity currently applies to areas that are designated nonattainment for the following transportation-related criteria pollutants: ozone, particulate matter ($PM_{2.5}$ and $PM_{10}$), carbon monoxide (CO), and nitrogen oxides ($NO_X$). Transportation conformity also applies to "maintenance areas", that is areas that have been redesignated to attainment after 1990.

Figure 7.0.1 is a flowchart depicting the transportation conformity process and how the elements of a conformity determination interact.

## 7.1 Overview of Transportation Conformity

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

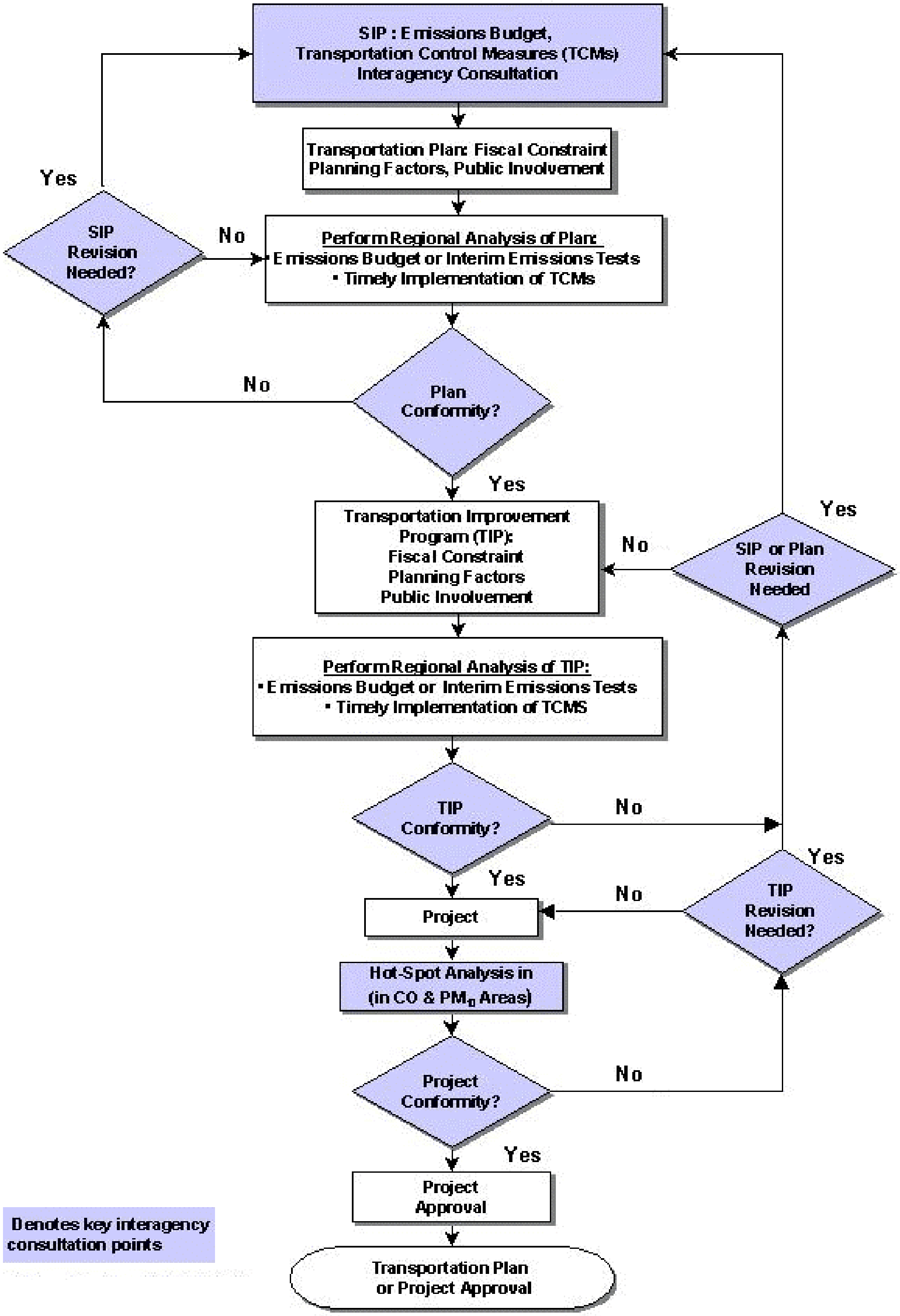
The State of Connecticut Department of Transportation (CTDOT) and the metropolitan planning organizations (MPOs) in Connecticut must determine conformity for any transportation plans, transportation improvement programs (TIPs), or any federally supported highway and transit projects.

Conformity determinations are developed by CTDOT in consultation with CTDEP and EPA. The Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA) agencies of the United States Department of Transportation (US DOT) review CTDOT's and the Connecticut MPO's submittals and makes a conformity determination. It is customary that EPA's regional office provides US DOT with a letter of support for the Connecticut air quality conformity report submittal.

Conformity determinations consist of the following components:

- Regional emissions analysis;
- Transportation modeling requirements;

## Figure 7.0.1: Transportation Conformity Process[1]



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[1] Source: Federal Highway Administration, http://www.fhwa.dot.gov/environment/conformity/ref_guid/sectiona.htm

- Latest planning assumptions and emissions model;
- Timely implementation of transportation control measures (TCMs);
- Interagency consultation;
- Public participation (consistent with U.S. DOT regulations); and
- Fiscal constraint (consistent with U.S. DOT regulations)

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

### 7.1.1 Requirements

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

On August 15, 1997, the United States Environmental Protection Agency (EPA) published the Final Conformity Rule.[2]

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)[3] revised the CAA conformity SIP requirements in order to use state and local resources more efficiently.

CTDOT produces a STIP in accordance with the terms and provisions of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)[4] and the CAA and all regulations issued pursuant thereto. As part of the STIP development, CTDOT conducts air quality assessments and prepares conformity reports. CTDEP evaluates the STIP and conformity reports.

The eight-hour ozone standard designations became effective on June 15, 2004. Conformity to the eight-hour ozone standard was required one year from the effective date of designation, on June 15, 2005. Conformity for the one-hour ozone standard was revoked one year after the effective date of designation of the eight-hour ozone standard. Since June 15, 2005 the one-hour ozone standard no longer applies. The one-hour ozone standard timeframe was coordinated with the date of conformity for the eight-hour ozone standard to ensure conformity is not required for both ozone standards at the same time.

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[2] 62 FR 43780.

[3] PL 109-59, August 10, 2005; (Section 6011).

[4] 70 FR 71949, Nov. 30, 2005.

### 7.1.2 Previous 1-Hour Ozone Budgets

The one-hour standard specified an ozone level no greater than 0.12 parts per million (ppm) for one hour. The entire State of Connecticut was designated nonattainment under the one-hour standard, with two nonattainment areas established on the basis of pollution severity. One was Fairfield County, minus the towns of Shelton, plus New Milford and Bridgewater, which was classified as a severe nonattainment area. The other area consisted of the rest of the state, which was classified as serious nonattainment.

Conformity is required for the ozone precursors, volatile organic compounds (VOCs) and oxides of nitrogen ($NO_X$). The approved 2007 motor vehicle emission budgets (MVEBs) for the one-hour ozone standard, which were used up to the June 15, 2005 date, are listed in Table 7.1.2.

**Table 7.1.2: Previous 1-Hour Ozone Nonattainment MVEBs for 2007**
**(Based on MOBILE6.2)[5]**

| Area | VOC (tons per summer day) | $NO_x$ (tons per summer day) |
|---|---|---|
| SWCT Portion of NY-NJ-LI | 16.4 | 29.7 |
| Greater Connecticut | 51.9 | 98.4 |
| Statewide Total | 68.3 | 128.1 |

## 7.2 Current Interim Transportation Conformity Budgets for the 8-Hour Ozone Standard

In July 1997, EPA promulgated a new eight-hour standard for ambient ozone concentrations. The eight-hour standard is more stringent than the previous one-hour standard, requiring that the average eight-hour ozone level be no greater than 0.08 ppm.

On June 15, 2004, EPA designated and classified two separate "moderate" nonattainment areas in the State of Connecticut for the eight-hour ozone standard. Fairfield, New Haven and Middlesex counties are included in the Southwest Connecticut portion of the New York-Northern New Jersey-Long Island, NY/NJ/CT eight-hour ozone non-attainment area. The Greater Connecticut eight-hour ozone non-attainment area consists of Hartford, Litchfield, New London, Tolland and Windham counties. In July 2004,[6] EPA finalized eight-hour conformity rules for ozone non-attainment areas, which required demonstrations of conformity to the eight-hour standard to be made starting one year from the date of nonattainment designation. Thus, the initial demonstration of conformity to the eight-hour standard was required as of June 15, 2005.

EPA issued guidance[7] specifying conformity procedures to be followed during the interim period between revocation of the 1-hour ozone NAAQS in June 2005 and the establishment of new 8-hour ozone budgets as part of the current 8-hour ozone planning process. In areas, such as

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[5] 69 FR 5286, February 4, 2004. The 1-hour ozone budgets were no longer applicable, as of June 15, 2005.
[6] 69 FR 40004; July 1, 2004.
[7] Memo from Donald Cooke (EPA New England Region) to Paul Bodner (CTDEP); "What Scenarios Apply in Connecticut and What 8-hour Conformity Test(s) Will Be Used ?"; December 6, 2004.

Connecticut, that were classified with statewide nonattainment for both the 1-hour and 8-hour NAAQS, EPA's guidance requires that existing SIP-approved 1-hour ozone conformity budget levels be reallocated to follow the new boundaries of the 8-hour nonattainment areas. Table 7.2.1 shows the resulting 1-hour interim budgets for Connecticut, which will continue to be used by CTDOT and the MPOs to determine conformity until EPA determines the 8-hour budgets listed in Section 7.3 adequate or approved into the Connecticut SIP.

**Table 7.2: Reallocated 1-Hour Ozone Nonattainment MVEBs for 2007**

| **Area** | **VOC** (tons per summer day) | **$NO_X$** (tons per summer day) |
|---|---|---|
| SWCT Portion of NY/NJ/CT | 34.6 | 66.5 |
| Greater Connecticut | 33.7 | 61.6 |
| Reallocated Statewide Total | 68.3 | 128.1 |

## 7.3 New Transportation Conformity Budgets for the 8-Hour Ozone Standard

As described in Section 4, this attainment plan includes numerous emission control programs designed to sufficiently reduce ozone precursor emissions in Connecticut to achieve compliance with the 8-hour ozone NAAQS. Emission control strategies are targeted at all types of emission sources, including large power plants and industries, smaller area sources such as lawn and garden equipment and gasoline stations, and on-road sources such as cars and diesel trucks (see Table 4.2 and 4.3.2).

Projected future emission levels in Connecticut resulting from these control strategies were previously summarized in Tables 4.4.1 and 4.4.2. The on-road portion of these emission estimates will serve as final transportation conformity emission budgets for the 8-hour ozone NAAQS, as listed in Table 7.3. Emission budgets are being established for the RFP milestone year of 2008, the required attainment year of 2009 and a future year of 2012. The 2012 budgets, although not required by the CAA or EPA regulation, provide an enforceable mechanism to ensure continued reduction in on-road emissions beyond the required attainment year. These new budgets will be applicable to conformity determinations when EPA determines them to be adequate or approves them into the Connecticut SIP.

**Table 7.3: Final Eight-Hour Ozone Nonattainment MVEBs**
**(tons per summer day)**

| **Area** | **2008** | | **2009** | | **2012** | |
|---|---|---|---|---|---|---|
| | **VOC** | **NOx** | **VOC** | **NOx** | **VOC** | **NOx** |
| SWCT Portion NY/NJ/CT | 29.7 | 60.5 | 27.4 | 54.6 | 20.6 | 38.2 |
| Greater Connecticut | 28.5 | 54.3 | 26.3 | 49.2 | 19.8 | 34.8 |
| Statewide Total | 58.1 | 114.8 | 53.7 | 103.8 | 40.4 | 73.0 |

## 8.0 Attainment Demonstration and Weight-of-Evidence

As described in Section 4.1.1, all of Connecticut is classified by the EPA as moderate nonattainment for the 8-hour ozone NAAQS. EPA requires that states with moderate (and above) ozone nonattainment areas prepare and adopt SIP revisions demonstrating attainment of the 8-hour ozone standard using photochemical grid modeling and weight-of-evidence (WOE) analyses. States with moderate nonattainment areas are required to attain the 8-hour ozone NAAQS by June 15, 2010. Because the June 15, 2010 deadline occurs in the middle of the 2010 ozone season, Connecticut and other states with moderate nonattainment areas must demonstrate NAAQS compliance for the preceding ozone season of 2009.

Sections 8.1 through 8.4 of this document describe the procedures, inputs and results of the regional photochemical grid modeling exercise. Section 8.5 describes various WOE analyses used as supplements to the modeling results to determine the likelihood of attaining the 8-hour NAAQS in both the Greater Connecticut nonattainment area and the Southwest Connecticut portion of the NY/NJ/CT nonattainment area.

CTDEP's primary conclusions based on the results of the photochemical modeling and WOE analyses are:

1) There is a high level of probability that the Greater Connecticut area will achieve attainment of the 8-hour ozone NAAQS by the end of the 2009 ozone season; and
2) A credible case can be made that Southwest Connecticut will attain by the end of the 2009 ozone season. The probability of attainment increases as additional emission reductions occur in each subsequent year, such that attainment by 2012 is highly probable.

## 8.1 Background and Objective of the Photochemical Modeling

The objective of the photochemical modeling study is to enable the CTDEP to analyze the efficacy of various control strategies, and to demonstrate that the measures adopted as part of the SIP will result in attainment of the 8-hour ozone standard by the June 15, 2010 deadline for moderate nonattainment areas. The modeling exercise predicts future year 2009 and 2012 air quality conditions based on the worst observed ozone episodes in the base year 2002 and demonstrates the effectiveness of new control measures in reducing air pollution.

The photochemical modeling was performed as part of a regional partnership under the auspices of the Ozone Transport Commission (OTC), a multi-state ozone planning organization created under the CAA to assist EPA and the states from Virginia to Maine, the Ozone Transport Region (OTR), with the development and implementation of regional solutions to the ground-level ozone problem in the Northeast and Mid-Atlantic regions. The OTC Air Directors served as the Oversight Committee for the modeling process, providing overall direction for all aspects of the modeling and control strategy development. Day-to-day management and coordination of modeling activities was provided by the OTC Modeling Committee, with the following workgroups established to accomplish assigned tasks. The various committees and workgroups were comprised of state air quality agency staff members (including CTDEP representatives), with support provided by OTC and the staff of the Mid-Atlantic Regional Air Management Association (MARAMA).

## Photochemical Modeling Workgroup

The Photochemical Modeling Workgroup was responsible for preparing the modeling assessment, collecting and processing model input data, setting up all model input files, performing model runs and interpreting and documenting the results of the modeling analyses The Workgroup also prepared and submitted all OTC SIP quality modeling system documentation to the Oversight Committee.

## Meteorological Modeling Workgroup

The Meteorological Modeling Workgroup was responsible for preparing and assessing meteorological fields for the OTR Modeling Domain. This Workgroup also worked with the Photochemical Modeling Workgroup to prepare all meteorological input files for the OTC SIP quality modeling system.

## Emission Inventory Development Workgroup

The Emission Inventory Development Workgroup was responsible for obtaining and developing guidance for preparing 2002 and 2009 state emission inventories for all states in the OTR. MARAMA and the Mid-Atlantic/Northeast Visibility Union (MANE-VU) organizations provided funding for contractors and worked with OTR states to help prepare state-of-the-art 2002 emission files, 2009 and 2012 CAA emission files and 2009 and 2012 Control Strategy emission files for the states in the OTR Modeling Domain. The Oversight Committee was responsible for obtaining emission inventories for non-OTR states in the OTR Modeling Domain.

## Control Strategy Development Workgroup

The Control Strategy Development Workgroup was responsible for evaluating control strategies and recommending to the Oversight Committee a suite of measures for attaining the ozone NAAQS in the OTR. Control strategy evaluation and selection was coordinated with the OTC Stationary/Area Source committee and the OTC Mobile Source Committee.

### 8.1.1 Conceptual Description

EPA recommends that a conceptual description of the area’s ozone problem be developed prior to the initiation of any air quality modeling study. A “conceptual description” is a qualitative way of characterizing the nature of an area’s nonattainment problem. Within the conceptual description of a particular modeling exercise, it is recommended that the specific meteorological parameters that influence air quality be identified and qualitatively ranked in importance.

A conceptual description of the ozone air quality problem in the OTR was prepared by the Northeast States for Coordinated Air Use Management (NESCAUM)[1] and is reproduced in Appendix 2A. A summary of key findings of the conceptual model was provided earlier in Section 2.0.

