# Analysis of 2007 Emissions from Power Plants and Other Large Combustion Sources in the Mid-Atlantic and Northeastern United States

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## About MANE-VU and MARAMA

The Mid-Atlantic Regional Air Management Association, Inc. (MARAMA) prepared this report for members of the the Mid-Atlantic/Northeast Visibility Union (MANE-VU). MARAMA is a voluntary, non-profit association of ten state and local air pollution control agencies. MANE-VU was formed by the Mid-Atlantic and Northeastern states, tribes, and federal agencies to coordinate regional haze planning activities for the region. MANE-VU provides technical assessments and assistance to its members, evaluates linkages to other regional air pollution issues, provides a forum for discussion, and encourages coordinated actions. MANE-VU also facilitates coordination with other regions. MARAMA's mission is to strengthen the skills and capabilities of member agencies and to help them work together to prevent and reduce air pollution in the Mid-Atlantic Region. This technical report was prepared for use by the MANE-VU States and does not necessarily represent the position of the U.S. Environmental Protection Agency, MARAMA, MANE-VU, or OTC.

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## Introduction

This report documents a series of data analyses of the variability of emissions from electric generating units (EGUs) and other large combustion sources by time period, geographical location, and type of 1) fuel, 2) combustion unit, and 3) control technology. The purpose of these analyses is to assist States in the Northeast / Mid-Atlantic region address policy-relevant questions concerning emissions during periods of peak electricity demand. Previous analysis by states in the region has shown that emissions on days with high electricity demand can be considerably higher than on other days.

This report focuses on sources in the Mid-Atlantic / Northeast Visibility Union (MANE-VU) area plus Virginia. In this document, this region will be referred to as the MANE-VU+VA region. The MANE-VU+VA region includes Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia. Local air planning agencies include Philadelphia and Allegheny County, Pennsylvania.

## Data Sources

All data used in these analyses were downloaded on September 15, 2009 from the U.S Environmental Protection Agency's (EPA's) web site (http://www.epa.gov/airmarkets). This EPA database contains information on all sources participating in several market-based regulatory programs designed to improve air quality and ecosystems. The most well-known of these programs are USEPA's Acid Rain Program, the NOx Budget Trading Program, and the Clean Air Interstate Rule, which reduce emissions of sulfur dioxide ($SO_2$) and nitrogen oxides (NOx).

EPA's Clean Air Markets Division (CAMD) implements the federal rule found in Volume 40 Part 75 of the Code of Federal Regulations (CFR), which requires an hourly accounting of emissions from each affected unit - i.e., sources participating in an emissions cap and trade program under the Acid Rain Control Program, the NOx Budget Trading Program, or the Clean Air Interstate Rule. Continuous emission monitoring systems (CEMS) are used to provide emissions data unless the unit qualifies to use one of the alternative monitoring methodologies specified in the rule. With few exceptions, the alternative methodologies apply to oil-fired and gas-fired units. The Part 75 rule generally requires the use of CEMS for units that combust coal or other solid fuel(s).

The CAMD database contains data for both EGUs and other large combustion sources that are required to report emissions. Data for all CAMD-reporting units were used in this analysis, including nonEGUs such as petroleum refinery process heaters and cement kilns.

For this report, the Mid-Atlantic Regional Air Management Association (MARAMA) developed a classification scheme for characterizing emissions units according to the percent of time the unit operated in 2007. Three categories were defined:

- Units that operated more than 50 percent of the time (>50% bin),
- Units that operated from 15 to 50 percent of the time (15-50% bin), and
- Units that operated less than 15 percent of the time (<15% bin).

Actual operating time was determined based on the period reported to CAMD for calendar year 2007. That is, if the unit reported data for the entire year, the percent of operating time was calculated based on actual operating hours divided by 8,760 hours. If the unit reported data for only a portion of the year, the percent of time operating was based on the actual operating hours divided by the maximum hours in the reporting period.

Based on the 2007 point source emissions inventory developed by MARAMA for the MANE-VU+VA region, 92 percent of point source $SO_2$ emissions and 68 percent of point source NOx emissions in 2007 were emitted from sources that report to CAMD.

## Data Caveats

Stakeholders pointed out two caveats associated with using the CAMD data, as discussed in the following paragraphs.

It should be noted that there are many other electrical generating units providing power during peak periods that do not report their emissions to CAMD because (i) their nameplate capacity is less than 25 MWe or (ii) the electrical generating units do not supply electricity to the local electrical grid (i.e., distributed generating units). These are primarily combustion turbines and diesel generators. These nonCAMD EGUs units are not subject to emissions monitoring and reporting to CAMD per 40 CFR 75 requirements. It is conceivable that NOx emissions from these units can be substantial because they may not be equipped with emission control devices.

The MARAMA 2007 emissions inventory indicates that on an annual basis, emissions from the nonCAMD EGUs are relatively small. We queried the MANE-VU+VA 2007 annual inventory for nonCAMD EGUs (i.e., source classification code of 1-01-xxx-xx or 2-01-xxx-xx that do not report to CAMD). For NOx, the annual emissions for CAMD reporting units were 431,331 tons, compared to only 14,677 tons for EGUs that do not report hourly data to CAMD. That is not to say that the emissions from nonCAMD EGUs are not important during peak periods. But the lack of sufficient hourly data precluded the inclusion of these units in the analysis at this time.

Stakeholders also commented that the CAMD database and the reporting methodology used were developed to document compliance for $SO_2$ and NOx trading programs. Stakeholders felt it was important to note that there are different reporting methodologies and the reported emission values for the units in the "Units that operated less than 15 percent of the time (<15% bin)" may be conservative estimates rather than direct measurements. However, stakeholders did not expect reporting methodology differences would affect the general conclusions derived from the analysis. One key finding was that "During certain peak emissions days, the relative importance of emissions from units in the 15-50% and <15% bins are much higher than their relative importance on a monthly or annual basis." This finding will not change, but stakeholders believe the magnitude of the contribution of the <15% bin is actually less than the CAMD emissions indicate. The stakeholders were concerned that that the low mass emission reporting methodologies over-estimate emissions on the order of 20% of what would be appropriate to use for SIP air quality modeling analyses.

However, we note that in 2007, the majority of units in the study area had stopped using the maximum default emission rate that results in over-estimates of up to 20%. Also, as noted above, with few exceptions, the alternative methods for calculating emissions do not apply to units that combust coal or other solid fuels. MARAMA compared the sum of hourly emissions for each unit to state-collected data on annual emissions for these units in preparing files for regional air quality modeling, and we found the CAMD data was consistent with the annual data.

## Report Highlights

This report documents the significant variability of emissions of SOx and NOx from large sources in the MANE-VU region in 2007. It is organized around thirteen questions, with information presented both graphically and in text. Emission units reporting to the U.S. Environmental Protection Agency's Clean Air Markets Division (CAMD) were grouped into three categories for analysis, based on the percent of time the units operated. Key points derived from the analysis include the following:

### Characteristics of Units

- There are more units reporting to CAMD that operate infrequently than there are units that operate over 50% of the time, and combustion turbines are the predominant type of unit operating less than 15% of the time. (See page 11.)
- About three quarters of the units that operate more than 50% of the time are boilers, with the remainder being combined cycle units. (See page 11.)
- Most coal-fired units operate more than 50% of the time. (See page 7.)

- Units operating less than 15% of the time are typically fired with natural gas, diesel oil, or residual oil. (See page 7.)

### Emissions During Peak Ozone Periods

- Emissions from units in all three classes tended to be higher on days with higher ozone concentrations. (See pages 33-37.) The percentage of emissions from units operating less than 50% of the time increased on peak ozone days. (See page 36.)
- On certain high ozone days in the New York area, the hourly NOx emissions from units in the <15% classification were greater than the emissions from units in the >50% classification. (See page 53, 57, 61.)
- Variations in emissions from these units within a metropolitan area do not, by themselves, account for all the variability in ozone concentration in that area. (See pages 46-61.)

### Emissions Controls and Rates

- About 15% of the units operating more than 50% of the time reported no NOx controls reported to the CAMD database. These uncontrolled units accounted for about 10% of the capacity in this category and about 7% of the monthly NOx emissions in July 2007. (See pages 14, 16, 17.)
- Units that operate infrequently are less well-controlled. Many units operating less than 15% of the time have NOx emission rates that exceed 0.5 lbs/MMBtu, while very few units that operate more than 15% of the time have rates this high. (See page 15.)
- In 2007, heat input and $SO_2$ emissions in MANE-VU were somewhat higher than in 2006 and 2008. (See pages 63-64.)
- Regionwide, NOx emissions from 2006 to 2009 declined year-to-year as a result of the implementation of controls under the NOx Budget Program, CAIR, and other agreements. (See pages 63-64.)

### Seasonal Variation

- NOx emissions are lower in May through September, when CAIR requires emissions controls, than during the rest of the year. (See page 20.)
- $SO_2$ emissions peaked in January-February and again in June, July, and August 2007 due to seasonal heating and cooling demands. The highest monthly emissions of $SO_2$ were in August 2007. (See page 21.)
- For the month of July 2007, coal-fired units operating at least 50% of the time were responsible for nearly all the $SO_2$ and all but a small percent of monthly NOx emissions from sources required to report to CAMD. (See pages 20-21.)

### Daily and Hourly Variation

- Emissions from units in the 15-50% and <15% classifications fluctuate widely from day-to-day and hour-to-hour. (See pages 22, 26-28, 30.)
- Emissions from units in the >50% classification are less variable on a percentage basis, but daily emissions from each of the three categories can vary by 200 to 250 tons per day from peak to minimum days. (See page 30.)
- During certain peak emissions days, the relative importance of emissions from units in the 15-50% and <15% classifications are much higher than their relative importance on a monthly or annual basis. (See pages 52-53, 56-57, 60-61.)