### 8.1.2 Regional Modeling Protocol

All aspects of the modeling effort were conducted in accordance with the modeling protocol developed by the OTC Modeling Committee (see Appendix 8A). The lead agency for coordinating and performing modeling runs for the OTC was the New York State Department of Environmental Conservation (NYSDEC). Modeling centers for the OTC included the NYSDEC, the University of Maryland at College Park (UMD), NESCAUM, the New Jersey Department of Environmental Protection (NJDEP) and the Virginia Department of Environmental Quality (VADEQ). Although NYSDEC was the lead agency for coordinating modeling runs, member states of the OTC, through participation on the OTC Modeling Committee and associated workgroups, managed the modeling project jointly.

## 8.2 Modeling Platform and Configuration

The following discussion provides an overview of the air quality, meteorological, and emission modeling systems used for the analysis, as well as a description of model configuration and quality assurance procedures. Much of this discussion is based on modeling documentation prepared by NYSDEC[2] for the OTC states and boilerplate OTR summaries included as part of the Washington, D.C. draft ozone SIP.[3]

### 8.2.1 Episode Selection

Since it would be impractical to model every violation day, EPA has traditionally recommended targeting a select group of episode days for ozone attainment demonstrations. Such episode days should be (1) meteorologically representative of typical high ozone exceedance days in the domain, and (2) so severe that any control strategies predicted to attain the ozone NAAQS for that episode day would also result in attainment for all other exceedance days.

While EPA's suggested approach is perhaps feasible for isolated urban areas, such an approach is impractical in this case given the spatial extent of the regional ozone problem in the Northeast and the resulting size of the modeling domain. Also, selection of episodes from different years would require the generation of multiple meteorological fields and emissions databases, which would be an extremely difficult proposition given the modeling domain.

Recent experience has shown that model performance evaluations and the response to emissions controls need to include consideration of modeling results from longer time periods, in particular

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[1] *The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description* (NESCAUM, October 2006).

[2] Modeling documentation prepared by NYSDEC is housed at: http://www.otcair.org/projects_details.asp?FID=101&fview=modeling.

[3] The draft Washington D.C. ozone SIP is located at: http://sharepoint.mwcog.org/airquality/default.aspx.

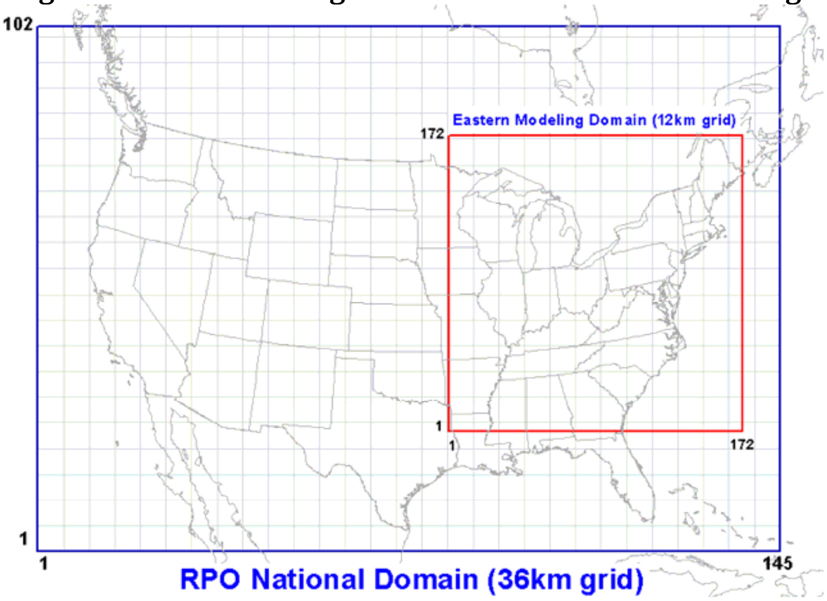
full synoptic cycles or even full ozone seasons. The 2002 ozone season had a significant number of exceedance days spread over numerous ozone episodes. As a result, the OTC Modeling Committee decided to investigate the appropriateness of modeling the entire 5-month 2002 ozone season with the OTC SIP Quality Modeling System. Results of that investigation, documented in a contractor report included as Appendix 8B,[4] demonstrate that 2002 episode days are (1) meteorologically representative of typical high ozone exceedance days in the domain, and (2) so severe that control strategies predicted to attain the ozone NAAQS for those episode days would likely also result in attainment for all other exceedance days. The total number of days examined for the complete ozone season far exceeds EPA recommendations and provides for better assessment of the simulated pollutant fields.

### 8.2.2 Modeling Domain

In defining the modeling domain, the following parameters should all be considered: location of local urban areas; the downwind extent of elevated ozone levels; the location of large emission sources; the availability of meteorological and air quality data; and available computer resources. In addition to the nonattainment areas of concern, the modeling domain should encompass enough of the surrounding area such that major upwind sources fall within the domain and emissions produced in the nonattainment areas remain within the domain throughout the day.

The areal extent of the OTR modeling domain (see Figure 8.2.2.1) is identical to the national grid adopted by the regional haze Regional Planning Organizations (RPOs), with a more refined "eastern modeling domain" focused on the eastern US and southeastern Canada. The placement of the eastern modeling domain was selected such that the northeastern areas of Maine are included. Based upon the existing computer resources, the southern and western boundaries of the imbedded region were limited to the area shown in Figure 8.2.2.1.

**Figure 8.2.2.1: Modeling Domain Used for OTR Modeling**



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[4] "Determination of Representativeness of 2002 Ozone Season for Ozone Transport Region SIP Modeling," ENVIRON, prepared for OTC, June 2005. (Report is contained in Appendix 8B.)

### 8.2.3 Horizontal Grid Size

As shown in Figure 8.2.1.1, the larger RPO national domain utilized a coarse grid with a 36-km horizontal grid resolution. The imbedded eastern modeling domain used a grid resolution of 12 km, resulting in 172 grids in both the east-west and north-south directions. More detailed descriptions regarding grid configurations are provided in Appendix 8C.

### 8.2.4 Vertical Resolution

The vertical structure of the air quality model is primarily defined by the vertical grid used in the meteorological modeling, which used a terrain-following coordinate system defined by pressure to create a total of 29 layers. The layer-averaging scheme adopted for the air quality modeling is designed to reduce the computational cost of the simulations, resulting in incorporation of 22 layers in the vertical, of which the lower 16 layers (approximately 3 km) coincide with those of the meteorological model. Layer averaging has a relatively minor effect on the model performance metrics when compared to ambient monitoring data. Appendix 8C contains the vertical layer definitions for the meteorological and air quality modeling domains.

### 8.2.5 Initial and Boundary Conditions

The objective of a photochemical grid model is to estimate the air quality given a set of meteorological and emissions conditions. When initializing a modeling simulation, the exact concentration fields are unknown in every grid cell for the start time. Therefore, photochemical grid models are typically started with clean conditions within the domain and allowed to stabilize before the period of interest is simulated. In practice this is accomplished by starting the model several days prior to the period of interest. For this application, the air quality modeling for 2002 began May 1, with the first 15 days assumed to be ramp-up days not used for performance evaluation or prediction purposes.

The winds move pollutants into, out of, and within the domain. The model handles the movement of pollutants within the domain and out of the domain. An estimate of the quantity of pollutants moving into the domain is needed. These are called boundary conditions. To estimate the boundary conditions for the modeling study, three-hourly boundary conditions for the outer 36-km domain were derived from an annual model run performed by researchers at Harvard University using the GEOS-Chem global chemistry transport model. The influence of boundary conditions was minimized by the 15-day ramp-up period, which is sufficient to establish pollutant levels that are encountered in the beginning of the ozone episode.

### 8.2.6 Meteorological Model Selection and Configuration

The Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Meteorological Model (MM5) was selected to produce meteorological data fields for the modeling analysis. MM5 is a non-hydrostatic, prognostic meteorological model routinely used for urban-scale and regional-scale photochemical regulatory modeling studies. Based on model validation and sensitivity testing, the MM5 configurations provided in Appendix 8D were selected. Results of the NYSDEC's detailed performance evaluation of the MM5 modeling used in conjunction with the OTC platform are provided in Appendices 8E and 8F.

### 8.2.7 Emissions Inventory and Model Selection and Configuration

Significant regional coordination was required to assemble the emission inventories needed to produce the emission data fields required for the modeling analysis. Recognizing the need for developing multi-pollutant inventories across many states to support both ozone and fine-particulate SIP modeling requirements, the Northeast and Mid-Atlantic states agreed to combine efforts under the MANE-VU RPO umbrella to compile base year and future year emission estimates for all required pollutants into a common format. The states were joined in the inventory development effort by MARAMA, OTC and NESCAUM.

Modeling inventories for the MANE-VU region were prepared, with the assistance of contractors, for the 2002 base year and the projection years of 2009 and 2012. The base year inventory was compiled using 2002 inventory estimates provided by the states. Projection year inventories account for any expected changes in economic activity as well the implementation of control strategies occurring after 2002. Inventories for adjacent areas outside the MANE-VU region were obtained from the corresponding RPOs. Detailed descriptions of the inventories are provided in Appendices 8G, 8H and 8I.

The Sparse Matrix Operator Kernel Emissions (SMOKE, Version 2.1) Emissions Processing System was used for pollutant speciation and for allocating annual county-level emissions from the regional inventory to grid cells on an hourly basis. Detailed descriptions of SMOKE processing are included in Appendices 8J and 8K.

### 8.2.8 Air Quality Model Selection and Configuration

EPA's Models-3/Community Multi-scale Air Quality (CMAQ) modeling system was selected for the attainment demonstration primarily because it is a "one-atmosphere" photochemical grid model capable of addressing ozone at regional scale. EPA considers CMAQ to be one of the preferred models for regulatory modeling applications, citing the model in its ozone modeling guidance.[5] The CMAQ configuration is provided in Appendix 8L.

### 8.2.9 Quality Assurance

All air quality, emissions, and meteorological data were reviewed to ensure completeness, accuracy, and consistency before proceeding with modeling. Any errors, missing data or inconsistencies were addressed using appropriate methods that are consistent with standard practices. All modeling was benchmarked at each of the OTC modeling centers through the duplication of a set of standard modeling results.

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[5] Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze; EPA OAQPS; EPA-454/B-07-002; April 2007; See: http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf. Hereinafter referred to as EPA Guidance (2007).

Quality assurance activities were carried out for the various emissions, meteorological, and photochemical modeling components of the modeling study. Emissions inventories obtained from the RPOs were examined to check for errors in the emissions estimates. When such errors were discovered, the problems in the input data files were corrected.

The MM5 meteorological and CMAQ air quality model inputs and outputs were plotted and examined to ensure accurate representation of the observed data in the model-ready fields, and temporal and spatial consistency and reasonableness. Both MM5 and CMAQ underwent operational and scientific evaluations in order to facilitate the quality assurance review of the meteorological and air quality modeling procedures.

## 8.3 Model Performance Evaluation

There are many aspects of model performance. This section will focus primarily on the methods and techniques recommended by EPA for evaluating the performance of the air quality model. It should be noted that the other parts of the modeling process, the emissions and meteorology, underwent a similar evaluation. As mentioned in Section 8.2.6, the NYSDEC conducted an evaluation of the MM5 meteorological model (see Appendices 8E and 8F). The remainder of this section focuses on the air quality model evaluation.

The first step in the modeling process is to verify the model’s performance in terms of its ability to predict the ozone in the right locations and at the right levels. To do this, model predictions for the base year simulation are compared to the ambient data observed in the historical episode. This verification is a combination of statistical and graphical evaluations. If the model appears to be producing ozone in the right locations for the right reasons, then the model can be used as a predictive tool to evaluate various control strategies and their effects on ozone. The purpose of the model performance evaluation is to assess how accurately the model predicts ozone levels observed in the historical episode.

The results of the model performance evaluation were evaluated prior to commencing modeling in support of the attainment demonstration. The performance of CMAQ was evaluated using both operational and diagnostic methods. Operational evaluation refers to the model’s ability to replicate observed concentrations of ozone and/or precursors (surface and aloft), whereas diagnostic evaluation assesses the model’s accuracy with respect to characterizing the sensitivity of ozone to changes in emissions (i.e., relative response factors).

The NYSDEC, Division of Air Resources, conducted a performance evaluation of the 2002 base case CMAQ simulation (May 15-September 30) on behalf of the OTC member States. Appendix 8M provides comprehensive operational and diagnostic evaluation results. Highlights of this evaluation are provided in the following sub-sections.

### 8.3.1 Diagnostic and Operational Evaluation

The issue of model performance goals for ozone is an area of ongoing research and debate. To evaluate model performance, EPA recommends that several statistical metrics be developed for air quality modeling. Two of the common metrics that are most often used to assess performance are the mean normalized gross error and the mean normalized bias. The mean normalized gross error (MNGE) parameter provides an overall assessment of model performance and can be interpreted as precision. The mean normalized bias parameter (MNB) measures a model's ability to reproduce observed spatial and temporal patterns and can be interpreted as accuracy. EPA suggests the following criteria: an MNB of < ±15%, and an MNGE of < 35% above a threshold of 40-60 ppb. These results are presented in Table 8.3.1.1 below for the local nonattainment areas and in Tables 8.3.1.2 and 8.3.1.3 on a monitor-by-monitor basis averaged over all days for the 40 ppb and 60 ppb thresholds, respectively. Figure 8.3.1.1 shows the location of the monitors.

**Table 8.3.1.1 Southwest CT and Greater CT Statistics for 8-hour Ozone**

| Location | Ozone Cutoff Threshold (ppb) | Mean Normalized Gross Error (MNGE) (%) | Mean Normalized Bias (MNB) (%) |
|---|---|---|---|
| SW CT Portion of NY/NJ/CT Area | 60 | 13.52 | 2.46 |
| Greater CT Area | 60 | 19.13 | 14.2 |

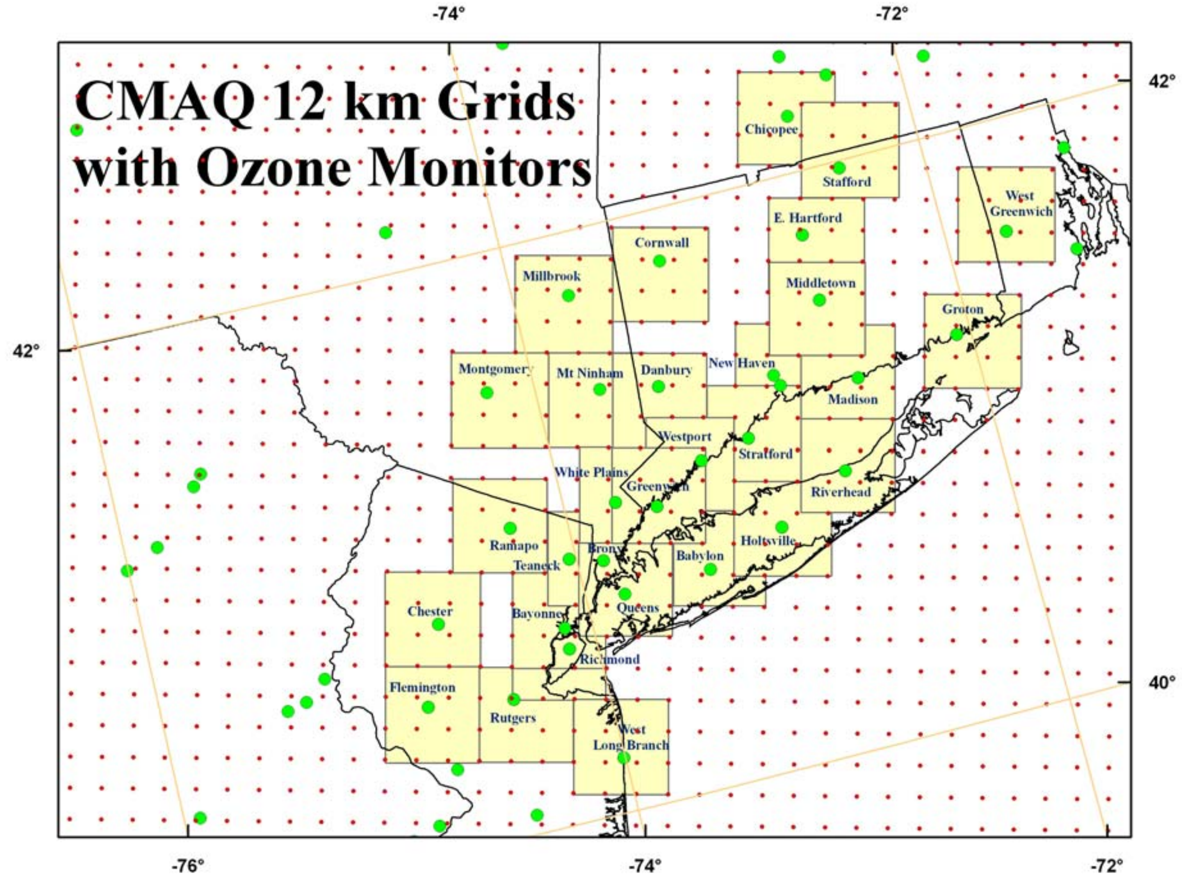
**Table 8.3.1.2 Individual Site Statistics for 8-hour Ozone Using 40 ppb Cutoff**

| Monitor AIRS-ID | Ozone Cutoff Threshold (ppb) | Site Name | County | Area | MNGE (%) | MNB (%) |
|---|---|---|---|---|---|---|
| 0900100171 | 40 | Greenwich | Fairfield | NY/NJ/CT | 13.94 | 3.75 |
| 0900111231 | 40 | Danbury | Fairfield | NY/NJ/CT | 15.35 | -2.77 |
| 0900130071 | 40 | Stratford | Fairfield | NY/NJ/CT | 15.8 | -0.03 |
| 0900190031 | 40 | Westport | Fairfield | NY/NJ/CT | 14.67 | 2.28 |
| 0900700071 | 40 | Middletown | Middlesex | NY/NJ/CT | 13.31 | 2.28 |
| 0900930021 | 40 | Madison | New Haven | NY/NJ/CT | 15.37 | 5.25 |
| 0900990051 | 40 | Hamden | New Haven | NY/NJ/CT | 15.99 | -0.67 |
| 0900310031 | 40 | East Hartford | Hartford | Greater CT | 13.36 | 2.59 |
| 0900500051 | 40 | Cornwall | Litchfield | Greater CT | 17.75 | -12.6 |
| 0901100081 | 40 | Groton | New London | Greater CT | 31.94 | 29.51 |
| 0901310011 | 40 | Stafford | Tolland | Greater CT | 12.53 | -4.67 |

**Table 8.3.1.3. Individual Site Statistics for 8-hr Ozone using 60 ppb Cutoff**

| Monitor AIRS-ID | Ozone Cutoff Threshold (ppb | Site Name | County | Area | MNGE (%) | MNB (%) |
|---|---|---|---|---|---|---|
| 0900100171 | 60 | Greenwich | Fairfield | NY/NJ/CT | 13.78 | 0.31 |
| 0900111231 | 60 | Danbury | Fairfield | NY/NJ/CT | 13.44 | -8.74 |
| 0900130071 | 60 | Stratford | Fairfield | NY/NJ/CT | 17.09 | -0.05 |
| 0900190031 | 60 | Westport | Fairfield | NY/NJ/CT | 12.18 | -1.76 |
| 0900700071 | 60 | Middletown | Middlesex | NY/NJ/CT | 10.66 | -3.71 |
| 0900930021 | 60 | Madison | New Haven | NY/NJ/CT | 14.54 | 1.67 |
| 0900990051 | 60 | Hamden | New Haven | NY/NJ/CT | 12.95 | -0.99 |
| 0900310031 | 60 | East Hartford | Hartford | Greater CT | 13.83 | 2.25 |
| 0900500051 | 60 | Cornwall | Litchfield | Greater CT | 20.17 | -17.7 |
| 0901100081 | 60 | Groton | New London | Greater CT | 30.34 | 28.1 |
| 0901310011 | 60 | Stafford | Tolland | Greater CT | 12.18 | -8.71 |

**Figure 8.3.1.1. Location of Ozone Monitors in the Vicinity of Connecticut**



The base year performance evaluation indicates that CMAQ model meets EPA's suggested criteria for the 40 ppb threshold at all Connecticut sites except Groton, where the MNB exceeds +/- 15% (+29.1%). EPA's suggested criteria for the 60ppb threshold are met at all Connecticut sites except Groton and Cornwall, where the MNB exceeds +/- 15% (+28.1% and –17.7%, respectively).

The following statistics for the OTC domain have also been provided in Appendix 8M:

1. Archive file containing time series of 8-hour average observed and predicted ozone organized by state;
2. Observed and predicted composite diurnal variations of selected species, including but not limited to ozone at State and Local Air Monitoring System and National Air Monitoring System (SLAMS/NAMS) sites, ozone at Clean Air Status and Trends Network (CASTNet) and other sites, VOC species such as ethene, isoprene, formaldehyde and gas phase compounds such as CO, NO and $NO_2$;
3. Statistical evaluation of daily maximum 8-hour ozone at SLAMS/NAMS sites and CASTNet/other sites. Statistics are computed using two different thresholds for observed daily maximum ozone - 40 and 60 ppb. Statistics are computed by date (all sites on a given day) and by site (one site over all days);
4. Statistical evaluation of daily maximum 8-hour ozone at SLAMS/NAMS sites that fall within nonattainment counties. Statistics are computed by nonattainment area.
5. Statistical evaluation of daily average CO, NO, $NO_2$, and $SO_2$ at SLAMS/NAMS and other sites Statistics are computed by date and by site);
6. Statistical evaluation of daily average ethene, isoprene, and formaldehyde at SLAMS/NAMS and other sites (statistics are computed by date and by site);
7. Plots of composite time series for daily max 8-hour ozone, root mean square error and mean bias for illustrative purposes; and
8. Tile plots of daily 8-hour maximum predicted ozone across the modeling domain compared with actual observations.

### 8.3.2 Summary of Model Performance

CMAQ was employed to simulate ozone concentrations for the 2002 season (May 15 through September 30). A comparison of the temporal and spatial distributions of ozone and its precursors was conducted for the study domain with additional focus placed on performance in the NY/NJ/CT and Greater Connecticut areas.

The CMAQ model performance for surface ozone is quite good overall, with low bias and error. Model performance is generally consistent from day to day. The results for the 2002 ozone season show that the modeling system tends to over-predict minimum concentrations and slightly under-predict peak concentrations. The over-prediction of minimum concentrations is not of great regulatory concern since attainment tests are based on the application of relative response factors to daily peak concentrations. However, prediction of minimum concentrations is still important to appropriately model regional transport and nighttime ozone removal processes in order to accurately estimate peak concentrations.

The model performance for the Southwest Connecticut portion of the NY/NJ/CT area and the Greater Connecticut area averaged over all stations and all days meet the guidelines suggested by EPA. The criteria for acceptable model performance are met on most individual days as well.

No significant differences in model performance for ozone and its precursors were encountered across the OTC. While there are some differences across sub-regions, there is nothing to suggest a tendency for the model to respond in a systematically different manner between regions. Examination of the statistical metrics by sub-region confirms the absence of significant performance problems arising in one area but not in another, building confidence that the CMAQ modeling system is operating consistently across the full OTC domain.

Overall, the modeling system does a good job of appropriately estimating 8-hour average surface ozone throughout the OTR and in the Southwest Connecticut and Greater Connecticut areas. This confidence in the modeling results allows for the modeling system to be used to support the development of emissions control scenarios to meet the 8-hour ozone NAAQS.

As stated previously, the model performance for the 2002 ozone season meets all EPA guidelines, demonstrating that the modeling platform is appropriate for modeling emissions controls scenarios for the 8-hour ozone SIP. However, it must be remembered that CMAQ has been evaluated by using measures that reflect its ability to represent average conditions instead of its ability to respond to changes in emissions. Thus, it is likely that although CMAQ has met the traditional performance measures set out in the EPA guidance, it may actually under-predict the magnitude of ozone changes due to various control measures being modeled. This means that future year modeling results should be viewed not in the traditional sense as being exact, but should be seen as an upper limit to anticipated ozone levels. This observation will be explored more fully as part of the weight-of-evidence discussion in Section 8.5.

## 8.4 Attainment Demonstration Modeling *(Note: The Hearing Report contains material that is supplemental to the information in Section 8.4.)*

The CMAQ modeling analyzes the potential for the Greater Connecticut area and the Southwest Connecticut portion of the NY/NJ/CT area to achieve attainment of the 8-hour ozone standard. The attainment demonstration is based on both the CMAQ modeling results and a number of additional weight-of-evidence analyses (provided in Section 8.5) that support the attainment modeling results. Details of the CMAQ modeling are provided in the following sub-sections.

### 8.4.1 Modeling Inventories

As described in Section 8.2.1, CMAQ modeling runs were completed for the 2002 baseline year and 2009 and 2012 projection years using inventories developed as part of cooperative effort by the MANE-VU states to support ozone, $PM_{2.5}$ and regional haze planning activities. Modeling results presented in this document are based on projected emissions representing the OTC's "beyond-on-the-way" (BOTW) control scenario, which is comprised of the suite of measures each state indicated were likely to be adopted as of the commencement of modeling runs in late 2006. A full description of the inventories is provided in Appendices 8G, 8H and 8I.

### 8.4.2 Modeled Attainment Test (MAT)

Consistent with EPA's guidance,[6] CMAQ modeled results were applied in a relative sense, assuming that measured values from the baseline period would decrease in proportion to modeled improvements between the baseline and future projection years. This "modeled attainment test" (MAT) was applied at each monitor using the following equation:

$$(DV_F)_I = (RRF)_I\,(DV_B)_I \qquad \textbf{(MAT Equation)}$$

Where:
$(DV_B)_I$ = the baseline measured concentration at site I, in ppb
$(RRF)_I$ = the relative response factor determined as the ratio of CMAQ modeled results between the future year and the baseline year, calculated near site I
$(DV_F)_I$ = the estimated future design value for the year of interest, in ppb.

The development of appropriate relative response factors (RRF) and baseline concentrations ($DV_B$) are described below.

**<u>Development of Relative Response Factors</u>**

The RRF used in the MAT Equation is determined by taking the ratio of the mean of the 8-hour daily maximum predictions in the future to the mean of the 8-hour daily maximum predictions with baseline emissions, over all relevant days at each monitor location. Consistent with EPA's recommendations,[7] "relevant days" were determined on a monitor-by-monitor basis using all days in 2002 with a maximum measured 8-hour value of 85 ppb or higher. All monitors in Connecticut recorded more than 10 days during 2002 with 8-hour ozone exceedances, satisfying EPA's criterion for using the 85 ppb threshold.

**<u>Development of Baseline Concentrations</u>**

As indicated by the MAT Equation, the $DV_B$ at each monitoring site serves as the reality-based "anchor point" for estimating future year projected concentrations. EPA's modeling guidance[8] lists the following attributes that should be reflected in the methodology selected to determine appropriate $DV_B$ values:

1) Should be consistent with the form of the applicable NAAQS;
2) Should be easy to calculate;
3) Should represent the baseline inventory year;
4) Should take into account the year-to-year variability of meteorology; and
5) Should take into account the year-to-year variability of emissions.

EPA's guidance also recommends that $DV_B$ values be determined using the average of the three 8-hour ozone design values that include the baseline inventory year. Accordingly, given a

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[6] EPA Guidance (2007) at page 20.
[7] Ibid. at page 147.
[8] Ibid. at pages 22 and 23.

baseline inventory year of 2002, the years used to calculate the $DV_B$ would range from 2000-2004. The resulting $DV_B$ calculation uses the 2000-2002, 2001-2003, and 2002-2004 design value periods, with the year 2002 "weighted" three times, 2001 and 2003 weighted twice each, and 2000 and 2004 weighted once each. EPA concludes that this default method has the desired effect of weighting the projected ozone values towards the middle year of the 5-year period (i.e., the 2002 baseline emissions year) while also taking into account the emissions and meteorological variability that occurs over the full 5-year period.

The guidance also notes that the default weighting procedure emphasizes the importance of the meteorology experienced during the middle years of the 5-year period. As a result, EPA recommends that meteorological data for the five years be evaluated to determine if any extreme conditions have occurred during the period, especially for the middle years that receive extra weighting in the recommended $DV_B$ methodology.

CTDEP has conducted such an evaluation for the 2000 to 2004 ozone seasons. Figure 8.4.2.1 shows the number of days with maximum temperatures of 90°F or more (90+°F) at Bradley Airport in north-central Connecticut, using EPA's default 5-year weighting method. The 5-year period ending in 2004 (i.e., with 2002 weighted three times) had the highest weighted number of 90+°F days for any 5-year period over the last 30 years (i.e., 20 days, tied with 2003).

**Figure 8.4.2.1**
**Number of Days with Maximum Temperature 90+°F**
**(5-Year EPA Weighted Average Method at BDL)**

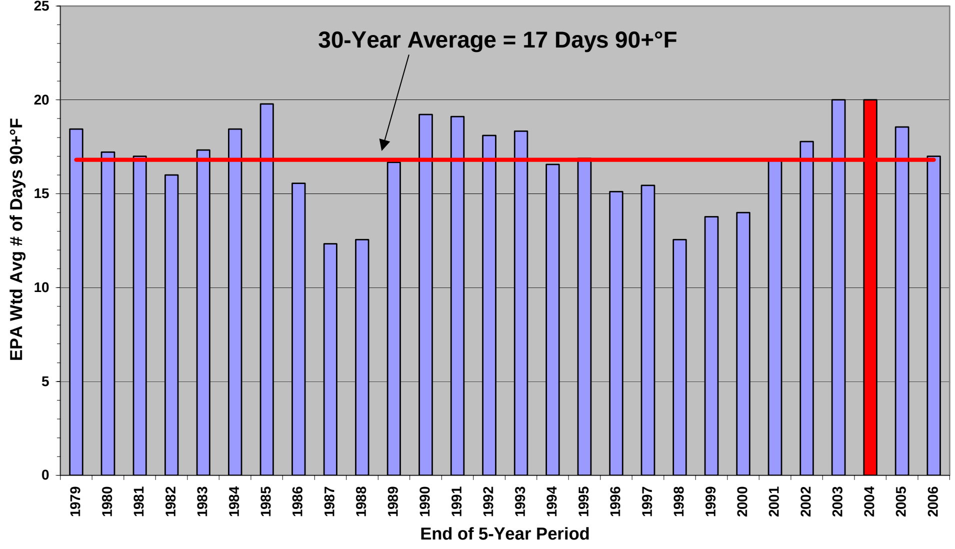


Figure 8.4.2.2 focuses on temperatures for the middle years (i.e., 2001 through 2003) that straddle the 2002 baseline year and which served as the design value period for EPA's 8-hour ozone nonattainment designations. The 3-year period ending in 2003 experienced the highest average number of days with temperatures of 90°F or higher over the 30-year period (i.e., 22 days, compared to the long-term average of 17 days).

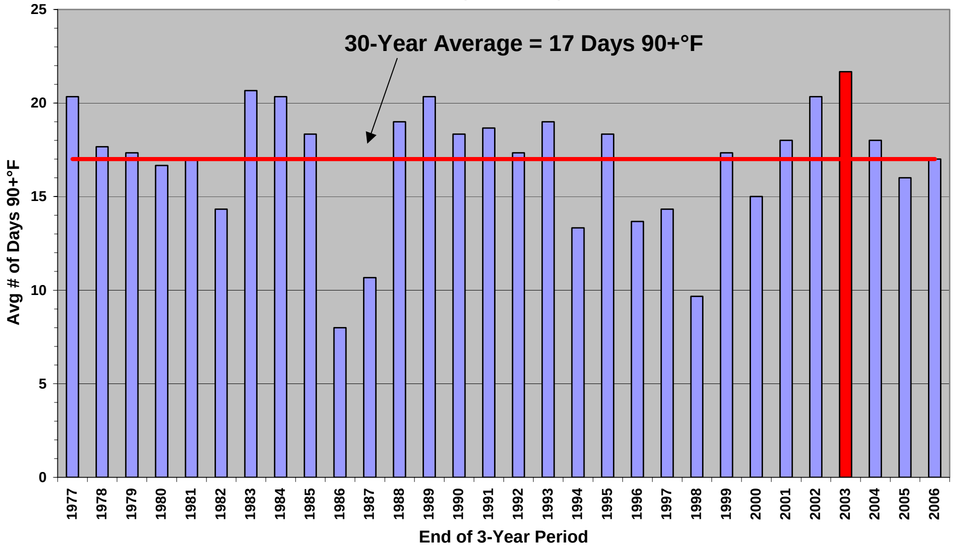


**Figure 8.4.2.2**
**Number of Days with Maximum Temperatures 90+°F**
**(3-Year Running Average at BDL)**

Based on this analysis, CTDEP concludes that EPA's default $DV_B$ weighting method should not be used for Connecticut due to the "extreme" meteorological conditions occurring during the middle years of the 5-year period. Instead, CTDEP has determined that a $DV_B$ method based on a non-weighted 5-year average of ozone concentrations (using 2000 through 2004 4th-high ozone values) more appropriately represents summer temperatures in Connecticut. Figure 8.4.2.3 illustrates this point, showing that, when simple 5-year averages of 90+°F days are analyzed, the 5-year period ending in 2004 is very close to the 30-year average of 90+°F days (i.e., 16 days compared to the long-term average of 17 days).