### Regional Characteristics

- In the New England region, NOx emissions from residual oil combustion on peak ozone days are higher than on days with low ozone concentrations. (See page 42.)
- Also in New England, on peak ozone days, NOx emissions from residual oil combustion are higher than NOx emissions from coal combustion. (See page 43.)
- In the New Jersey/New York region, NOx emissions from residual oil, diesel and natural gas combustion on peak ozone days are higher than on days with low ozone concentrations. (See page 42.)
- Units in major metropolitan areas in the MANE-VU+VA region accounted for about 56% of the annual NOx emissions and 55% of the annual $SO_2$ emissions in 2007. Units in small towns and rural areas accounted about 30% of the NOx emissions and 31% of the $SO_2$ emissions in 2007. (See page 78.)
- $SO_2$ and NOx emissions in the Midwest and Southeast decreased significantly between 2005 and 2008, even though the heat input was relatively constant. (See pages 63-64.)

## Implications

States within this region are pursuing measures to reduce emissions that cause regional haze and contribute to high concentrations of ozone and fine particles. The relative importance of various types of sources varies within the MANE-VU region and on a seasonal, daily, and hourly basis. The variability in emissions documented by this analysis supports the importance of considering hourly emissions from sources reporting to CAMD along with hourly meteorological data when modeling air quality impacts.

# 1 Types of Combustion Units and Fuels by Operating Time

***What type of units generally fall into the three classifications? (For example, are the units operating more than 50% of the time generally large coal fired boilers?) Where information is available, this should be addressed both in terms of technology (e.g., boiler vs. combustion turbine) and in terms of fuel (e.g., coal, oil, gas, diesel).***

We used CAMD 2007 annual or ozone season hours of operation data for calendar year 2007 to classify electric generating units into three bins based on the percent of time that the unit operated. These three bins are defined as:

- **> 50% -** the unit operated more than 50 percent of the time during the period in which the unit was required to report (i.e., > 4,380 hours for 12-month reporting units; > 2,196 hours for 6-month reporting units);
- **15-50% -** the unit operated between 15 and 50 percent of the time during the period in which the unit was required to report;
- **< 15% -** the unit operated less than 15 percent of the time during the period in which the unit was required to report.

The following charts provide descriptive statistics on unit counts, capacity, and emissions for these three classification bins by fuel type, combustion type, and NOx control type. These charts are for units in the MANE-VU+VA region.

Figure 1-1 provides a count of units in each bin by fuel type. Coal-fired units generally operate more than 50% of the time. There are a large number of units that operate less than 15% of the time, including a number of residual oil-fired units, as well as diesel and natural gas-fired units.

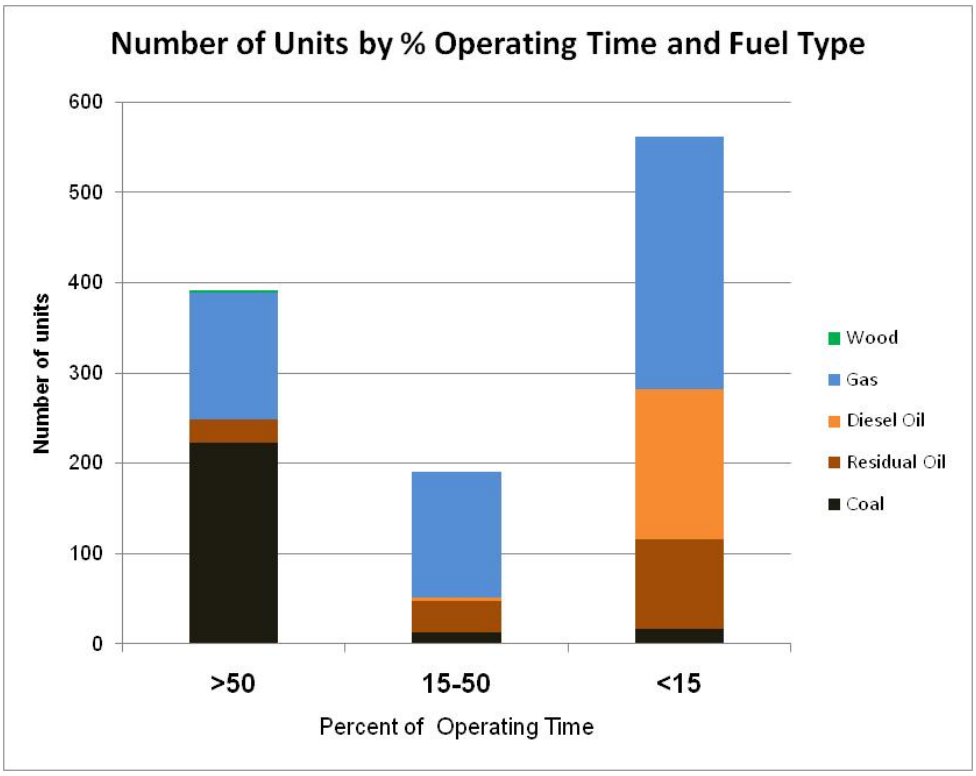



**Figure 1-1.** Number of Units by % Operating Time and Fuel Type.

Figure 1-2 shows the capacity of units in each of the three bins by fuel type. There is a large amount of capacity associated with units that operate infrequently.

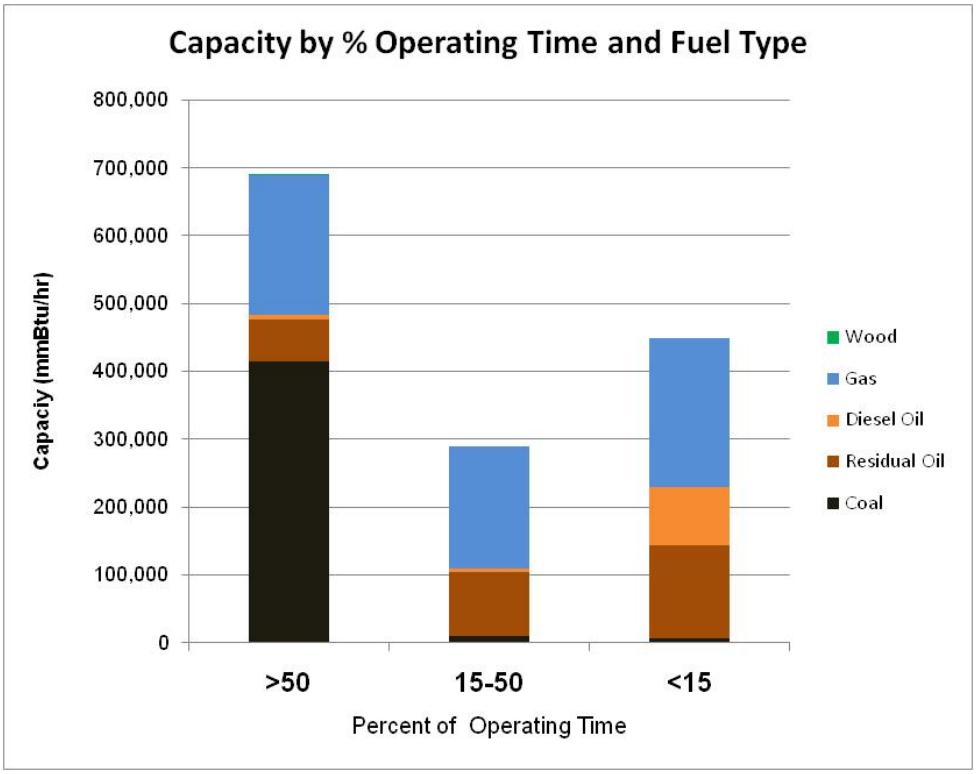



**Figure 1-2.** Capacity by % Operating Time and Fuel Type.

Figure 1-3 shows the July 2007 NOx emissions by percent operating time and fuel type. As shown in the previous two figures, there are many units with large aggregate capacity in the15-50% and <15% operating time bins, but these units contribute relatively little to region-wide total emissions on a monthly basis.

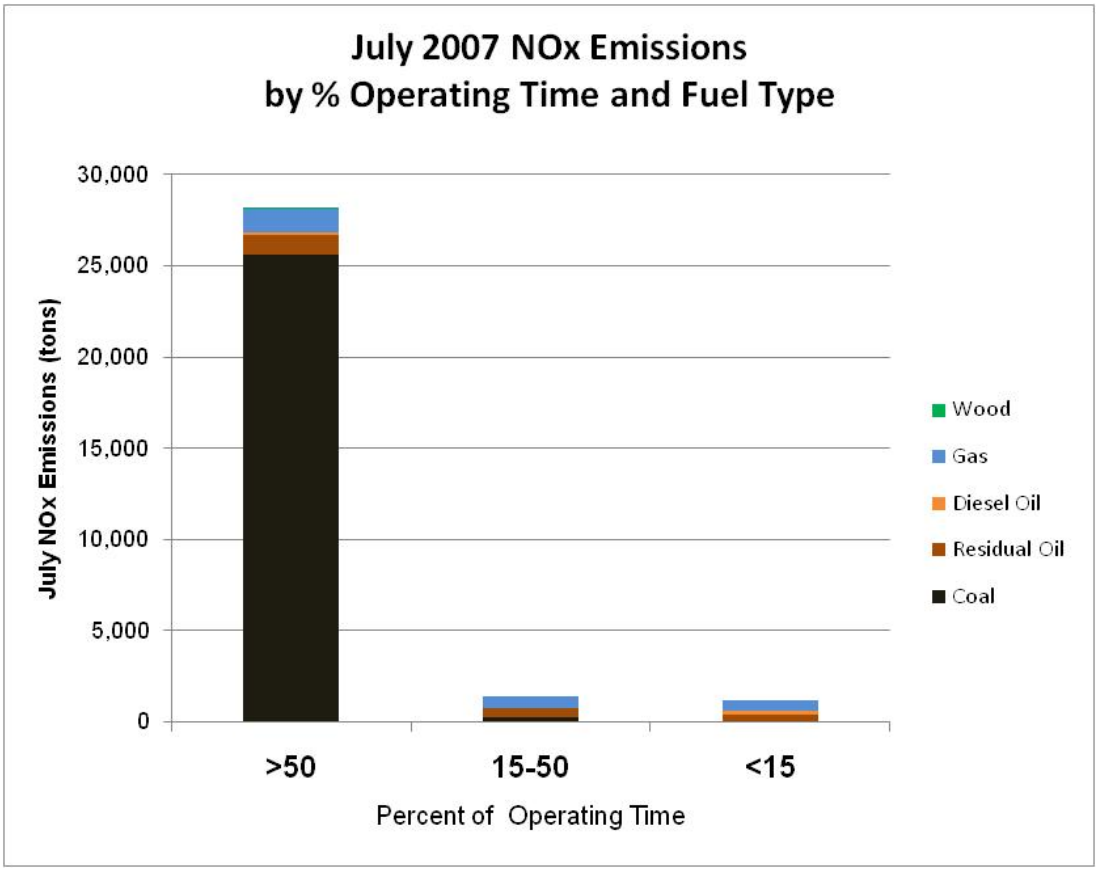



**Figure 1-3.** July 2007 NOx Emissions by % Operating Time and Fuel Type.

Figure 1-4 shows the July 2007 $SO_2$ emissions by percent operating time and fuel type. As shown in the previous two figures, there are many units with large aggregate capacity in the region, but these units contribute relatively little to region-wide total emissions on a monthly basis. Nearly all $SO_2$ emissions in July 2007 came from coal-fired units that operate over 50% of the time.