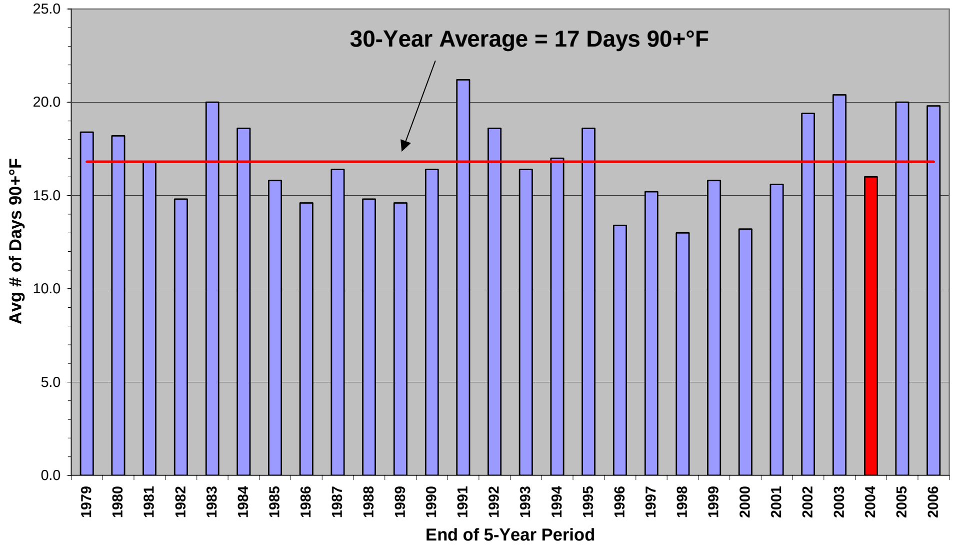


**Figure 8.4.2.3**
**Number of Days with Maximum Temperatures 90+°F**
**(5-Year Running Average at BDL)**

### 8.4.3 Unmonitored Area Analysis

The State of Connecticut's monitoring network, laid over the 12 kilometer CMAQ modeling grid, is depicted in Figure 8.3.1.1. This dense network of monitors covers virtually the entire state when the nine CMAQ modeling grid squares encompassing each of the monitors are considered. Also, the densest portion of the network is along the coastline, where Connecticut's nonattainment issues are the most problematic. Thus, the existing monitoring network is adequate to detect high ozone levels and an analysis of unmonitored areas is unnecessary.

### 8.4.4 Results of the Modeled Attainment Test

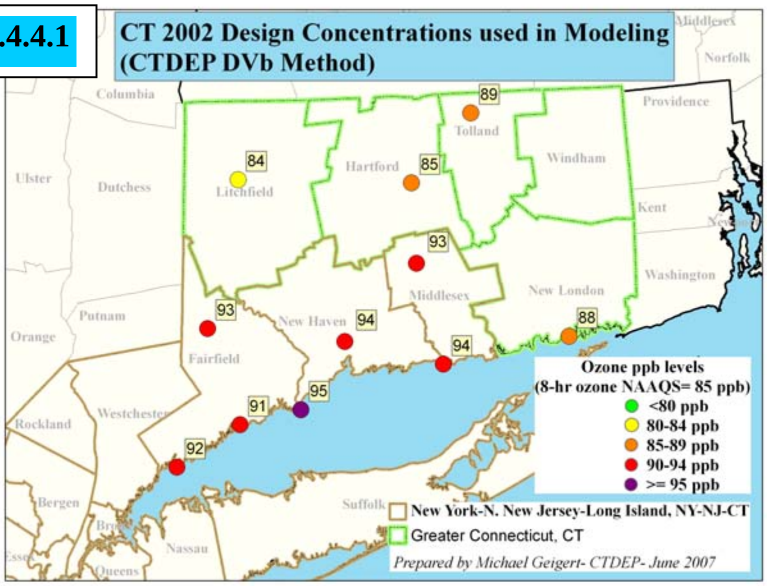
Projected ozone levels in 2009 and 2012 were determined using the MAT Equation, including RRF values developed from the CMAQ BOTW modeling and CTDEP's $DV_b$ values determined as described above. Results are summarized in Table 8.4.4.1, with the $DV_f$ values representing the CMAQ projected 8-hour ozone levels, with BOTW controls, in 2009 or 2012. Results are also displayed in Figures 8.4.4.1 through 8.4.4.3, showing the rapid improvement in ozone levels over the period modeled.

**Table 8.4.4.1: CMAQ Modeling Results for Connecticut for 2009 and 2012**

| 2009<br>Monitor | CTDEP DVb (ppb) | 2009 BOTW RRF | 2009 BOTW DVf (ppb) |
|---|---|---|---|
| **Greater CT** | | | |
| East Hartford | 85.0 | 0.876 | 74 |
| Cornwall | 83.5 | 0.870 | 72 |
| Groton | 87.8 | 0.879 | 77 |
| Stafford | 89.0 | 0.867 | 77 |
| **Southwest CT** | | | |
| Greenwich | 91.8 | 0.913 | 83 |
| Danbury | 93.2 | 0.897 | 83 |
| Stratford | 95.4 | 0.919 | 87 |
| Westport | 91.4 | 0.909 | 83 |
| Middletown | 93.4 | 0.888 | 82 |
| Madison | 94.4 | 0.905 | 85 |
| Hamden | 93.8 | 0.912 | 85 |

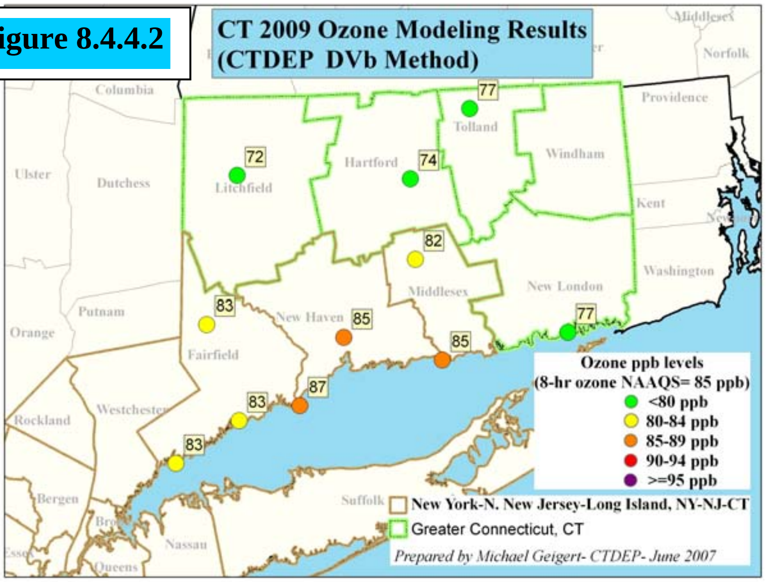
| 2012<br>Monitor | CTDEP DVb (ppb) | 2012 BOTW RRF | 2012 BOTW DVf (ppb) |
|---|---|---|---|
| **Greater CT** | | | |
| East Hartford | 85.0 | 0.826 | 70 |
| Cornwall | 83.5 | 0.818 | 68 |
| Groton | 87.8 | 0.831 | 72 |
| Stafford | 89.0 | 0.814 | 72 |
| **Southwest CT** | | | |
| Greenwich | 91.8 | 0.874 | 80 |
| Danbury | 93.2 | 0.853 | 79 |
| Stratford | 95.4 | 0.878 | 83 |
| Westport | 91.4 | 0.868 | 79 |
| Middletown | 93.4 | 0.839 | 78 |
| Madison | 94.4 | 0.853 | 80 |
| Hamden | 93.8 | 0.874 | 81 |

**Figure 8.4.4.1**



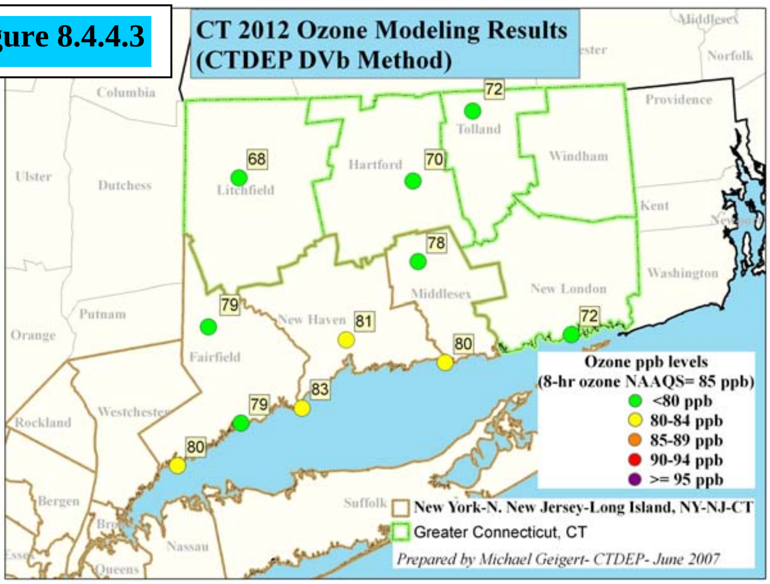
CT 2002 Design Concentrations used in Modeling (CTDEP DVb Method)

**Figure 8.4.4.2**



CT 2009 Ozone Modeling Results (CTDEP DVb Method)

**Figure 8.4.4.3**



CT 2012 Ozone Modeling Results (CTDEP DVb Method)

### 8.4.5 Conclusions for the Greater Connecticut Area

As displayed in Table 8.4.4.1, all four monitors located in the Greater Connecticut moderate nonattainment are projected by the CMAQ model to reach attainment of the 85 ppb 8-hour ozone NAAQS by 2009. Predicted 2009 ozone design values range from a high of 77 ppb in Groton and Stafford to a low of 72 ppb in Cornwall. All monitors are projected to have design values below the low-end threshold (i.e., 82 ppb) where EPA's modeling guidance recommends the use of supplemental weight of evidence analyses to demonstrate attainment. Therefore, with CMAQ projected concentrations well below both the NAAQS and WOE range, CTDEP concludes that there is a high probability that the Greater Connecticut area will achieve attainment of the 8-hour ozone NAAQS by the end of the 2009 ozone season. Improvements are expected to continue beyond 2009, with the CMAQ model projecting 8-hour ozone levels of 72 ppb or lower in the Greater Connecticut area by 2012.

### 8.4.6 Conclusions for the Southwest Connecticut Area

The CMAQ modeling projects that four of the seven monitors located in the Southwest Connecticut portion of the NY/NJ/CT moderate nonattainment area will reach attainment levels by 2009. The model predicts that residual nonattainment will remain in 2009 at three mid-coast monitors: Stratford (87 ppb), Hamden (85 ppb) and Madison (85 ppb). Finally, the CMAQ modeling projects that attainment of the ozone NAAQS will occur throughout all of Southwest Connecticut sometime between 2009 and 2012, with a peak design value of 83 ppb predicted in Stratford in 2012.

All seven Southwest Connecticut monitors are projected by the model to have 2009 design values within the "inconclusive" range (i.e., 82 ppb to 87 ppb) where EPA recommends the use of supplemental weight-of-evidence analysis techniques to better assess the probability of attaining by 2009. Several WOE analyses are presented in the following section. The results of these analyses lead CTDEP to conclude that there is a credible case for attainment throughout all of Southwest Connecticut by the end of the 2009 ozone season.

## 8.5 Weight-of-Evidence Analysis *(Note: The Hearing Report contains material that is supplemental to the information in Section 8.5.)*

By definition, models are simplistic approximations of complex phenomena. It is generally recognized that there is significant uncertainty associated with the results of photochemical grid modeling. In addition to the uncertainties associated with the dispersion and chemical response mechanisms built into the air quality model, the required meteorological, baseline and projected emissions, and air quality input data sets also contain their own levels of uncertainty that can affect the performance of the modeling system. These uncertain aspects of the modeling analyses can sometimes prevent definitive assessments of future attainment status especially when projected pollutant levels are at levels close to air quality standards.

Due to these uncertainties, modeling results should not be used in a strictly deterministic fashion to determine "bright-line" compliance by comparing projected air quality levels directly with the ozone NAAQS. Modeling is more appropriately used as a probabilistic tool, along with other available assessment techniques, to assess the likelihood of complying with the NAAQS by a certain deadline. Of course, a properly performing model which projects air quality in an area to be well above, or well below, the level of the NAAQS may warrant greater consideration among the mix of available other assessments when determining the likelihood of compliance.

EPA addresses the modeling uncertainty issue in its modeling guidance,[9] recommending that WOE analyses be performed to better determine the likelihood of NAAQS compliance when the model attainment test results are "inconclusive". EPA's guidance establishes the "inconclusive" range for 8-hour ozone modeling as MAT results between 82 ppb and 87 ppb for the required attainment year. As described above in Section 8.4, 2009 CMAQ MAT results for the Greater Connecticut area are well below this "inconclusive" range, providing a high degree of confidence that Greater Connecticut area will comply with the NAAQS by 2009. CMAQ MAT results for the Southwest Connecticut area fall within the "inconclusive" range, warranting consideration of other evidence to assess the probability of attaining in that area by 2009. Therefore, the focus of the WOE study is on the Southwest Connecticut area.

Several topics are included in the WOE discussion that follows below, including modeling uncertainties, air quality trends, comparison of modeled and monitored ozone levels, additional emission reductions not included in the CMAQ modeling and other important considerations.

### 8.5.1 Modeling Uncertainties Indicate the CMAQ Model May Overpredict 2009 Ozone Levels

Several contributors to modeling uncertainty may result in overestimation by CMAQ of projected 2009 design values. These include the inadequate incorporation by the modeling system of $NO_X$ emissions occurring during high electric demand days (HEDD), potential problems with the model's treatment of aloft transport and difficulties simulating marine boundary layer and sea breeze effects.

#### 8.5.1.1 Modeling Uncertainty Related to HEDD Emissions

Emissions from the electricity generating source sector vary widely both diurnally and on a day-to-day basis, dependent upon the demand for electricity and the emission characteristics of the mix of electric generating units (EGUs) dispatched to meet changing demand and reserve capacity requirements. The highest level of EGU emissions typically occur on hot summer days, when the demand for air conditioning results in dispatch of load-following and quick-start EGU peaking units, most of which emit $NO_X$ at much higher rates (per unit of heat input or power output) than base-load units. Unfortunately, these HEDD emissions often occur during the meteorological conditions most conducive to producing the highest levels of ozone. For Connecticut, the most favorable meteorological conditions for ozone production include high temperatures on sunny summer days, with lower level transport winds from the southwest and upper level transport winds from the west, regions rich with emissions from EGUs and other source categories.

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[9] Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze; EPA OAQPS; EPA-454/B-07-002; April 2007; See page 98 of: http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf.

The variability of EGU emission profiles in New England is depicted in Figure 8.5.1.1, which shows that daily EGU $NO_X$ emissions in New England on high ozone days can be more than twice what they are on low ozone days (e.g., 260 tons on Aug 14, 2002 compared to 130 tons on Aug 8, 2002). In Figure 8.5.1.2, similar variations in emissions are seen upwind from Connecticut in the metropolitan New York City-New Jersey area, with more than double the emissions on high ozone days compared to New England (i.e., maximum 590 tons in the NYC metro area compared to a maximum of 260 tons in New England). These New York City-New Jersey sources impact the key monitors along the southern and western boundaries of Connecticut.