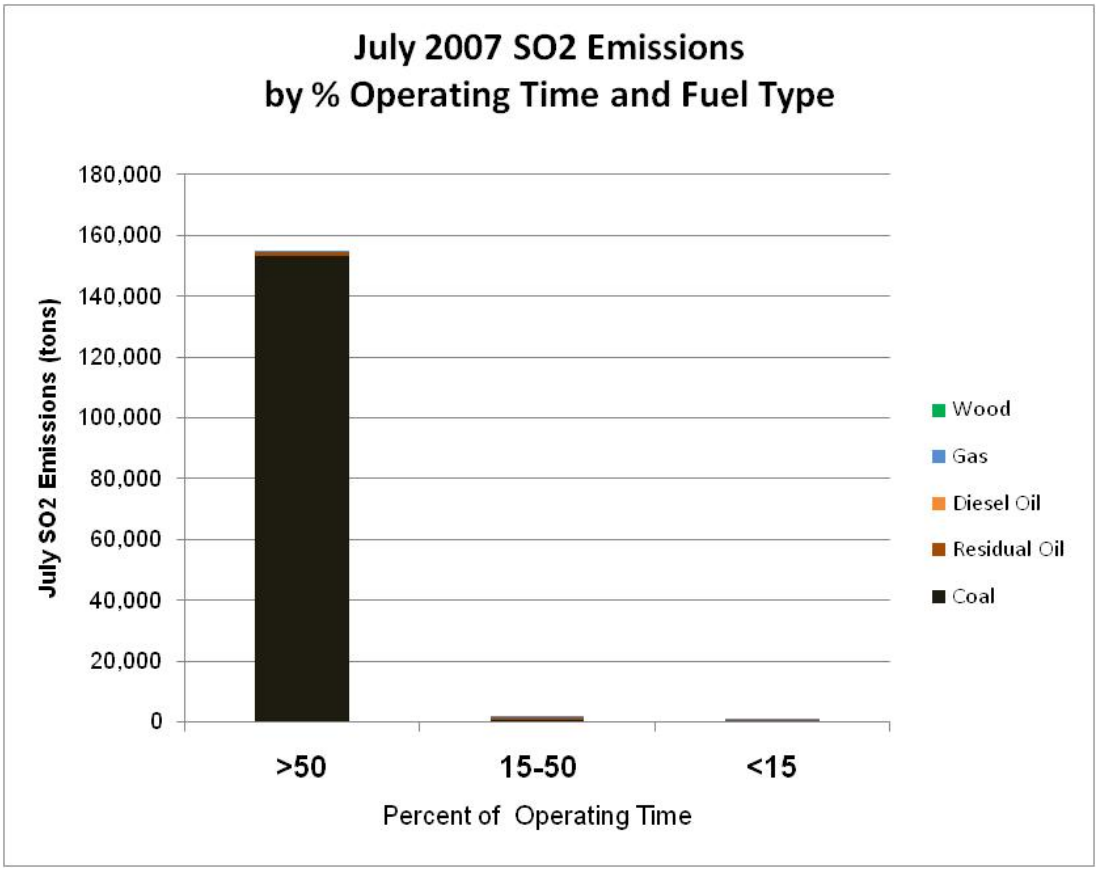



**Figure 1-4.** July 2007 $SO_2$ Emissions by % Operating Time and Fuel Type.

Figure 1-5 provides a count of the number of units in each bin by unit type. About three quarters of the units operating more than 50% of the time are boilers, with the remainder being primarily combined cycle units. Combustion turbines are the predominant unit type operating less than 15% of the time, although there are also boilers and combined cycle units in this bin.

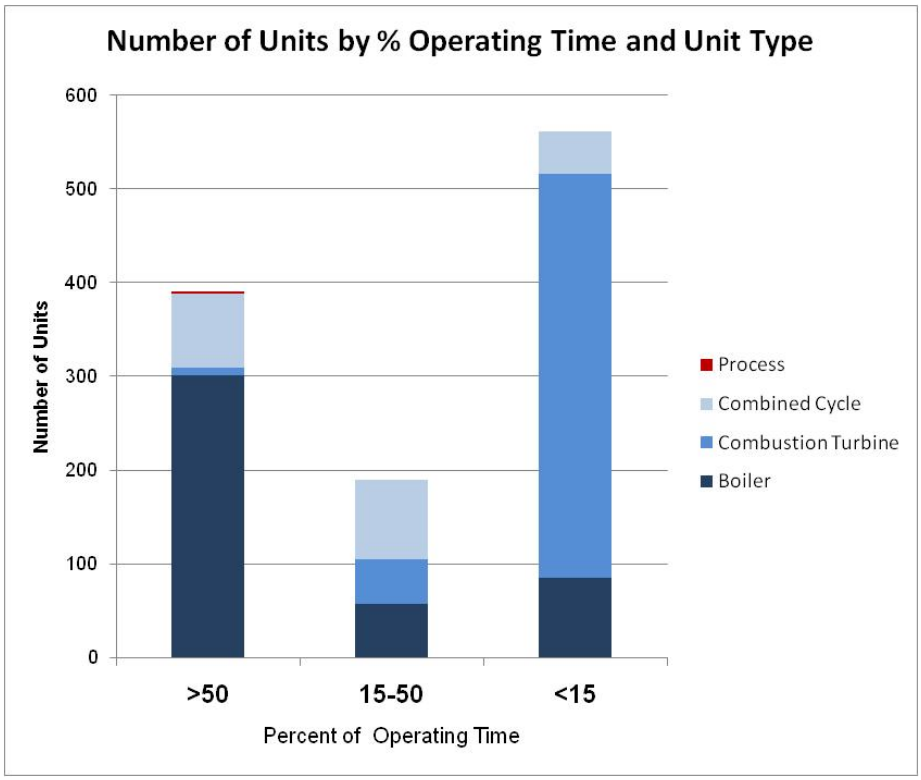



**Figure 1-5.** Number of Units by % Operating Time and Unit Type.

Figure 1-6 shows the capacity of units in each of the three bins by unit type. There is a relatively large amount of capacity associated with units operating less than 15 percent of the time.

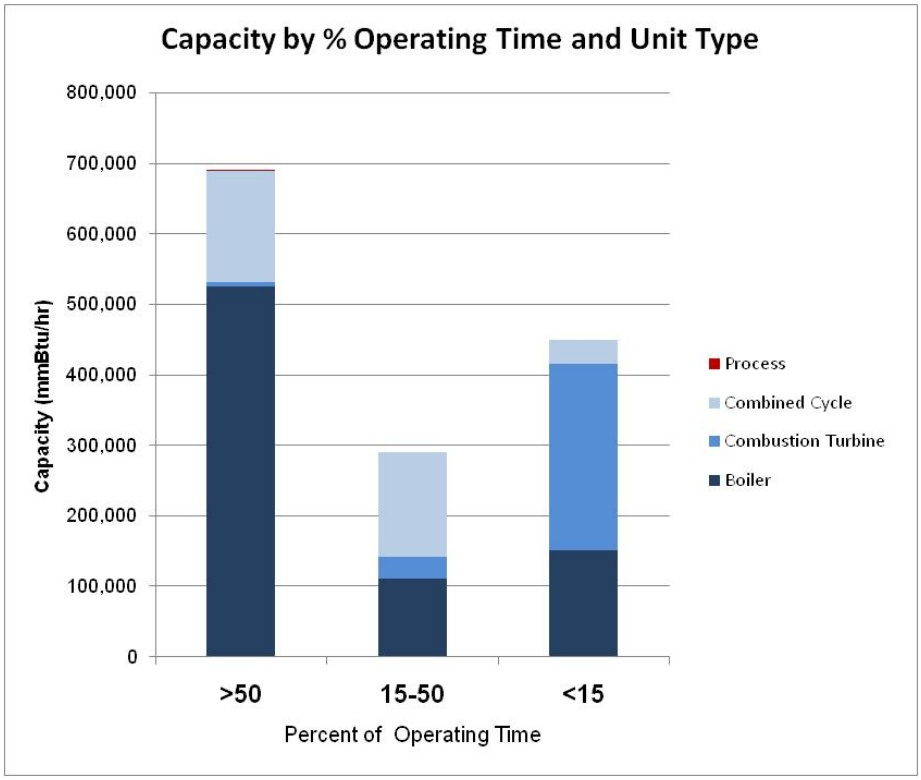



**Figure 1-6.** Capacity by % Operating Time and Unit Type.

Figure 1-7 shows the July 2007 NOx emissions by percent operating time and unit type. As shown in the previous two figures, there are many combustion turbine and combined cycle units with large aggregate capacity in the 15-50% and <15% operating time bins, but these units contribute relatively little to the region-wide total emissions on a monthly basis. A very high percentage of the NOx emissions in July 2007 came from boilers operating at least 50% of the time.

No chart was prepared to show July 2007 $SO_2$ emissions by percent operating time and unit type since nearly all of the July 2007 $SO_2$ emissions were from boilers that operated more than 50% of the time.

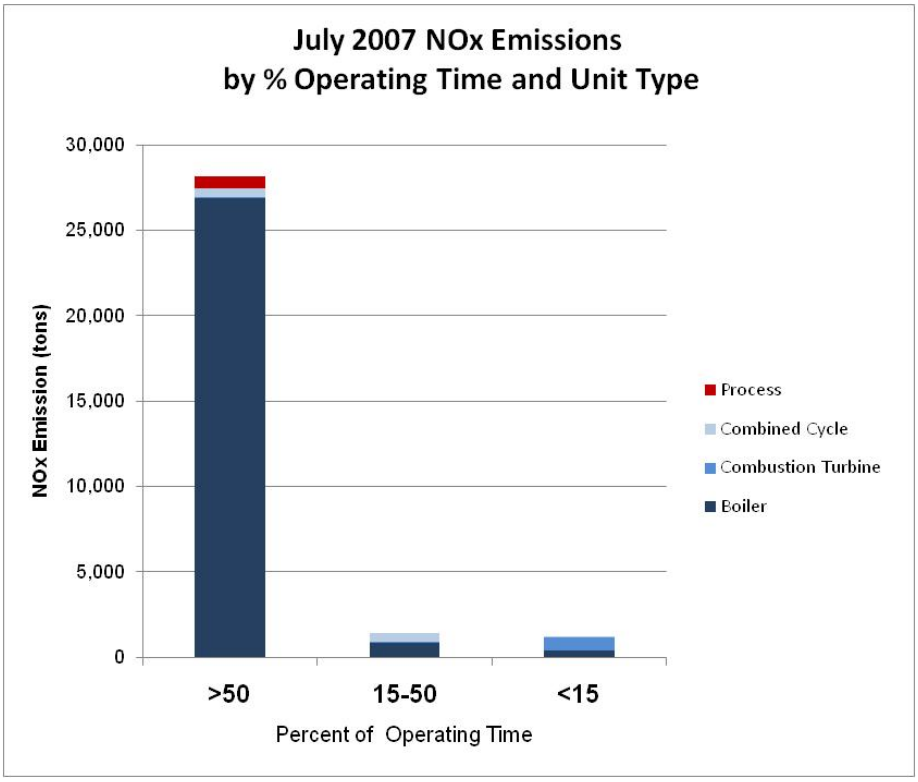



**Figure 1-7.** July 2007 NOx Emissions by % Operating Time and Unit Type.

Figure 1-8 provides a count of the units in each bin by NOx control technology type. Many units have multiple NOx control technologies, i.e., a unit may have both low NOx burners and selective catalytic reduction (SCR), as reported in the CAMD database. To simplify the numerous combinations of NOx control technologies, for each combination we assigned the most stringent control technology based on the emission reduction potentials presented in Table 1.1-2 of AP-42. For example, for a unit that had both low NOx burners and SCR, we assigned that unit to the SCR control technology bin.

For units that operate more than 50% of the time, a variety of controls are used. About 37.5% of the units in this bin employ SCR and SNCR add-on controls. About 15 percent of the units in this bin had no reported NOx controls in the CAMD database.

For units that operate less than 15% of the time, over half (58%) reported no NOx controls in the CAMD database. Another 24% reported steam/water injection as the most stringent control.

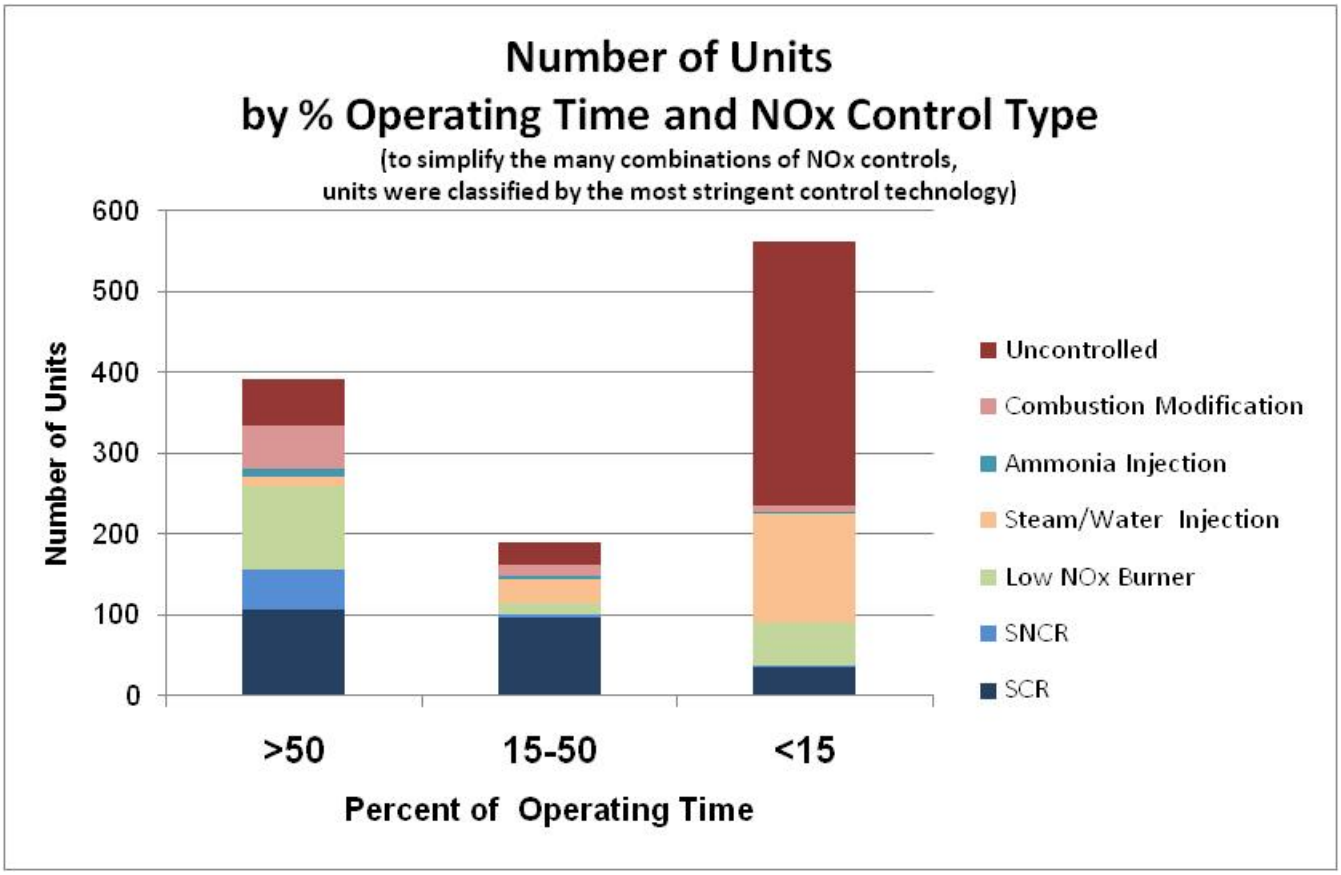



**Figure 1-8.** Number of Units by % Operating Time and NOx Control Technology.

Figure 1-9 provides a count of the units in each bin by annual NOx emission rate. Many units in the <15% bin have NOx emission rates that exceed 0.5 lbs/MMBtu, while very few units in the >50% and 15-50% bins have rates this high.

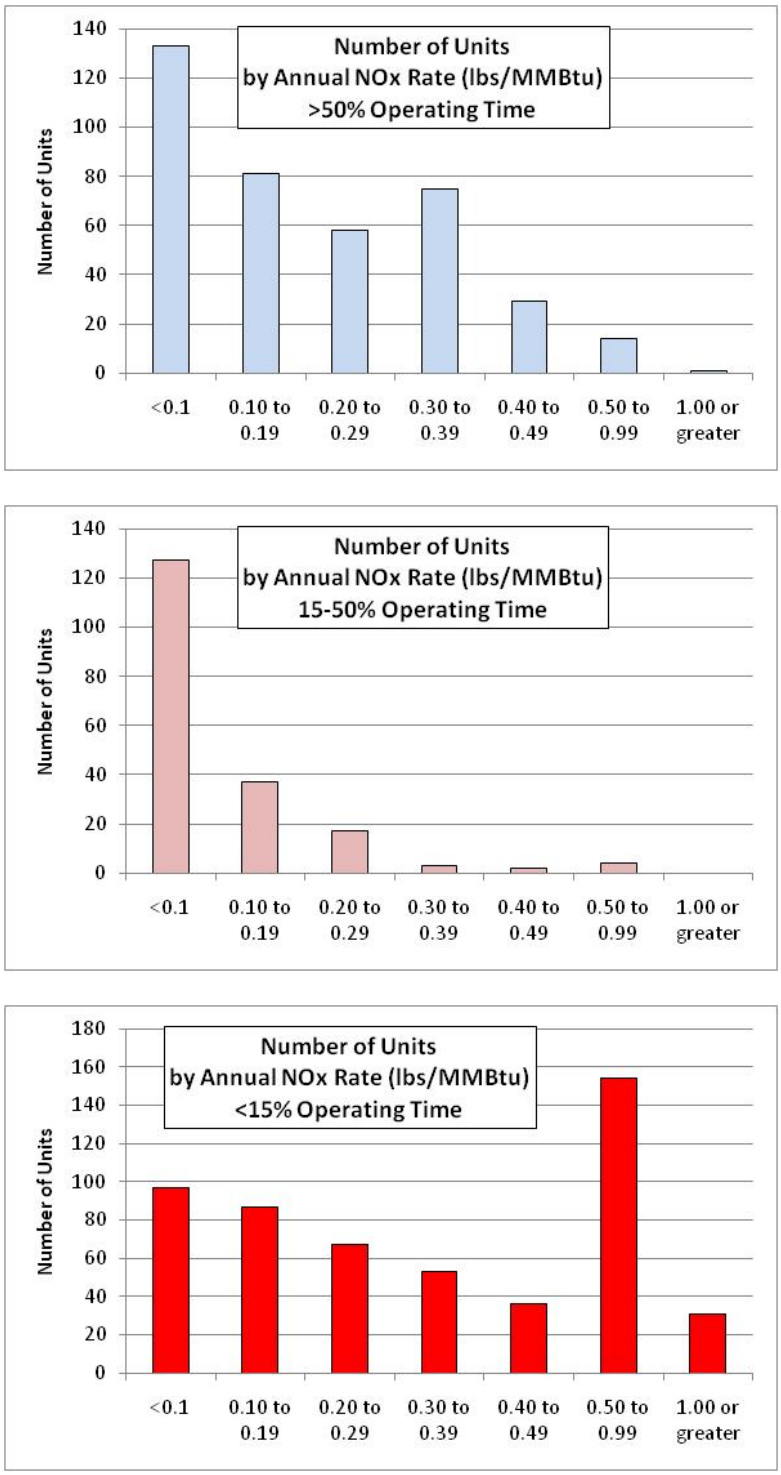



**Figure 1-9.** Number of Units by % Operating Time and NOx Emission Rate.

Figure 1-10 provides the capacity of units in each bin by NOx control technology type.