**Figure 8.5.1.1 Daily $NO_X$ emissions from EGUs in New England**

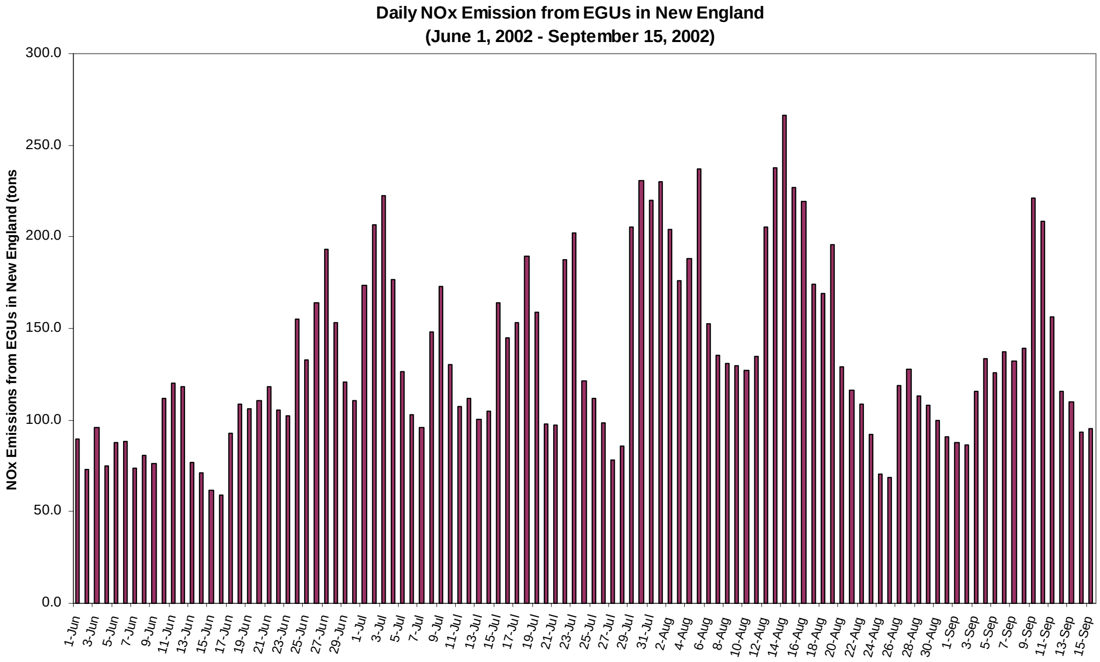
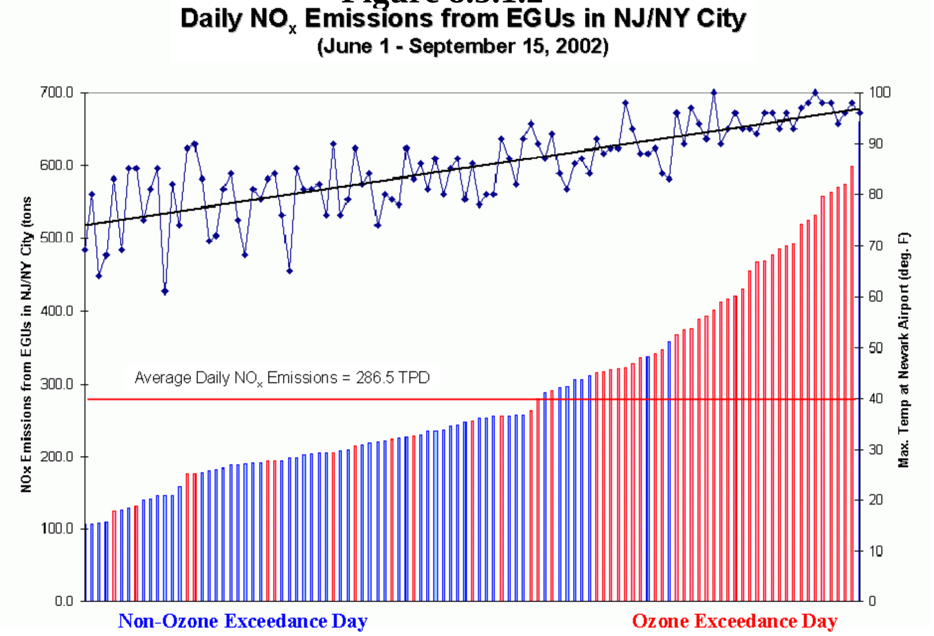
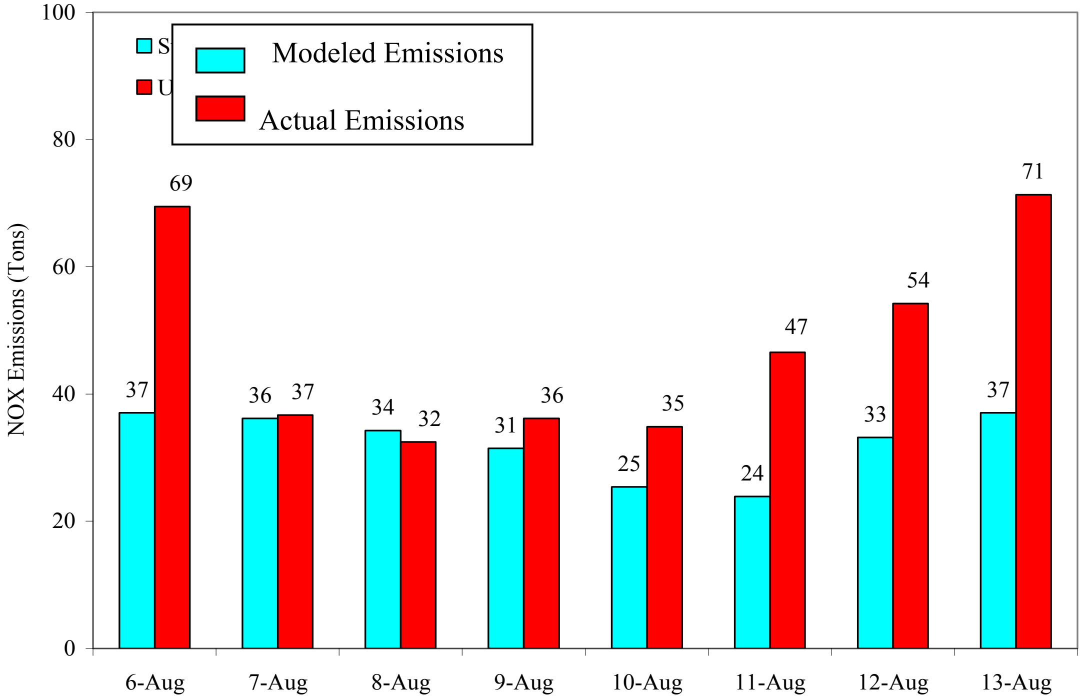


**Figure 8.5.1.2**



The CMAQ modeling system is not structured to capture the large day-to-day variability that occurs in actual EGU $NO_X$ emissions. Due to limitations in projecting temporal and spatial distributions of future EGU dispatch, EGUs are simulated by the modeling system using uniform $NO_X$ hourly profiles that vary only by month of the year and by day of the week, with no distinction made between the highest demand and lowest demand days. The difference between actual and modeled emissions is depicted in the example provided in Figure 8.5.1.3. Modeled emissions for Hudson County, New Jersey follow a day-of-week repeating profile for August 2002. Note that modeled August 6 emissions of 37 tons are repeated one week later, on August 13, in accordance with the day-of-week profile. Meanwhile, actual emissions vary considerably throughout the week depending on electricity demand, with the highest demand days producing $NO_X$ emissions almost twice those that were modeled. Ozone levels on August 13, 2002 were among the highest that year in Connecticut, with five of the state's eleven monitors measuring 8-hour values in excess of 120 ppb.

**Figure 8.5.1.3 Comparison of Actual and Modeled EGU Emissions for Hudson County, NJ**



This large (i.e., factor of two) underestimate of EGU $NO_X$ emissions on high demand days has implications for CMAQ modeling results in both the baseline and future year modeling scenarios. Effectively doubling modeled levels of EGU emissions on high demand days (which are often high ozone days) increases the importance of the EGU sector relative to other source categories. As a result, post-2002 controls on the EGU sector, such as the CAIR program and potential HEDD strategies, may result in greater improvements in actual future year ozone levels than the current modeling results indicate.

### 8.5.1.2 Modeling Uncertainty Related to CMAQ's Response to Emission Reductions

Two recent real-world examples provide an opportunity for assessing the capabilities of the CMAQ modeling system to properly respond to emission changes, especially from elevated EGU emission sources that are known to contribute significantly to ozone transport:

- 2003 Northeast Power Blackout; and
- Implementation of EPA's $NO_X$ SIP Call.

Detailed descriptions of these events have been developed by the State of Maryland, as presented in that state's ozone SIP.[10] Much of the related analyses are based on aircraft measurements of meteorological and pollutant parameters conducted by the University of Maryland along the eastern seaboard during the 2002 and 2003 ozone seasons (including the 2003 Northeast blackout period), as well as subsequent attempts to simulate each event with the CMAQ model. The summaries provided below are based on the descriptions provided in Maryland's attainment demonstration.

In both of these real-world cases, comparison of actual ozone reductions to CMAQ modeling results reveals that the CMAQ model underpredicted the level of measured ozone improvement associated with reductions in EGU emissions, possibly due to model problems with the simulation of elevated transport. These findings reinforce the possibility that post-2002 EGU reductions from the CAIR program and potential HEDD strategies may result in greater improvements in actual 2009 year ozone levels than indicated by the modeling results described in Section 8.4.5.

#### <u>2003 Northeast Power Blackout</u>

Shortly after 4 p.m. eastern daylight time on August 14, 2003, a chain reaction triggered the shutdown of much of the generating capacity in the northeastern U.S. and southeastern Canada. This largest single electricity outage in North American history affected an estimated 50 million people, with 61,800 megawatts (MW) of electrical load lost in parts of Ohio, Michigan, New York, Pennsylvania, New Jersey, Connecticut, Massachusetts, Vermont and the province of Ontario. Many units shut down completely at the start of the blackout, with maximum impact reached a short time later, resulting in 531 units at 263 power plants being shut down. Most of these units remained shut down for 24 hours or more.

Although many ground-based ozone monitoring stations were without electricity, the University of Maryland instrumented aircraft flew that day based on a forecast for high ozone. Airborne measurements were taken over Maryland and Virginia (outside the blackout area) and Pennsylvania (in the center of the area affected by the blackout) on August 15, 2003, 24 hours into the blackout. The data from these flights provided a rare opportunity to test the response of air quality models to a large, sudden drop in emissions.

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[10] "Baltimore Nonattainment Area 8-Hour Ozone State Implementation Plan and Base Year Inventory"; SIP Number: 07-04; June 15, 2007; See: http://www.mde.state.md.us/Programs/AirPrograms/air_planning/index.asp. In particular, see Appendices G1, G8, G-9, and G-10 of the Maryland SIP.

Airborne measurements collected during the blackout show that ozone was 30 ppb lower throughout the lowest 1.5 km of the atmosphere and 38 ppb lower at ground level on that day, compared to measurements on a meteorologically similar day, August 4, 2002.[11] Comparison to another day (August 3, 2005) that may have been even more similar to the blackout day, especially in regards to transport, found smaller differences in ozone, around 7 ppb. It is important to note that the August 3, 2005 flight occurred after the significant EGU $NO_X$ reductions from the $NO_X$ SIP Call were implemented, which likely explains the smaller differences when compared to the blackout measurements.

The only identified CMAQ modeling study of the 2003 blackout event[12] estimated that the blackout resulted in only 2.2 ppb of ozone reduction, far less than the 7 ppb to 38 ppb response determined by either of the above observation-based methods. These comparisons suggest that the model is not appropriately capturing the response in ozone due to changes in power plant emissions.

## EPA's $NO_X$ SIP Call

EPA, in collaboration with researchers from several universities, is performing a CMAQ simulation of 2002 and 2004 summertime air quality to determine the benefits of the $NO_X$ SIP Call.[13] The $NO_X$ SIP Call provided a large reduction in $NO_X$ emissions over a relatively short period of time, providing an opportunity to assess the performance of the CMAQ modeling system.

The final manuscript has not yet been released, but preliminary results indicate that, although observed median 8-hour ozone levels improved by about 18 ppb during the 2002 to 2004 period, the CMAQ model only simulated a change of 8 ppb. If these results are not explained by other factors, they would suggest that the CMAQ model may underpredict changes in ozone, especially from reductions in sources of elevated $NO_X$ emissions that contribute to transport.

The 2003 Northeast Blackout studies and EPA's $NO_X$ SIP Call analysis highlight an apparent "stiffness" of the CMAQ model in properly responding to elevated $NO_X$ reductions. This suggests that the 2009 CMAQ predictions presented in Section 8.4 may be too high, not adequately accounting for the level of ozone improvements that can be expected from control programs such as CAIR. These findings also provide hope that the HEDD reductions being pursued by several Northeast states (including Connecticut) will provide significant additional ozone reductions that have not been reflected in the modeling results.

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[11] Marufu,L.T., B. F. Taubman, B. Bloomer, C. A. Piety, B. G. Doddridge, J. W. Stehr, and R. R. Dickerson; "The 2003 North American electrical blackout: An Accidental Experiment in Atmospheric Chemistry"; *Geophysical Research Letters*; Vol. 33, L22810, doi:10.1029/2006GL027252, 2006..

[12] Hu, Y. M. T. Odman, and A. G. Russell; "Re-examination of the 2003 North American electrical blackout impacts on regional air quality", *Geophysical Research Letters*, Vol. 33, L22810, doi:10.1029/2006GL027252, 2006.

[13] Gilliland et al; manuscript in preparation, 2007.

### 8.5.1.3 Modeling Uncertainty Related to Sea Breeze Circulations

A sea breeze typically forms along coastlines during afternoons when the land is considerably hotter than the adjacent ocean or bay. The difference in temperature between the land and adjacent water body results in a pressure difference that drives the air circulation. Air flows from the high pressure over the ocean toward the low pressure over land. At night, the opposite may happen as the land cools below the ocean's temperature, and a land breeze blows out to sea. Because the nighttime land and water temperature differences are usually much smaller than in the day, the land breeze is weaker than the sea breeze. Sea breezes typically only penetrate a few kilometers inland because they are driven by temperature contrasts that disappear inland.

The coastal sea breeze can be an important ozone transport mechanism, sweeping ashore pollutants originally transported over the ocean parallel to the coastline. Ozone moving over water is, like ozone aloft, isolated from destructive forces. When ozone gets transported into coastal regions by sea breezes, it can arrive highly concentrated. Conversely, when the offshore air mass contains few pollutants, the sea breeze can draw clean marine air into coastal areas.

Transport over the ocean is commonly observed downwind of the New York City metropolitan area during the summer months due the city's proximity to the Atlantic Ocean and the Long Island Sound. The relatively cool summertime waters of Long Island Sound limit vertical mixing and deposition of ozone, often resulting in a concentrated ozone plume just offshore that is fueled by upwind emission sources located southwest of Connecticut. On days when a sea breeze forms in the afternoon, the shift in wind can bring high ozone concentrations to Connecticut's coastal monitors. Given the small temporal and spatial scale of sea breeze effects, the CMAQ model is challenged to resolve this feature, thus introducing a significant level of uncertainly to projections at the coastal Connecticut sites. Furthermore, since the emissions contained in the offshore plume do not originate from CT sources, in-state reductions have little effect on coastal concentrations affected by the sea breeze. This further emphasizes the importance of upwind reductions to reach attainment in coastal Connecticut.

The sea breeze effect along Connecticut's coastline is depicted in the four pollution rose plots presented in Figure 8.5.1.3.1. These pollution roses represent the frequency of wind direction on the highest 10 percentile ozone concentration days from April 1 to October 31 during the years 1997 to 2005.[14] The winds on the highest ozone days point at the New York City metropolitan area at all locations along the Connecticut shoreline. Going along the Connecticut shoreline from the west (i.e. Greenwich) to the east (i.e., Groton), the predominant wind frequency direction (noted in red) shifts increasingly to the west, tracking the upwind location of the New York City metropolitan area.

This analysis suggests that most high ozone events in coastal Connecticut are caused by emissions transported from upwind areas, rather than by in-state emissions. To the extent that any coastal nonattainment issues remain after 2009, additional upwind reductions will be necessary to achieve compliance.

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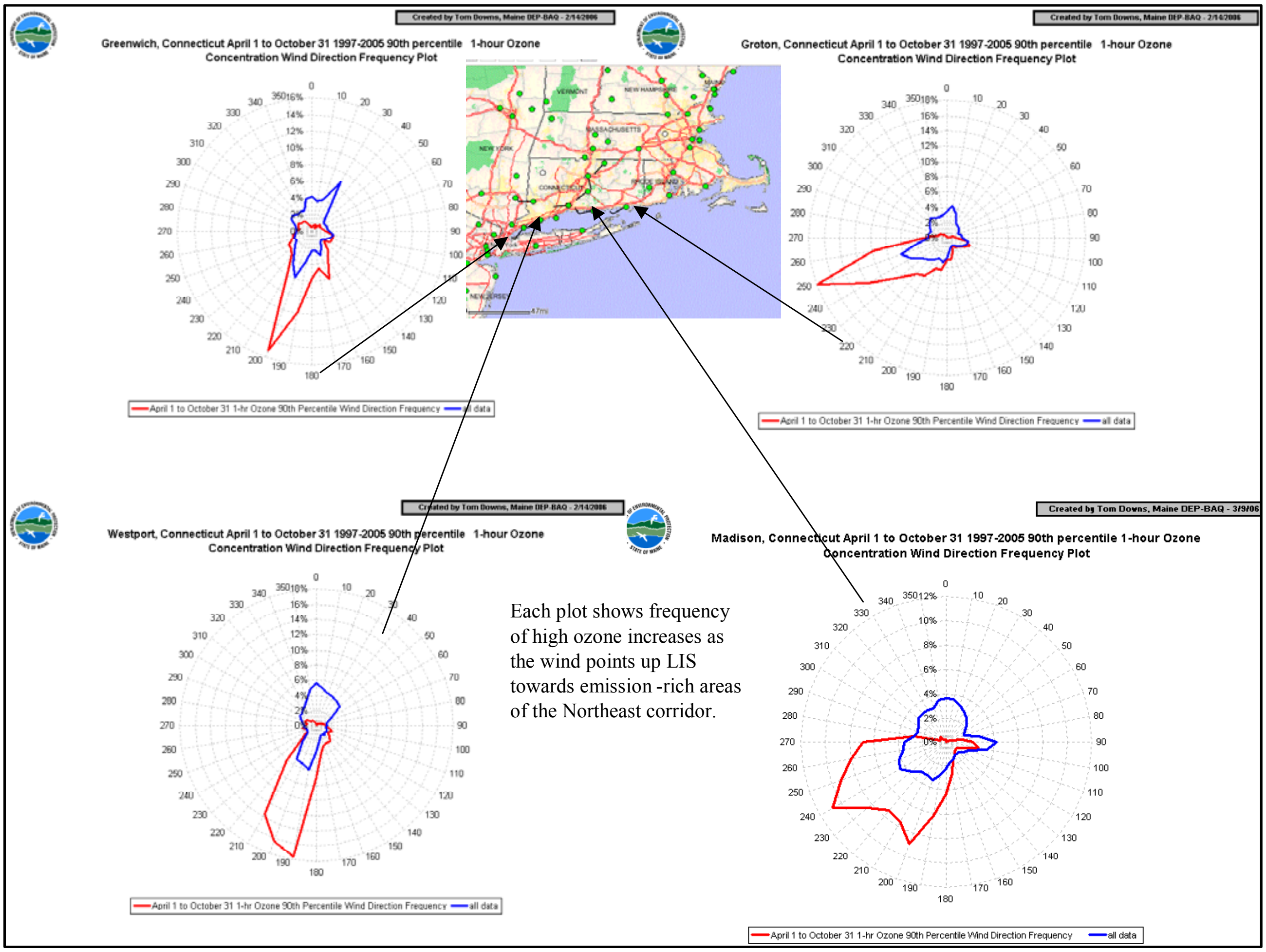
[14] "The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description"; NESCAUM; October 2006; See http://bronze.nescaum.org/committees/attainment/conceptual/.

**Figure 8.5.1.3.1 Wind rose plots along Connecticut shoreline for the time period April 1 to October 31 during the years 1997 through 2005**



Each plot shows frequency of high ozone increases as the wind points up LIS towards emission -rich areas of the Northeast corridor.

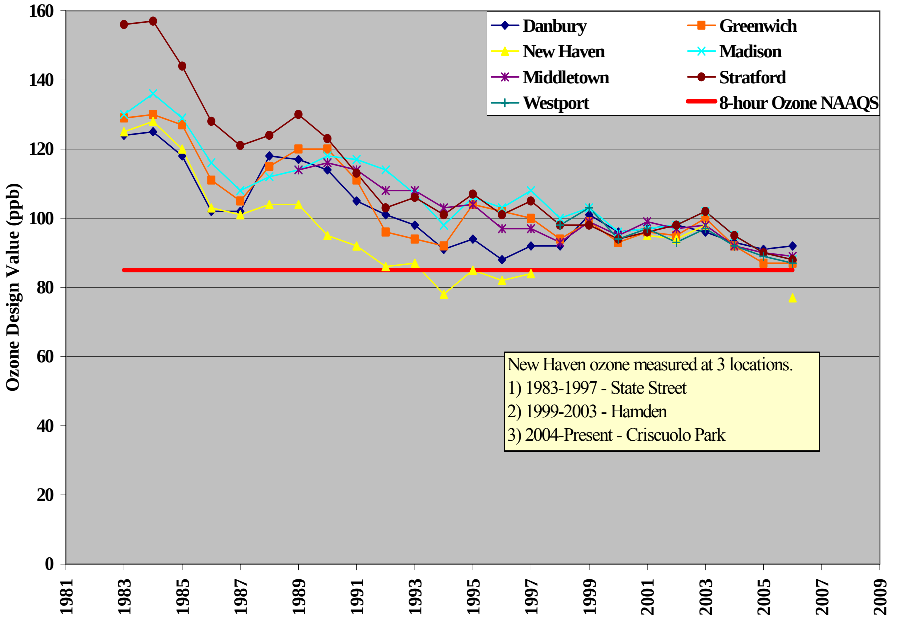
### 8.5.2 Air Quality Trends Indicate the CMAQ Model May Overpredict 2009 Ozone Levels

Emission reduction programs implemented over the last 25 years have resulted in significant decreases in peak ozone levels in Connecticut. The control strategies included in this SIP revision will continue to advance that progress. The following subsections briefly review the progress that has been made to date (see Section 3 for a more complete discussion) and examine how well the CMAQ model captures the progress that has been made since 2002, the baseline year used in the modeling analysis.

#### 8.5.2.1 Air Quality Trends Suggest Southwest Connecticut is on Track for Attainment

As previously described in Section 3, measured levels of ozone and ozone precursor have dramatically decreased in Connecticut over the last 25 years. Figure 8.5.2.1 depicts the substantial reductions in 8-hour ozone design values that have occurred over that period at all monitors in the Southwest Connecticut Area.

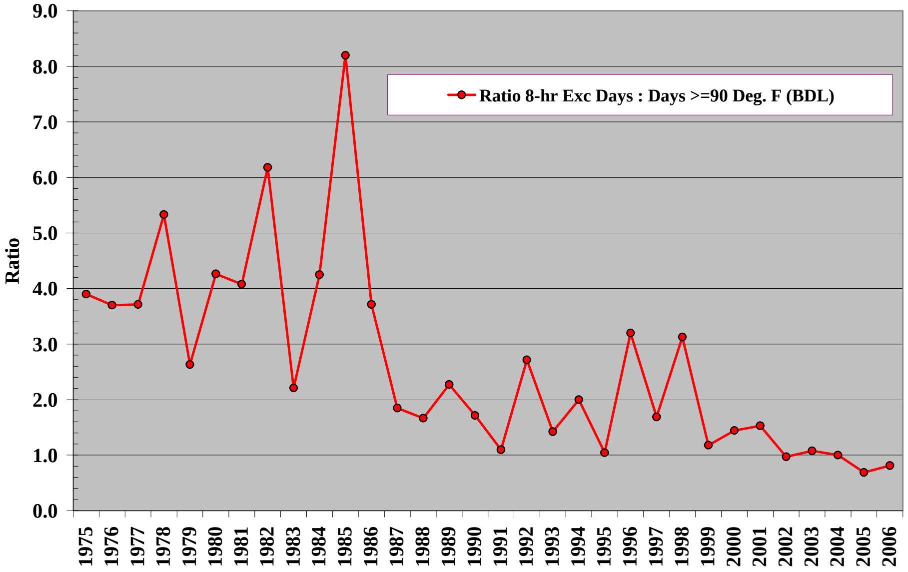
**Figure 8.5.2.1 Trends in 8-Hour Ozone Design Values for the SWCT Area**



New Haven ozone measured at 3 locations.
1) 1983-1997 - State Street
2) 1999-2003 - Hamden
3) 2004-Present - Criscuolo Park

The decline in peak ozone levels is apparent even when year-to-year summertime temperature fluctuations are considered. Figure 8.5.2.2 depicts the ratio of ozone exceedance days to the number of days with maximum temperatures of 90°F or more in Connecticut for the period from 1975 through 2006. There were 2.2 to 8 times more exceedance days than hot days during the first ten years of the period (1975 to 1985). Ratios subsequently decreased to levels ranging from one to three exceedance days per each hot day through the 1990s. Most recently, the ratio has declined to one exceedance day or less per hot day since 2002. In 2006, the ratio was 0.81, with 13 exceedance days versus 16 hot days during the ozone season.

**Figure 8.5.2.2: Connecticut Statewide 8-Hour Ozone Standard Ratio of "Unhealthy" to "Hot" Days through 2006**



These improvements in ozone levels have resulted from continuing reductions in ozone precursor emissions in Connecticut, throughout the OTR and elsewhere. As is more fully described in Section 4.3, control programs included in Connecticut's RFP demonstration are projected to result in 25% reductions in anthropogenic VOC emissions and 31% reduction in anthropogenic $NO_X$ emissions between 2002 and 2009, with considerable additional reductions projected through 2012 and beyond.

The dramatic improvement in ozone levels since 1985 in the Northeast is displayed in a series of isopleth maps provided in Appendix 8N. The plots show the progressive reduction in both the magnitude and spatial extent of high ozone levels as the ozone plume has "retreated" towards the southwest due to the success of emission control programs.

Finally, improvements in measured ozone levels suggest that Southwest Connecticut is on-track to achieve the necessary design value of less than 85 ppb to attain the 8-hour NAAQS by the end of the 2009 ozone season. Actual rate-of-progress towards the attainment goal is summarized in Figure 8.5.2.3. EPA used the 2003 design value of 102 ppb, measured at Stratford and Madison, Connecticut to classify the NY/NJ/CT area as moderate nonattainment for the 8-hour ozone NAAQS. Assuming improvements are achieved at an even rate over the 6-year period from 2003 to 2009, ozone levels would need to decline by 3 ppb per year to achieve attainment by 2009. Over the 3-year period from 2003 to 2006, this would require an improvement of 9 ppb, corresponding to a 2006 design value goal of 93 ppb. The highest measured design value in 2006 was 92 ppb, suggesting the Southwest Connecticut area is on-target for attainment in 2009.

**Figure 8.5.2.3 Measured Improvement in Design Values Compared to Rate-of-Progress Needed to be On-Target for 2009 Attainment**

1) **Base Year (2003)**: Design Value = 102 ppb (measured in Stratford and Madison, CT)

2) **Target Year (2009) Goal:** Design Value ≤ 85 ppb

3) **Desired Rate-of-Progress to Meet Target (assumes even rate):**
2009 – 2003 = 6 years
102 ppb - 84 ppb = 18 ppb
18 ppb/6 years = 3 ppb/year

4) **Goal for 2006:**
2006-2003 = 3 years
3 ppb/year x 3 years = 9 ppb (ozone improvement goal)
102 ppb - 9 ppb = 93 ppb (ozone design value goal for 2006)

5) **Status for 2006:** Highest measured design value = 92 ppb (measured in Danbury, CT)

6) **Conclusion:** On-target for attainment in 2009

### 8.5.2.2 Ozone Improvements Outpace CMAQ Modeled Projections at Key Monitors

As previously described in Section 8.4.3, CMAQ modeling for 2009 projects that only the Stratford, Madison and Hamden monitors in Southwest Connecticut will have design values exceeding the 85 ppb 8-hour ozone NAAQS. Model projections for the other four Southwest Connecticut monitors (and all four Greater Connecticut monitors) are below the level of the NAAQS in 2009.

Measured 2006 design values provide a means to assess how well the CMAQ model is performing relative to actual measured ozone levels. Table 8.5.2.2.1 compares actual measured 2006 design values to 2006 interpolated CMAQ modeling results at the key monitoring sites in Southwest Connecticut. The 2006 modeled values were determined by linearly interpolating between the 2002-era baseline design values (DVb) used as the anchor point in the modeling analysis and the CMAQ-modeled 2009 BOTW results.

**Table 8.5.2.2.1 Comparison of 2006 Actual Design Values to CMAQ Interpolated Results**

| Key SWCT Monitors | CTDEP DVb (ppb) | 2009 CMAQ BOTW DVf (ppb) | Interpolated 2006 CMAQ DV (ppb) | Actual 2006 DV (ppb) | Are Measured Design Values Ahead or Behind Model Predictions? |
|---|---|---|---|---|---|
| Stratford | 95.4 | 87.7 | 91.0 | 88 | Ahead |
| Madison | 94.4 | 85.4 | 89.3 | 88 | Ahead |
| Hamden | 93.8 | 85.5 | 89.1 | *na* | *na* |
| Danbury | 93.2 | 83.6 | 87.7 | 92 | Behind |

*na* – not applicable (The Hamden monitor was moved to New Haven in 2004. The 2006 design value in New Haven was 77 ppb.)

For the two key monitors at Stratford and Madison, actual 2006 design values are somewhat ahead of the interpolated CMAQ results for 2006. Stratford's monitored 2006 design value is 88 ppb, while linear interpolation between the 2002 modeling design concentration and the 2009 CMAQ modeling results yields a "modeled" 2006 value of 91 ppb. Similarly, the actual 2006 design value for Madison is 88 ppb, while the interpolated CMAQ results produce a "modeled" 2006 value of 89 ppb. If these differences carry forward to 2009, Stratford's 2009 modeled value of 87 ppb would translate to a possible 2009 design value of 84 ppb and Madison's modeled value of 85 ppb would translate to a possible 2009 design value of 84 ppb, both in compliance with the 8-hour ozone NAAQS of 85 ppb. Note that the Hamden ozone monitor was moved to New Haven in 2004, so a similar comparison cannot be made for that site. The 2006 design value at the New Haven site was 77 ppb, in compliance with the ozone NAAQS.

These findings are somewhat consistent with those observed in New Jersey, where all monitored design values in 2006 have already reached CMAQ modeled values for 2009. However, one monitor in Southwest Connecticut, located in Danbury, appears to be significantly behind the design value that might be anticipated by the CMAQ modeling. Danbury's 2006 design value, 92 ppb, is about 4 ppb greater than the interpolated CMAQ value of 88 ppb for 2006, raising doubts that the CMAQ predicted 2009 design value of 83 ppb will actually be realized at that site. It is worth noting that Danbury's measured 2006 design value of 92 ppb is comprised of fourth-high concentrations of 86 ppb in 2004, 104 ppb in 2005, and 87 ppb in 2006. The 104 ppb value from 2005 dominates the three-year design value average. The summer of 2005 experienced 29 days of 90°F or higher temperatures, the 5th hottest summer in the last 30 years.

As discussed further in the following subsection, ozone levels have improved to the point that the prospect for attainment in 2009 in Southwest Connecticut is strongly tied to the meteorological conditions that will occur during the summers of 2007, 2008 and 2009.

### 8.5.3 Attainment Levels Have Been Achieved During A Previous Cool Summer

The occurrence of one or more cool summers would increase the prospects of attaining the ozone standard in Southwest Connecticut by the end of 2009. For example, the 2004 summer experienced only 6 days with maximum temperatures of 90°F or higher (an average summer has 17 days $\geq$ 90°F). As a result, all Connecticut ozone monitors, except for Danbury, recorded 4th-high 8-hour ozone levels that were less than the 8-hour ozone NAAQS of 85 ppb. Note that 4th-high values are used in the three-year design value calculation to determine NAAQS compliance. The Danbury 4th-high value in 2004 was 86 ppb, marginally greater than the standard. Emissions have decreased significantly since the 2004 ozone season, with a 20% reduction in ozone precursors expected between 2004 and 2009. Based on that level of emission reduction, if one or more of the summers of 2007, 2008 and 2009 are similar to, or even slightly warmer than the summer of 2004, compliance with the NAAQS could be achieved.

### 8.5.4 "Clean Data" in 2009 would Qualify SWCT for Clean Air Act Extension Year(s)

Section 181(a)(5) of the CAA provides a mechanism for states to apply to the EPA administrator for an extension of the attainment deadline:

> "Upon application by any State, the Administrator may extend for 1 additional year (hereinafter referred to as the "Extension Year") the date specified in table 1 of paragraph (1) of this subsection if-
> (A) the State has complied with all requirements and commitments pertaining to the area in the applicable implementation plan, and
> (B) no more than 1 exceedance of the national ambient air quality standard level for ozone has occurred in the area in the year preceding the Extension Year.
> No more than 2 one-year extensions may be issued under this paragraph for a single nonattainment area."

The reference to "table 1" points to the classification categories and attainment dates specified by the CAA Amendments of 1990 for the now revoked 1-hour ozone NAAQS. Under the 1-hour NAAQS, compliance in a nonattainment area was determined based on a design value defined as the maximum recorded 4th-highest 1-hour concentration recorded at any monitor over the most recent three-year period (i.e., an average of one exceedance per year was allowed at a monitor).

Under the current 8-hour NAAQS, compliance in a nonattainment area is determined based on a design value defined as the average of the 4th-highest concentration recorded at a monitor each year over the most recent three-year period. This design value definition allows compliance to be achieved even with three or more exceedances of the 8-hour NAAQS in a given year, provided the three-year average of 4th-high values at each monitor is less than 85 ppb.

Section 181(a)(5) of the CAA was written using the definitions of "design value" and "compliance" for the then applicable 1-hour ozone NAAQS and is not as easily interpreted in relation to the changed definitions of those terms for the 8-hour NAAQS. One reasonable interpretation for the 8-hour NAAQS would be that an area is eligible for a one-year extension of the attainment deadline if the maximum measured 4th-high concentration in the required attainment year (i.e., in this case, 2009) is less than 85 ppb.

Based on this interpretation, and assuming that the nonattainment area does not have a 2009 design value that fully complies with the NAAQS, Southwest Connecticut would be eligible for a one-year extension of the attainment deadline if the maximum recorded 4th-high concentration in 2009 at each monitor in the nonattainment area is less than 85 ppb. Section 181(a)(5) would also allow an additional extension year to achieve attainment, through 2011, if "clean data" were recorded throughout the nonattainment area in 2010.