For units that operate more than 50% of the time, various control types are employed. About 43 percent of the total capacity for units in this bin is associated with units that employ SCR add-on controls. About 10 percent of the total capacity for units in this bin is associated with units that reported no NOx controls to CAMD.

For units that operate less than 15% of the time, about 43 percent of the total capacity is associated with units that reported no NOx controls to CAMD . Very little of the capacity is associated with units equipped with SCR or SNCR.

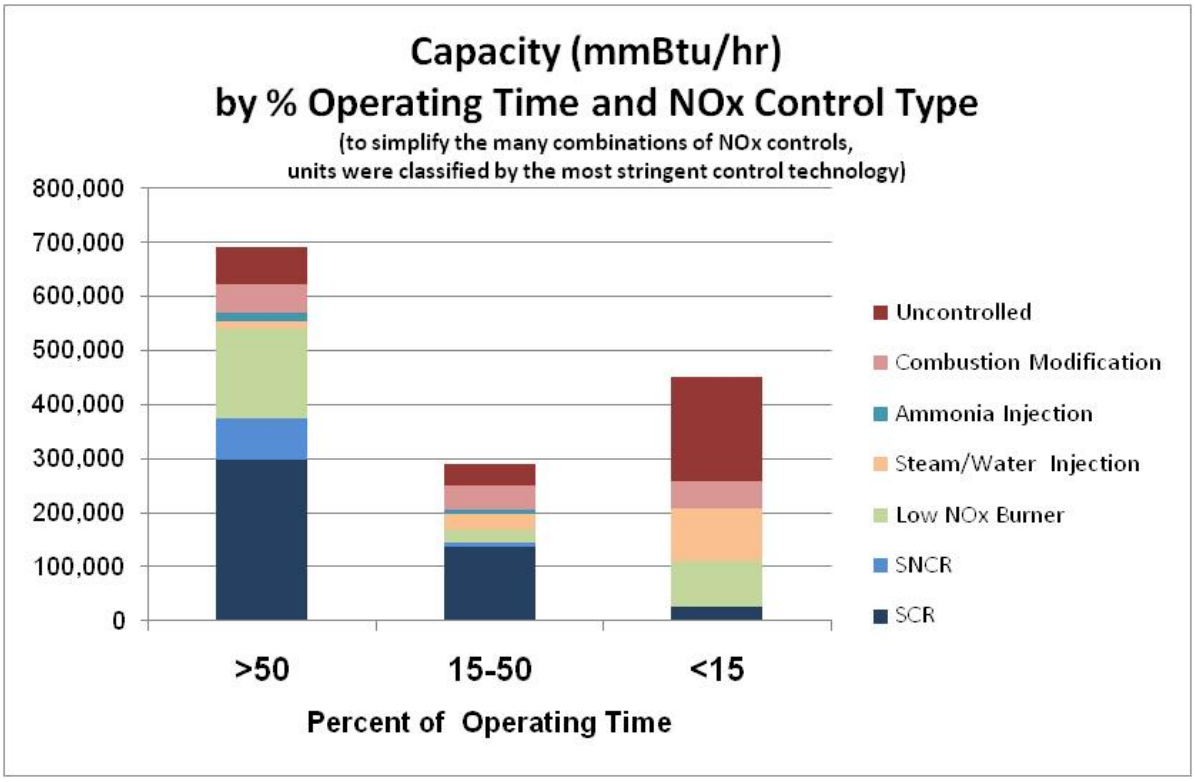



**Figure 1-10.** Capacity by % Operating Time and NOx Control Technology.

Figure 1-11 provides July 2007 NOx emissions associated with units in each bin by NOx control technology type for MANE-VU+VA states. Figure 1-12 provides the same information for each USEPA region. (Note the difference in scales on the three charts.)

For units that operate more than 50% of the time, about 62 percent of the July 2007 NOx emissions were emitted by units without SCR or SNCR control technology. Only about 7 percent of the July 2007 NOx emissions are associated with units that reported no NOx control to CAMD.

Units in the 15-50% and <15% bins contribute relatively little to the region-wide total emissions on a monthly basis.

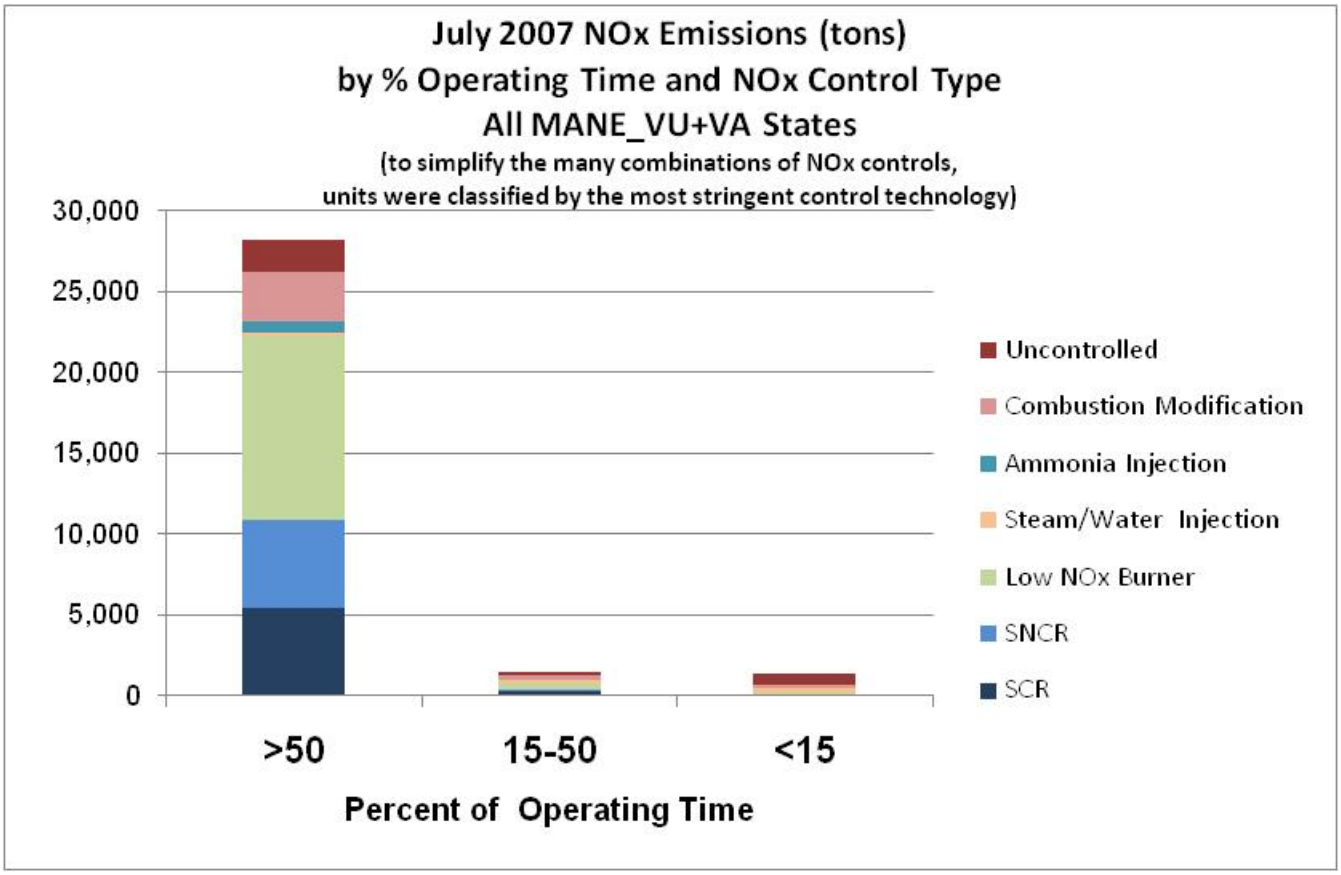
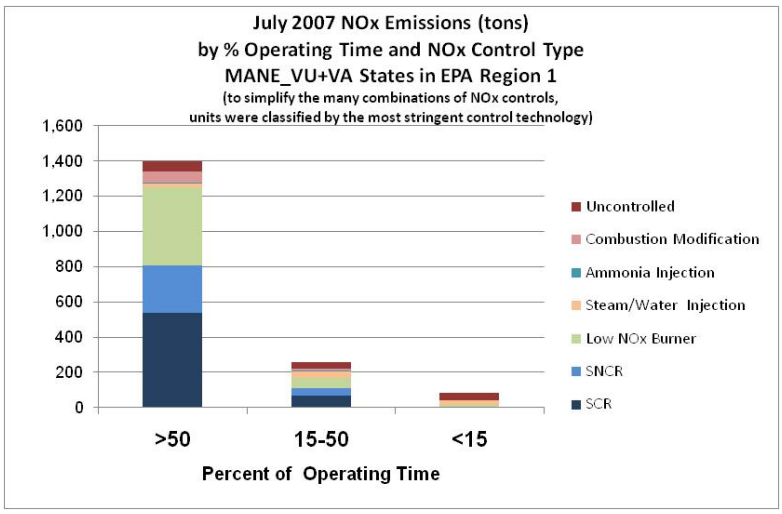
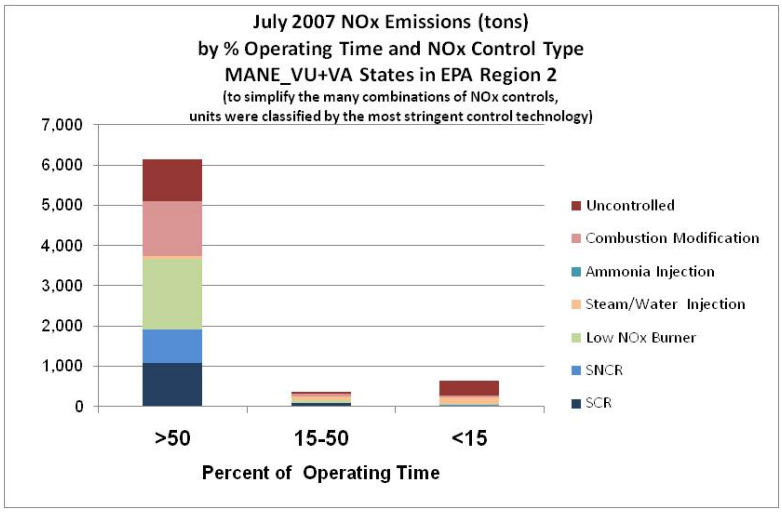