Section 181(b)(2) also exempts nonattainment areas that receive attainment deadline extensions from the "bump-up" provision of the CAA (emphasis added):

> "Reclassification upon failure to attain.- (A) Within 6 months following the applicable attainment date **(including any extension thereof)** for an ozone nonattainment area, the Administrator shall determine, based on the area's design value (as of the attainment date), whether the area attained the standard by that date. Except for any Severe or Extreme area, any area that the Administrator finds has not attained the standard by that date shall be reclassified by operation of law in accordance with table 1 of subsection (a) to the higher of-
>
> (i) the next higher classification for the area, or
>
> (ii) the classification applicable to the area's design value as determined at the time of the notice required under subparagraph (B).
>
> No area shall be reclassified as Extreme under clause (ii)."

Based on the above discussion, Southwest Connecticut could reach attainment of the NAAQS in 2011 and still comply with CAA requirements for moderate nonattainment areas.

### 8.5.5 Modeling Does Not Include Several Important Emission Control Strategies

The CMAQ modeling conducted for the attainment demonstration does not account for several control strategies that are expected to provide additional emission reductions in the 2009 timeframe, thereby increasing the likelihood that ozone levels in 2009 will be lower than the modeled levels reported in Section 8.4. The most important strategies, which are not at this time being proposed for inclusion in the ozone SIP, are summarized in Table 8.5.5.1 with discussion of some of the key Connecticut initiatives provided below.

## Table 8.5.5 Additional Emission Control Strategies Not Included in the CMAQ Modeling

| Strategy | Timing | Comments |
|---|---|---|
| High Electric Demand Day Reductions (HEDD) | 2009 ozone season | **Northeast MOU in place; pursuing this initiative** |
| CT Energy Efficiency, Load Shifting & Clean Energy Programs | Ongoing & Increasing | |
| CT Energy Bill of 2007 Programs | 2008 | **Plans for peaking generation**;<br>**Comprehensive plan** for procurement of energy resources;<br>**Annual Assessment** of energy capacity requirements, demand growth, environmental impacts, security and costs |
| CT $1 Billion Commitment to Reduce Highway Congestion<br>- Regional planning for commuter transport<br>- Encourage port and rail freight use<br>- Expand rail commuter service<br>- Fuel cell study<br>- Telecommuting/flexible employee scheduling | 2008 + | Includes New Haven-Hartford-Springfield MA commuter rail line; other transit; telecommuting |
| NYC Hybrid Taxi and Energy Efficiency | 2007-2012 | All hybrid taxi fleet by 2012 |
| OTC Auto Refinishing VOC Content Limits | 2012 (anticipated) | Approximately 65% reduction in VOC emissions anticipated from the 2002 baseline for this sector. The requirements are now adopted in some California air quality districts. |
| EPA National Measures | | |
| - Aerosol Coatings | 2009 | Consumer products & AIM included in modeling only for OTR states. |
| - Consumer Products | 2009 | |
| - Architectural Coatings (AIM) | 2009 | |
| Group II VOC Control Technique Guidelines (CTGs)<br>- Flexible package printing<br>- Offset lithographic/letterpress printing<br>- Industrial cleaning solvents | 2009 | Rule amendment under development. |
| Diesel Locomotives & Marine Diesel Engines | 2009 starts phase-in | Proposal published March 2007 |
| Small Spark-Ignited Lawn & Garden and Marine Engines | Phase-in starts 2009 Marine & 2011 Nonroad | Proposal published May 2007 |
| $NO_X$ reductions from minor source asphalt production facilities | 2009-2010 | State initiative under development |

### 8.5.5.1 High Electric Demand Day (HEDD)

As discussed in Section 8.5.1.1, emissions from the electricity generating source sector can vary widely on a day-to-day basis, depending upon the demand for electricity and the emission characteristics of the mix of electric generating units (EGUs) dispatched to meet changing demand and reserve capacity requirements. The highest levels of EGU emissions typically occur on hot summer days, when the demand for air conditioning results in dispatch of load-following and quick-start EGU peaking units, most of which emit $NO_X$ at much higher rates (per unit of heat input or power output) than base-load units. Unfortunately, these HEDD emissions often occur during the meteorological conditions most conducive to producing the highest levels of ozone. For Connecticut, the most favorable meteorological conditions for ozone production include high temperatures on sunny summer days, with lower level transport winds from the southwest and upper level transport winds from the west, regions with abundant emissions from EGUs and other source categories.

While not specifically quantified in the modeling process, Connecticut worked with the Ozone Transport Commission (OTC) to design a high electric demand day strategy, which, when implemented throughout the OTC and aggressively targeted to the inner core, would achieve real air quality benefits.[15] Due to the high cost of electricity at peak demand times and the need to assure reliability of supply, Connecticut's energy planning and air quality planning are inextricably linked and being coordinated. Preliminary estimates indicate that current demand side reduction efforts have a 7 ton-per-day (tpd) $NO_X$ reduction benefit on peak days,[16] and the State commitment to reduce peak demand will achieve a very significant further $NO_X$ reduction benefit on peak days.

### 8.5.5.2 Reducing Peak Demand

The current approaches to $NO_X$ control are not designed to effectively address short-term (e.g., hourly or daily) spikes in $NO_X$ emissions on high electric demand days. However, Connecticut has demonstrated that energy policies can be designed to significantly reduce peak electric demand and its resulting emissions.

In September of 2006, Governor M. Jodi Rell addressed the peak demand issue in her "Energy Vision" for the state,[17] setting a goal of achieving a 20% reduction in electric-peak consumption by 2020. Then, in June of 2007, she signed into law Public Act 07-242, An Act Concerning Electricity and Energy Efficiency (Energy Act),[18] which includes three significant peak reduction measures. On the supply side, the Energy Act calls for mandatory decoupling of utility revenue from the sales of each electric and gas company in the next rate proceeding, thereby

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[15] "Memorandum of Understanding Among the States of the Ozone Transport Commission Concerning the Incorporation of High Electrical Demand Day Emission Reduction Strategies into Ozone Attainment State Implementation Planning" March 2, 2007 and attached hereto as Appendix 8O.

[16] "Avoided Nitrogen Oxide Emissions from Energy Efficiency on High Electric Demand Days in Connecticut: A preliminary Analysis", Resource Systems Group Inc. – March 2007, reproduced in Appendix 8P.

[17] "Connecticut's Energy Vision for a Cleaner, Greener State," September 18, 2006, available at http://www.ct.gov/governorrell/lib/governorrell/ctenergyvisionsept19.pdf .

[18] Public Act 07-242, available at http://www.cga.ct.gov/2007/ACT/PA/2007PA-00242-R00HB-07432-PA.htm.

ending the incentive for electric utilities to sell more energy to increase profits. On the demand side, the Energy Act calls for the development of plans to implement time-of-use pricing with appropriate metering and network support ("smart meters") to provide incentives for consumers to reduce electricity use at times of peak demand. The act will also reduce peak demand by providing rebates for the replacement of inefficient home air conditioning units with units that meet the federal Energy Star standard.

### 8.5.5.3 Energy Efficiency Measures

The State's efforts to promote Energy Efficiency (EE) as the "resource of first choice" have earned national recognition as Connecticut was named as one of the most energy efficient states in the country.[19] When Governor Rell signed the Energy Act on June 4, 2007, she was building on existing exemplary demand reduction programs in effect in Connecticut. In addition to those mentioned above, several specific provisions of the Energy Act, when fully implemented, will result in additional emission reductions, which can be applied toward attainment. Some of these provisions include:

- The mandatory assessment of energy efficiency and other clean energy resources, such as renewable energy, by Connecticut's two major load serving entities – United Illuminating and Connecticut Light and Power;
- A requirement that energy capacity needs must first be met through all available energy efficiency and demand-side resources that are cost effective, reliable and feasible;
- The mandatory assessment of how best to eliminate or stabilize growth in electric demand;
- The mandatory incorporation of the impact of current and projected environmental standards, including the ozone standard;
- All state building projects over $5 million must meet Leadership in Environmental Design Silver (LEEDS Silver) standards or better;
- The creation of the first home heating oil conservation and efficiency program;
- The adoption of appliance efficiency standards for nine additional products; and
- The continued ramp-up of renewable energy portfolio requirements under which 20% of Connecticut's energy shall be derived from renewable resources by the year 2020.

Even without the legislative driver to reduce energy costs, per capita energy use in Conecticut, which has been constant at 250 million BTUs (75 MWh), is significantly lower than the average US consumption rate of 340 million BTUs (100 MWh). Only California and New York City have lower per capita consumption figures of 225 million BTUs (65 MWh).[20] This low rate was achieved by Connecticut's commitment to demand-side management.

In Connecticut, the Energy Conservation Management Board (ECMB) advises and assists Connecticut's electric distribution companies in the development and implementation of comprehensive and cost-effective energy conservation and market transformation plans. The

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[19] "The State Energy Efficiency Score Card", American Council for an Energy-Efficient Economy Report - Number E075, June 2007.

[20] The Connecticut Academy of Science and Engineering, "Energy Alternatives and Conservation," December 2006.

ECMB utilizes the Connecticut Energy Efficiency Fund (CEEF) to provide financial support to homeowners and renters, small and large businesses, and state and local governments, for more efficient energy use. Measures include reducing lighting loads, installing more efficient air conditioning and cooling systems, improving insulation and replacing older motors and pumps with state-of-the-art high efficiency units.

Additional support for demand-side management is provided by ISO-New England's new Forward Capacity Market (FCM) Rules. Market Rule 1, and the new FWC rules, which take effect in 2010, will value EE and demand-side resources the same as traditional generation.[21]

EE measures have a lasting 'cumulative' effect on electric demand. The savings in the installation year of an EE measure continue for the duration of its known measured life, usually 15 years. Therefore, efficiency savings installed one year can be added to the measures included in all of the proceeding years within its measured life. ECMB projected that $4 in future savings was generated from every $1 spent by CEEF in 2006, making for significant annual and cumulative totals. This concept is clearly shown in Table 8.5.5.3 below using data from the ECMB annual reports 2003 through 2006.[22] The increased ECMB funding from the Energy Act, in conjunction with the ISO-NE FCM Rules should further increase $NO_X$ reductions in 2007.

**Table 8.5.5.3: Energy Savings and Emissions Reductions from CEEF Projects, 2003-2006**

| YEAR | Energy Saved in Thousands MWh | CUMULATIVE ENERGY SAVED Thousands MWh | $NO_X$ reduced (Tons) | Lifetime $NO_X$ Reduced from annual projects (Tons) |
|---|---|---|---|---|
| 2003 | 130.7 | 130.7 | 73 | 1151 |
| 2004 | 291 | 421.7 | 112 | 1548 |
| 2005 | 318 | 739.7 | 123 | 1702 |
| 2006 | 328 | 1067.7 | 89 | 1243 |
| TOTALS | 1067.7 | 1067.7 | 397 | 5644 |

Although an assessment of reductions from EE measures is difficult to accomplish with a high-degree of precision, CTDEP with assistance from Resource Systems Group, Environmental Resources Trust (ERT) and DJ Consulting, LLC, developed a methodology designed to estimate $NO_X$ emission reductions on HEDDs resulting from EE and distributed resource measures.[23] CTDEP plans to further develop inputs to assess the effectiveness of this methodology in the belief that it will be an important tool moving forward.

The adoption of Connecticut's newest energy legislation, in addition to EE measures already in effect, demonstrates a firm commitment to EE by the State. While it is not yet possible to determine EE-associated emission reductions with the precision necessary for full federal approval and for SIP credit towards attainment of the 8-hour ozone NAAQS, this information and the future direction of Connecticut's energy efficiency programs convey a compelling

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[21] ISO-NE, Market Rule 1 and FWC Rules available at: http://www.iso-ne.com/index.html.

[22] ECMB Annual Reports can be found at: http://www.ctsavesenergy.com/ecmb/documents.php?section=16. The ECMB 2006 Annual Report, March 2007 is reproduced in Appendix 8Q.

[23] The full report is reproduced in Appendix 8P.

argument that Connecticut's EE programs are doing much to limit the growth of electricity demand and the otherwise high $NO_X$ emissions associated with such growth.

The efforts Connecticut has made to reduce peak demand and encourage EE provide further weight-of-evidence that Connecticut could attain the 8-hour ozone NAAQS by 2009.

### 8.5.6 Conclusions Based on Modeling and Weight of Evidence Analyses

CMAQ modeling performed by the OTC states and weight-of-evidence (WOE) analyses conducted by CTDEP indicate the following for the Greater Connecticut moderate ozone nonattainment area:

- The CMAQ model projects that the 8-hour ozone NAAQS of 85 ppb will be achieved in the Greater Connecticut area by the June 2010 attainment deadline (as determined based on ozone levels at the end of the previous full ozone season, 2009).
- Projected ozone levels throughout Greater Connecticut in 2009 are also less than the lower WOE boundary of 82 ppb, providing a high degree of confidence that the area will reach attainment by the end of the 2009 ozone season.

The CMAQ modeling and WOE analyses indicate the following for the Southwest Connecticut portion of the NY/NJ/CT moderate ozone nonattainment area:

- The CMAQ model projects that four of the seven monitors in Southwest Connecticut will achieve 2009 design values lower than the 85 ppb 8-hour NAAQS. CMAQ projects residual nonattainment at the other three Southwest Connecticut monitoring sites, with design values at all seven sites within the WOE bounds of 82 to 87 ppb.
- Several forms of WOE analyses were conducted for Southwest Connecticut. Findings are listed below.

    - CMAQ modeling uncertainties regarding EGU HEDD emissions, EGU control strategy effectiveness, elevated transport, and sea breeze effects suggest that CMAQ predictions of 2009 ozone levels may be overestimated and that any residual nonattainment at coastal sites will require additional upwind reductions to achieve attainment.
    - Improvements in actual measured ozone levels over the last several years have outpaced CMAQ model predictions in northeastern states, including key monitors in Southwest Connecticut. These improvements suggest that measured design values in 2009 may be less than predicted by the CMAQ model and may be low enough to achieve attainment by 2009.
    - In 2004, Connecticut experienced a cool summer with 4th-high ozone levels at (85 ppb in Danbury) or below (all other Connecticut monitors) the 8-hour ozone NAAQS. With significant emission reductions occurring between 2002 and 2009, a similar, or even slightly warmer summer, could produce ozone levels in Southwest Connecticut that meet the NAAQS.

  - Section 181(a)(5) of the CAA provides a mechanism for up to two, one-year extensions of the June 2010 attainment deadline for moderate areas. Therefore, if "clean data" are recorded throughout the nonattainment area in 2009, Southwest Connecticut could be eligible for a CAA extension of the moderate nonattainment area attainment deadline to as late as the end of the 2011 ozone season.
  - Significant emission control programs not included in the CMAQ modeling should provide additional improvements in ozone levels. These include HEDD emission reductions strategies being pursued by Connecticut and other northeastern states, expanding energy efficiency programs, recent large financial commitments to mass transit and other efforts to reduce vehicle traffic and emissions, and EPA national efforts to further reduce VOC and $NO_X$ emissions from a number of stationary and mobile source categories.

In conclusion, the results of the CMAQ modeling and WOE analyses suggest a high degree of confidence that the Greater Connecticut area will attain the 8-hour ozone NAAQS by 2009. In addition, a very credible case can be made for attainment of the NAAQS throughout Southwest Connecticut by 2009, with a greater level of confidence in each subsequent year, such that attainment is highly likely by the end of the 2012 ozone season.

# 9.0 Contingency Plans

Section 172(c)(9) of the CAA and EPA's Phase 2 8-hour ozone implementation rule[1] require states with 8-hour ozone nonattainment areas to include contingency measures in the SIP. These measures are to be implemented if the area fails to satisfy a reasonable further progress milestone or fails to attain the 8-hour ozone NAAQS by the applicable attainment date. Such measures must be fully adopted rules that are ready for rapid implementation upon failure to achieve RFP or attainment.

In the development of contingency plans, the following factors should be considered:

- Contingency measures are required for each RFP milestone year. For moderate 8-hour ozone nonattainment areas with 2010 attainment dates, the only applicable RFP milestone year is 2008;
- Contingency measures are also required for the attainment milestone year, which is 2009 for moderate nonattainment areas with a June 2010 deadline; and
- Contingency measures must provide for a 3% reduction in the adjusted 2002 base year VOC emissions inventory for both RFP and attainment. The reduction must go beyond the level required to meet the RFP target level of emissions. $NO_X$ reductions can be used as a direct substitute for up to 90% of the VOC reductions. Therefore VOC reductions must account for at least a 0.3% reduction.