**Figure 1-11.** July 2007 NOx Emissions by % Operating Time and NOx Control Technology – All MANE-VU+VA States.



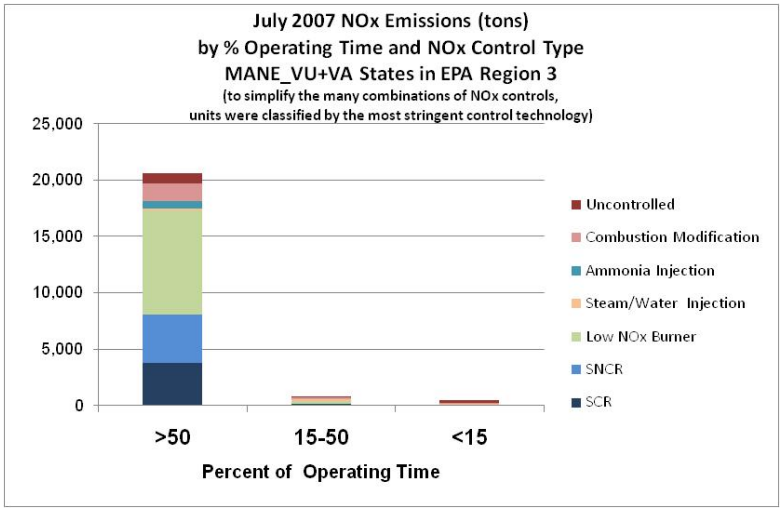




**Figure 1-12.** July 2007 NOx Emissions by % Operating Time and NOx Control Technology and EPA Region.

## 2 Monthly Emissions by Operating Time

***How much (both in total and as a percent) of the emissions from these sources come from the units in each of the three classifications? Does this change over the course of the year?***

The following charts show how NOx and $SO_2$ emissions for the three classification bins vary by month.

Figure 2-1 shows the 2007 NOx emissions by month for units in each of the three classification bins. Clearly the total NOx emissions are higher in non-ozone season months (Jan-Apr, Oct-Dec) than in ozone season months (May-Sep), due to seasonal NOx controls. Within the ozone season, NOx emissions are lower in May and September when temperatures are generally not as hot as in June/July/August.

As shown in Figure 2-2, the combined NOx emissions from units in the 15-50% and <15% classification bins account for 2 to 11 percent of the total monthly NOx emissions. During February (typically the coldest month), the combined NOx emissions from units in the 15-50% and <15% classification bins account for 11 percent of the monthly NOx emissions. During August (typically the hottest month), these units also account for about 11 percent of the total monthly NOx emissions.

Figure 2-3 shows the 2007 $SO_2$ emissions by month for units in each of the three operating time classification bins. Unlike NOx, $SO_2$ emissions are not generally lower in the ozone season. Rather, $SO_2$ emissions are the highest in the colder months (Jan/Feb) and hotter months (Jul/Aug).

As shown in Figure 2-4, $SO_2$ emissions from units in the 15-50% and <15% classification bins generally account for less than four percent of the monthly total. The only exception is in February, where $SO_2$ emissions from units in the 15-50% and <15% classification bins account for about eight percent of the monthly total.

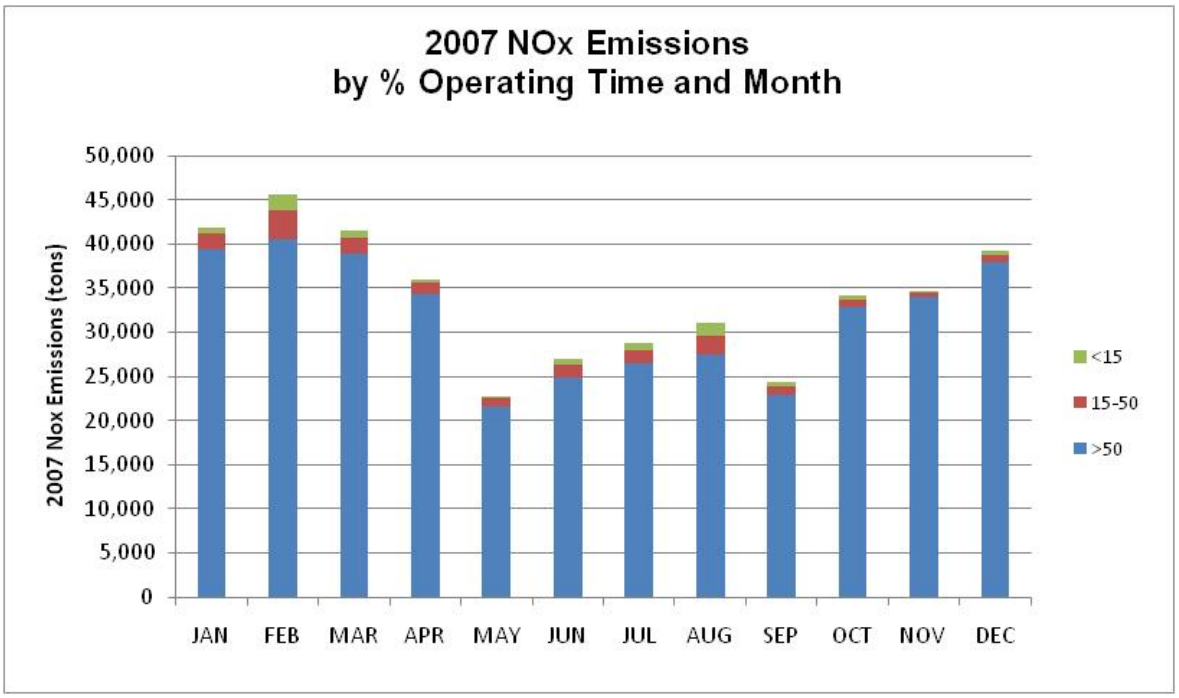



**Figure 2-1.** NOx Emissions (tons) by % Operating Time and Month.

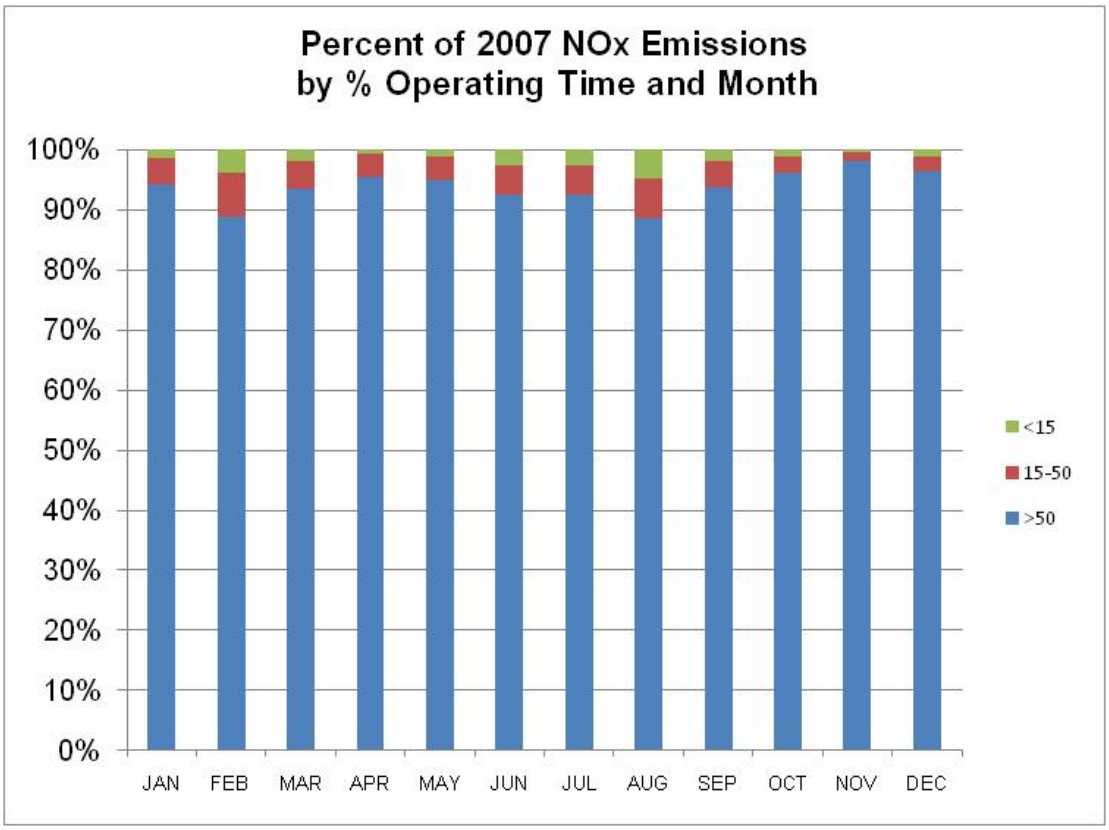



**Figure 2-2.** NOx Emissions (percentage) by % Operating Time and Month.

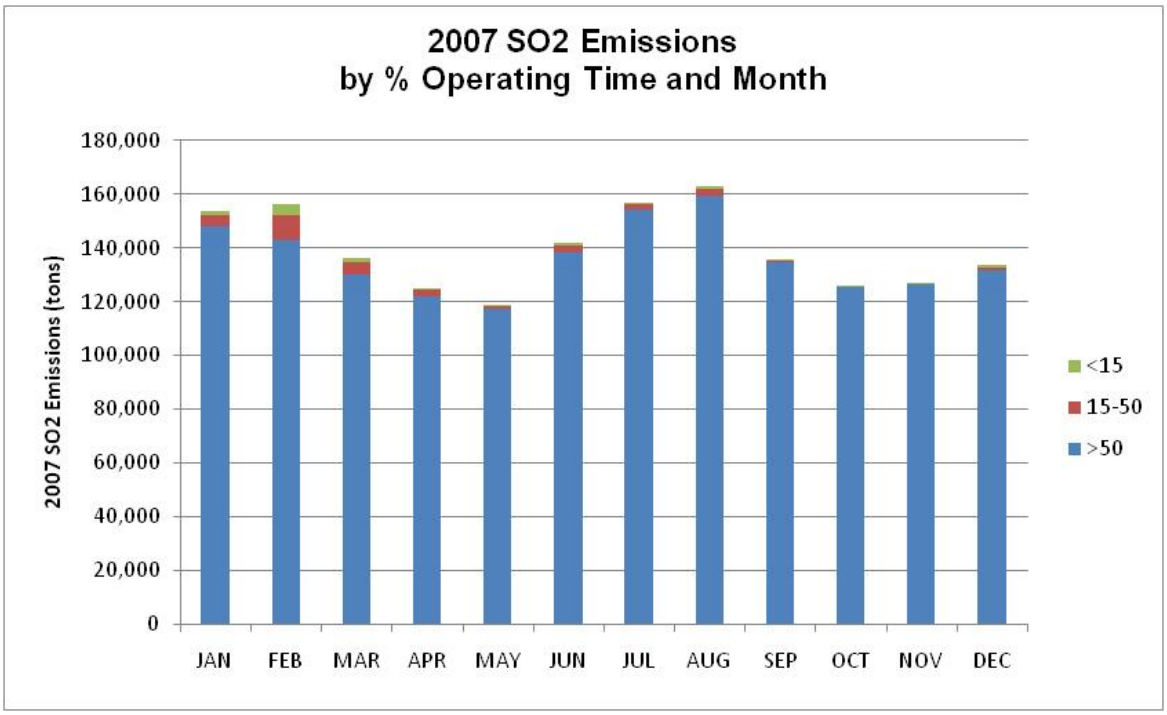



**Figure 2-3.** $SO_2$ Emissions (tons) by % Operating Time and Month.

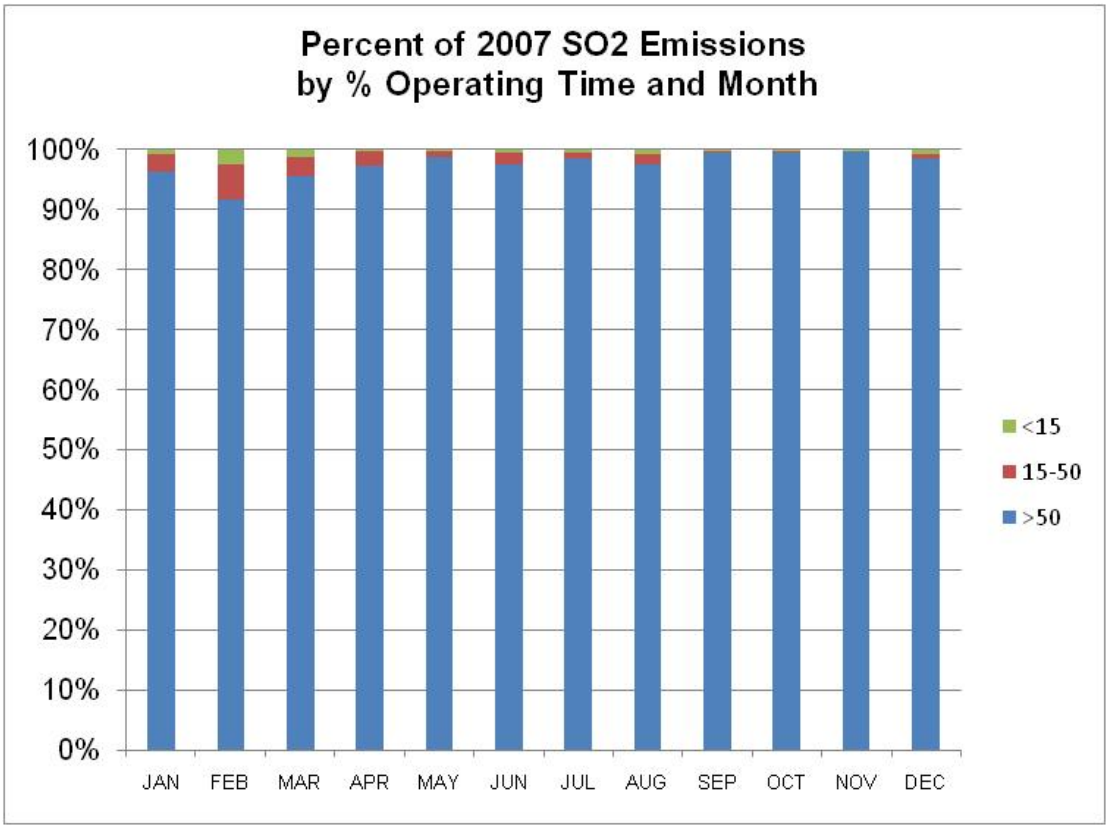



**Figure 2-4.** $SO_2$ Emissions (percentage) by % Operating Time and Month.

## 3 Daily Emissions by Operating Time

***Are there seasonal or daily patterns in the data, in terms of the amount of emissions and the proportion of emissions coming from the three classifications?***

Figures 3-1 and 3-2 plot daily NOx emissions for each of the three classification bins. Figure 3-1 shows total emissions from each bin, while Figure 3-2 shows the percentage of daily emissions from each bin. Generally, the combined NOx emissions from units in the 15-50% and <15% classification bins account for at most 10 percent of the daily NOx emissions. But in February and August, the relative contribution of units in the 15-50% and <15% classification bins can account for as much as 29 percent of the daily emissions on certain days.

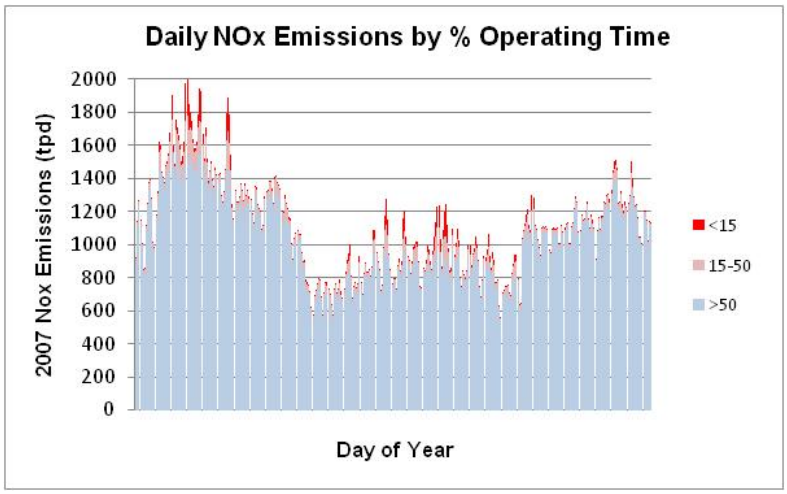



**Figure 3-1.** Daily NOx Emissions (tons) by % Operating Time.

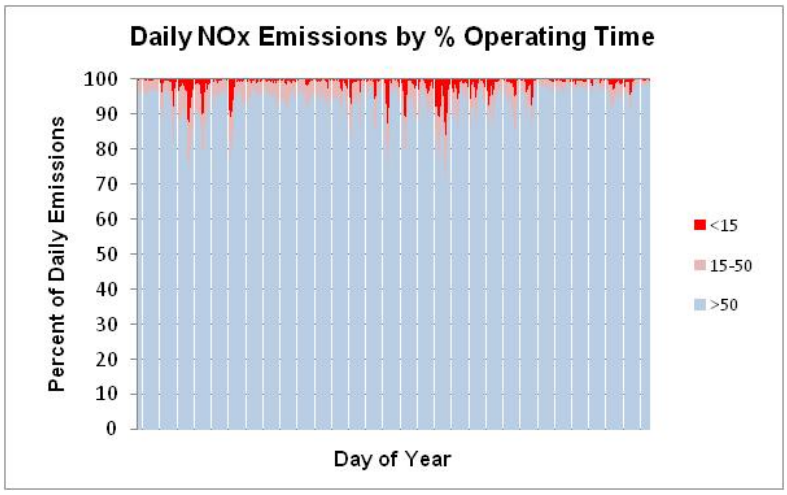



**Figure 3-2.** Daily NOx Emissions (percentage) by % Operating Time.

Zooming in on February 2007, Figure 3-3 plots the daily NOx emissions from each of the three classification bins. The period of February 4-8, 2007 represents a period when most of the northeastern part of the country experienced an artic blast of cold air pouring in from northern Canada. In most of the region, temperatures were significantly below normal. On February 5, for example, the daily high temperature in most of the northeast region did not rise above 20 degrees Fahrenheit, about 10-15 degrees below normal. Similarly, low temperatures were in the single digits, about 10-15 degrees below normal. During this 5-day period of extreme cold, the relative importance of emissions from units in the 15-50% and <15% classification bins was much higher than their relative importance on a monthly or annual basis. The accounted for about 12% to 25% of daily NOx emissions during this period.