Table 9.0 lists the adjusted 2002 base year emissions inventories[2] and the corresponding level of VOC emission reductions needed to satisfy each of the contingency measure requirements (i.e., 5.3 tons/summer day in Greater Connecticut and 6.2 tons/summer day in Southwest Connecticut). Details regarding the specific control measures selected to meet the contingency plan requirements for RFP and failure-to-attain are described below.

**Table 9.0**
**Emission Reduction Requirements for Contingency Plans**

| Area | 2002 Adjusted Base Year Inventory (tons per summer day) | | Contingency Plans Required VOC Reduction* (tons per summer day) |
|---|---|---|---|
| | VOC | $NO_X$ | VOC |
| Greater Connecticut | 177.1 | 136.3 | 5.3 |
| Southwest Connecticut | 205.2 | 174.6 | 6.2 |
| Statewide | 382.3 | 310.9 | 11.5 |

* The contingency requirements can be met using any combination of VOC and $NO_X$ reductions totaling 3% of the 2002 adjusted base year inventory. CTDEP has elected to comply using VOC reductions only. Both the RFP and the failure-to-attain contingency plans must achieve the emission reduction listed for each nonattainment area.

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[1] 70 FR 71612.

[2] The development of the adjusted 2002 base year inventory is fully described in Section 5.

## 9.1 Contingency Plan for Failure to Achieve Reasonable Further Progress

The RFP contingency plan must identify control measures sufficient to secure an additional 3% reduction in ozone precursor emissions beyond the 15% RFP reduction required to be achieved by 2008 in moderate 8-hour ozone nonattainment areas. The RFP contingency requirement may be met by including in the SIP a demonstration of at least 18% RFP by 2008 and specifying which control measures capable of providing the excess reduction are to be used for the contingency plan. EPA also allows reductions achieved through early implementation of an emission reduction measure to be used towards the contingency requirement.

As previously described in Section 5.3 (also see Tables 5.3.1 and 5.3.2), the suite of control programs that have been adopted in each of Connecticut's nonattainment areas are projected to provide combined VOC and $NO_X$ reductions that exceed the 15% RFP requirement by more than 20% relative to the 2002 adjusted base year inventory. These surpluses of emission reductions in 2008 will far exceed the additional 3% reduction called for by the RFP contingency requirement in each area. As a result, any combination of these SIP measures providing a 3% VOC reduction can be specified for inclusion in the RFP contingency plan.

Connecticut's RFP contingency plan requirement will be met by using a portion of the expected emission reductions occurring from state rules limiting VOC emissions from architectural and industrial maintenance coatings (AIM) and solvent cleaning. As more fully described in Section 4 (also see Table 4.3.2), these regulations will result in a combined VOC reduction exceeding 16 tons/summer day by 2009, providing more than a 4% reduction relative to the 2002 adjusted base year VOC inventory, thus satisfying the 3% reduction requirement.

## 9.2 Contingency Plan for Failure to Attain the 8-Hour Ozone NAAQS

The failure-to-attain contingency plan must identify control measures sufficient to secure an additional 3% reduction in ozone precursor emissions should a moderate nonattainment area fail to attain the 8-hour ozone NAAQS by the June 2010 required attainment date. EPA will determine each moderate area's attainment status in 2010, using 2009 ozone design values. If EPA determines that an area has failed to attain, the contingency plan would be triggered for implementation beginning with the 2011 ozone season.

Connecticut's failure-to-attain contingency plan requirement will be met by using a portion of the expected emission reductions occurring from federal measures tightening engine and fuel standards for on-road vehicles and non-road equipment. As more fully described in Section 4, these adopted federal programs will continue to provide an increasing level of VOC and $NO_X$ emission reductions through 2012 and beyond. Total VOC emission reductions from these two sectors are estimated to be 19.3 tons/summer day between 2009 and 2012 (i.e., 13.3 tons/summer day from on-road vehicles and 6.0 tons/summer day from non-road equipment; see Table 4.3.2). Assuming the reductions increase linearly between 2009 and 2012, VOC reductions between 2009 and 2011 would total 12.9 tons/summer day. This equates to a 3.3% VOC reduction relative to the 2002 adjusted base year VOC inventory, satisfying the 3% reduction requirement.

## 10.0 Commitments and Requests for EPA Actions

The ultimate success of this attainment demonstration will depend upon the fulfillment of a number of commitments made by Connecticut, other states and EPA to adopt, implement and enforce a wide array of ozone precursor control measures and to comply with relevant CAA requirements. This section summarizes the commitments CTDEP has made elsewhere in this SIP document and makes requests of EPA to pursue additional national control measures and to exercise its CAA authority to ensure other states no longer contribute significantly to ozone violations in Connecticut.

### 10.1 Connecticut's SIP Commitments

Connecticut has already adopted and/or initiated implementation of several post-2002 control strategies to assist with achieving attainment with the 8-hour ozone NAAQS, including the enhanced vehicle emission inspection maintenance program and regulations restricting emissions from portable fuel containers, automotive refinishing operations, gasoline station pressure vent valves, and municipal waste combustion units. As summarized below, Connecticut is also committing to pursue adoption of additional regulations and the State is participating in other initiatives to secure additional reductions in ozone precursor emissions.

### 10.1.1 Status of Connecticut's Ozone Control Strategy Regulations

As more fully described in Section 4, Connecticut has adopted, or is currently pursuing adoption of a number of new and revised regulations that will provide a significant level of ozone precursor emission reductions by the June 2010 attainment deadline. Connecticut has already adopted and initiated implementation of several post-2002 control strategies, including the enhanced motor vehicle emission inspection maintenance program and regulations restricting emissions from portable fuel containers, automotive refinishing operations, gasoline station pressure vent valves, and municipal waste combustion units. Table 10.1.1 summarizes the status of the remaining 8-hour ozone SIP regulations that CTDEP is committing to pursue through Connecticut's rulemaking process.

In addition to formal SIP commitments to pursue adoption of the regulations summarized in Table 10.1.1, CTDEP and other state agencies are involved with several non-SIP initiatives that have produced or will produce reductions in emissions of ozone precursors to further improve ozone levels. These non-SIP programs, which are described more fully in Section 8.5.5, include:

- High Electric Demand Day (HEDD): Currently, EGU emissions on days with peak power demand can be more than double the emissions on an average demand day. Four northeastern states have recently signed a memorandum of understanding (MOU) to pursue reductions of peak day emissions from electricity generation. Negotiations continue with other states and stakeholders to expand this initiative. In addition, the recent passage of new comprehensive Connecticut law addressing electricity and energy efficiency[1] will also play a key role in shaping the final form of the HEDD initiative in Connecticut.

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[1] Public Act 07-242, An Act Concerning Electricity and Energy Efficiency.

**Table 10.1.1: Status of Regulations CTDEP Commits to Pursue to Adopt for the 8-Hour Ozone SIP**

| Control Measure | Pollutant | Section of the Regulations of Connecticut State Agencies | Status of Regulation Adoption | Date Requirements Apply to Create Emissions Reductions |
|---|---|---|---|---|
| Standards for **Municipal Waste Combustion** | $NO_X$ | 22a-174-38 | Adoption of amendment completed October 26, 2000 | May 1, 2003 |
| Stage II Vapor Recovery – **Gasoline Service Station Pressure Vent Valves** | VOC | 22a-174-30 | Adoption of amendment completed May 10, 2004 | May 10, 2005 |
| **Automotive Refinishing** Operations | VOC | 22a-174-3b(d) | Adoption of amendment completed April 4, 2006 | April 4, 2006 |
| Design Improvements for **Portable Fuel Containers** | VOC | 22a-174-43 | Initial rule adopted May 10, 2004; amendment adopted January 29, 2007 | Initial rule:<br>May 1, 2004<br>Amendment:<br>July 1, 2007 |
| Reduced Vapor Pressure Limitation for **Solvent Cleaning** | VOC | 22a-174-20(*l*) | Adoption of amendment completed July 26, 2007 | May 1, 2008 |
| $NO_X$ Reductions from **ICI Boilers** | $NO_X$ | 22a-174-22 | Public Hearing held October 19, 2006 | May 1, 2009 (anticipated) |
| **CAIR** $NO_X$ Ozone Season Trading Program | $NO_X$ | 22a-174-22c | Adoption completed September 4, 2007 | May 1, 2009 |
| VOC Content Limits for **AIM Coatings** | VOC | 22a-174-41 | Adoption completed July 26, 2007 | May 1, 2008 |
| Restrictions on **Asphalt** in **Paving** Operations | VOC | 22a-174-20(k) | Public Hearing held May 1, 2007 | May 1, 2008 (anticipated) |
| VOC Content Limits for **Consumer Products** | VOC | 22a-174-40 | Adoption completed July 26, 2007 | January 1, 2009 |
| Restrictions on the Manufacture and Use of **Adhesives and Sealants** | VOC | 22a-174-44 | Public Hearing held October 16, 2007 | January 1, 2009 (anticipated) |

- The Connecticut Energy Efficiency Fund (CEEF)[2] provides about $60 million each year to support energy efficiency projects for business, government and residences. Available estimates indicate that CEEF projects funded since 2001 have resulted in the avoidance of $NO_X$ emissions on the order of two tons per day. Demand response programs are also being implemented, including a new initiative that provides discounted rates to residential customers who reduce peak summer electrical usage.
- Connecticut's legislature has committed $1 billion to programs designed to reduce traffic congestion, including development of a New Haven-Hartford-Springfield, MA commuter rail line, other expanded transit alternatives, increased telecommuting and flexible employee scheduling, and increased port and rail freight options.[3]

### 10.1.2 Schedule to Implement New EPA Control Techniques Guidelines

EPA is in the process of adopting several new Control Technique Guideline (CTG) requirements for various VOC source categories. On October 5, 2006, EPA published CTGs for the following source categories: Lithographic Printing Materials, Letterpress Printing Materials, Flexible Packaging Printing Materials, Flat Wood Paneling Coatings, and Industrial Cleaning Solvents.[4] SIP revisions for these CTGs are due by October 4, 2007. EPA is scheduled to propose two more groups of CTG categories in the near future. By October of 2007, EPA expects to publish CTGs for: Paper, Film, and Foil Coatings; Metal Furniture Coatings; and Large Appliance Coatings. EPA expects to issue finalized CTGs for five additional categories by October 2008. These are: Miscellaneous Metal Products Coatings; Fiberglass Boat Manufacturing Materials; Miscellaneous Industrial Adhesives; Plastic Parts Coatings; and Auto and Light Duty Truck Original Equipment Manufacturer (OEM) Coatings.

Table 10.1.2 provides a summary of the new EPA CTG categories. As appropriate, Connecticut will analyze the need to adopt requirements to address these CTGs for sources in the state and pursue adoption of such requirements in subsequent SIP submittals. Although emission reductions from these categories are expected to occur prior to 2012, they are not included in the attainment demonstration modeling. As a result, future adoption of CTG-related rules will provide emission reductions beyond those modeled, increasing the likelihood of future attainment.

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[2] See web site at: http://www.ctsavesenergy.com/about/index.php.

[3] Public Act 06-136, An Act Concerning the Roadmap for Connecticut's Economic Future, http://www.cga.ct.gov/2006/ACT/Pa/pdf/2006PA-00136-R00HB-05844-PA.pdf

[4] 71 FR 58745.

### Table 10.1.2: CTGs Scheduled for Adoption by EPA Since 2005

| Control Techniques Guideline (CTG) Category | EPA's Expected/ Actual Date of Final Rule | CT SIP Revision Due |
|---|---|---|
| Lithographic Printing Materials | October 5, 2006* | October 4, 2007 |
| Letterpress Printing Materials | October 5, 2006* | October 4, 2007 |
| Flexible Packaging Printing Materials | October 5, 2006* | October 4, 2007 |
| Flat Wood Paneling Coatings** | October 5, 2006* | October 4, 2007 |
| Industrial Cleaning Solvents | October 5, 2006* | October 4, 2007 |
| Paper, Film, and Foil Coatings | October 2007 | Probably will be required in October 2008 |
| Metal Furniture Coatings | October 2007 | Probably will be required in October 2008 |
| Large Appliance Coatings** | October 2007 | Probably will be required in October 2008 |
| Miscellaneous Metal Products Coatings | October 2008 | Probably will be required in October 2009 |
| Fiberglass Boat Manufacturing Materials | October 2008 | Probably will be required in October 2009 |
| Miscellaneous Industrial Adhesives | October 2008 | Probably will be required in October 2009 |
| Plastic Parts Coatings | October 2008 | Probably will be required in October 2009 |
| Auto and Light Duty Truck OEM Coatings** | October 2008 | Probably will be required in October 2009 |

*71 FR 58745
**Sources that do not exist in Connecticut.

### 10.1.3 New Source Review Requirements

New Source Review requirements apply to major stationary sources, as defined in CAA section 302, and as modified by sections 182(b), (c), (d) or (e) based on the severity of an area's ozone nonattainment classification. Additionally, states located in the Ozone Transport Region (OTR) are subject to CAA section 184.

As moderate 8-hour ozone nonattainment areas in the OTR, both the Southwest Connecticut and Greater Connecticut areas would be subject to "major source" potential-to-emit thresholds of 100 tons per year of $NO_X$ and 50 tons per year of VOC, as well as to one-to-one offset ratios. However, Connecticut's regulations retain the more restrictive thresholds of the now revoked 1-hour ozone NAAQS, with major source thresholds of either 25 or 50 tons per year for both $NO_X$ and VOC, and offset ratios of 1.3- or 1.2-to-one, respectively, for these areas previously classified as severe and serious nonattainment areas. As a result, Connecticut's new source review regulations are more stringent than required by the CAA for the 8-hour ozone NAAQS, and no changes are necessary.

### 10.1.4 Monitoring Network

CTDEP maintains an extensive network for monitoring ambient 8-hour ozone concentrations. As depicted previously in Figure 3.0.1, CTDEP operated 11 ozone monitors in 2006. A full description of Connecticut's air monitoring program is included in the current version of the CTDEP's annual monitoring plan[5]. Connecticut commits to maintaining an adequate ozone monitoring network, subject to a joint annual review process by CTDEP and EPA.

## 10.2 Connecticut's Reliance on the Actions of Other States and EPA for Attainment

Connecticut's recently submitted Section 110(a)(2)(D) SIP revision[6] includes a discussion of EPA's CAIR modeling analysis,[7] which identifies eight upwind states that contribute significantly to 8-hour ozone NAAQS nonattainment in Connecticut (i.e., NY, PA, NJ, OH, VA, MD/DC, WV, MA). The analysis showed that Connecticut is the only state subject to transport exceeding 90% of projected 2010 ozone levels, illustrating the unique and overwhelming influence upwind emissions have on Connecticut's prospects for achieving timely attainment. EPA's modeling also predicts that CAIR will provide minimal relief to Connecticut, reducing by less than one percent the ozone transport affecting the state on high ozone days.

EPA's CAIR modeling highlights the importance of securing sufficient upwind reductions to enable Connecticut to attain the 8-hour ozone NAAQS in a timely manner. As described in Section 8, the modeling used in this attainment demonstration is based on the OTC's "beyond-on-the-way" suite of control measures. CTDEP is pursuing adoption of these measures, and is dependent on upwind states doing the same.

Although the weight-of-evidence analyses included in Section 8 support CTDEP's conclusion that 8-hour ozone attainment is likely in Greater Connecticut by 2009 and may credibly be achieved in Southwest Connecticut by 2009, the probability of attainment will be enhanced if additional non-modeled upwind reductions are secured. CTDEP requests that EPA, when reviewing ozone attainment demonstrations and other related SIP revisions, ensures that adequate emission controls are adopted and implemented by upwind states such that no other state continues to significantly contribute to ozone nonattainment in Connecticut.

CTDEP also requests that EPA adopt additional, national and regional emission control programs to ensure that equitable and cost-effective progress is made to achieve both the current and proposed 8-hour ozone NAAQS. At a minimum, EPA should follow through with timely promulgation of the CTGs listed in Table 10.2, and ensure that states comply promptly; and EPA should move forward with the adoption of the most stringent possible non-road and on-road emission standards for all mobile source categories. We also urge EPA to work with states to address HEDD emissions that exacerbate ozone air quality problems on hot summer days.

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[5] A draft of CTDEP's 2007 monitoring plan, "Connecticut 2007 Annual Monitoring Network Plan" is available at: http://www.ct.gov/dep/lib/dep/air/siprac/2007/2007networkplan.pdf.

[6] "Revision to Connecticut's State Implementation Plan: Meeting the Interstate Air Pollution Transport Requirements of Clean Air Act Section 110(a)(2)(D)(i)"; Submitted to EPA on March 13, 2007; See: http://www.ct.gov/dep/lib/dep/air/regulations/proposed_and_reports/revsipsec110appendix.pdf.

[7] "Technical Support Document for the Final Clean Air Interstate Rule: Air Quality Modeling"; US EPA OAQPS; March 2005; See: http://www.epa.gov/cleanairinterstaterule/pdfs/finaltech02.pdf.