| | Percent of NOx Emissions by Bin | | | |
|---|---|---|---|---|
| **DATE** | **>50** | **15-50** | **<15** | **Total** |
| 02/04/07 | 88.2 | 8.4 | 3.5 | 100 |
| 02/05/07 | 77.0 | 11.4 | 11.6 | 100 |
| 02/06/07 | 75.6 | 11.9 | 12.5 | 100 |
| 02/07/07 | 80.0 | 11.7 | 8.3 | 100 |
| 02/08/07 | 83.8 | 10.8 | 5.4 | 100 |

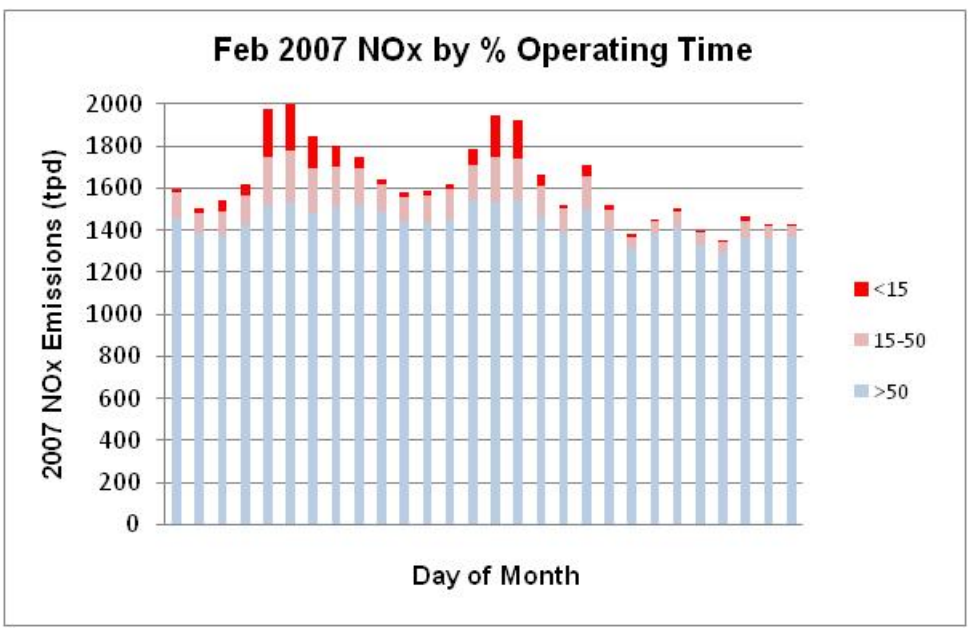



**Figure 3-3.** February Daily NOx Emissions (tons) by % Operating Time.

Zooming in on August 2007, Figure 3-4 plots the daily NOx emissions from each of the three classification bins. The five-day period of august 6-10 was characterized by a strong upper-level ridge that produced hot weather over most of the southern and eastern United States on August 7 and 8. High temperatures in most of the region were about 10 degrees above normal. In Virginia, for example, this heat wave brought Richmond its hottest day in roughly 30 years - the actual high temperature of 104 degrees on August 8$^{th}$. The heat wave was short-lived with the passage of a backdoor cold front into the mid-Atlantic by August 10$^{th}$, resulting in the core of the hot air being pushed south of the Virginia-North Carolina border. During this heat wave, the relative importance of the emissions from units in the 15-50% and <15% classification bins was much higher than their relative importance on a monthly or annual basis. They accounted for about 12% to 29% of daily NOx emissions during this heat wave.

| | Percent of NOx Emissions by Bin | | | |
|---|---|---|---|---|
| **DATE** | **>50** | **15-50** | **<15** | **Total** |
| 08/06/07 | 85.4 | 9.6 | 5.0 | 100 |
| 08/07/07 | 76.2 | 11.6 | 12.2 | 100 |
| 08/08/07 | 71.5 | 12.4 | 16.1 | 100 |
| 08/09/07 | 80.7 | 9.7 | 9.6 | 100 |
| 08/10/07 | 88.0 | 8.9 | 3.1 | 100 |

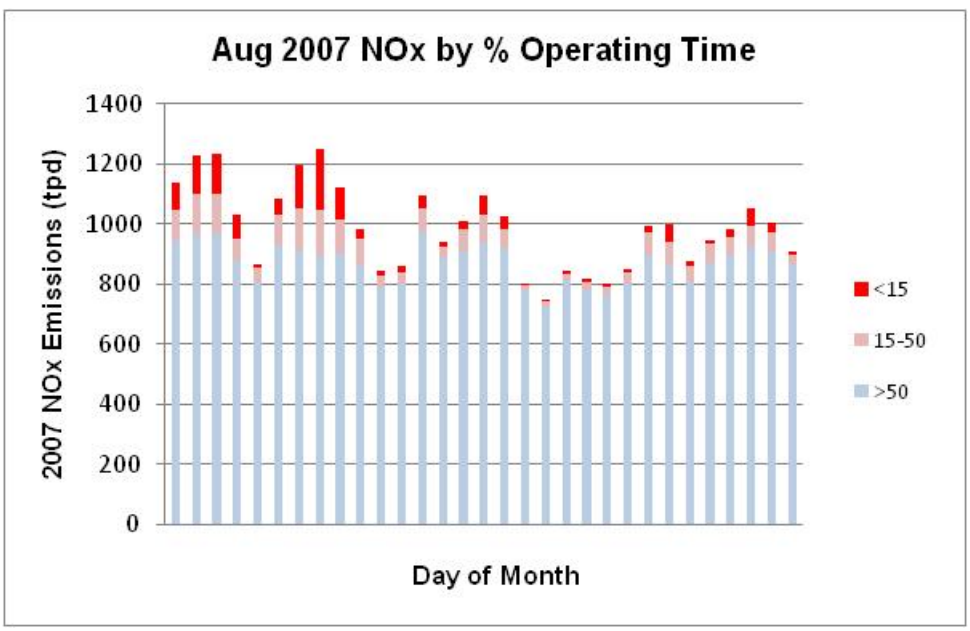



**Figure 3-4.** August Daily NOx Emissions (tons) by % Operating Time.

# 4 Hourly Emissions by Operating Time

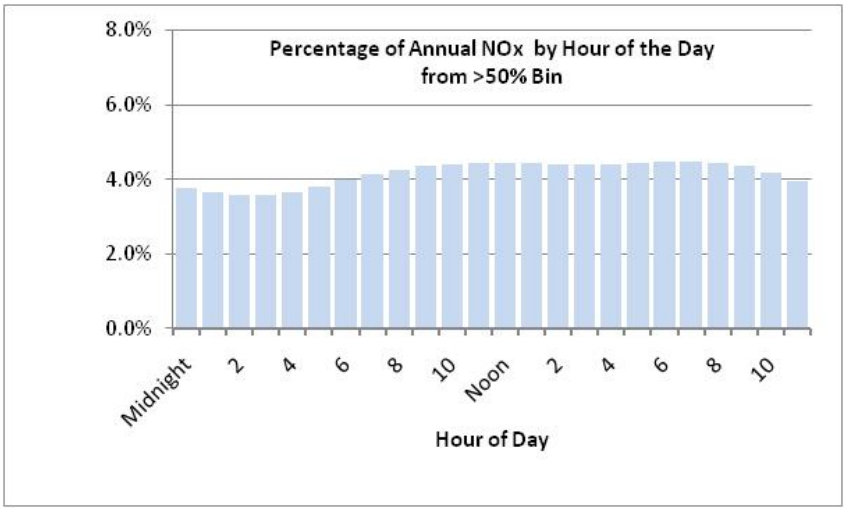
***What is the time-of-day variability by source grouping?***

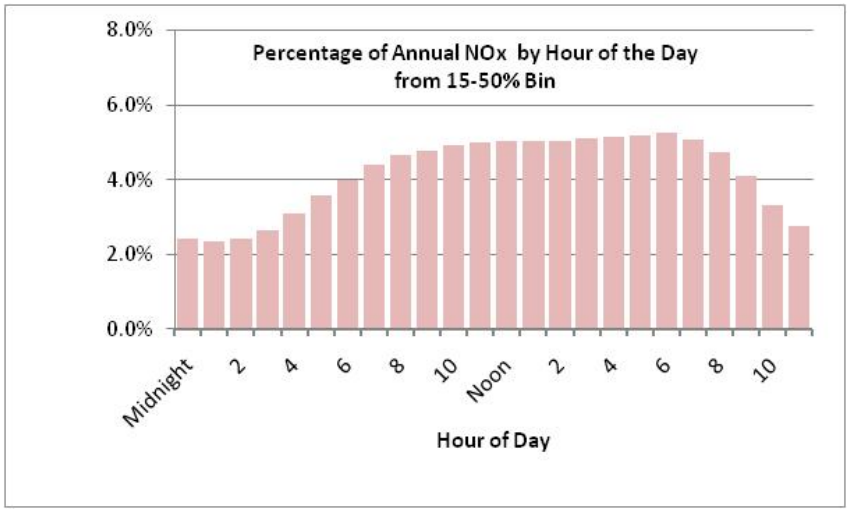
The following charts show how NOx emissions for these three classification bins vary by time of day.

Figure 4-1 shows how 2007 annual NOx emissions vary by time-of-day for units in each of the three classification bins. Emissions from units in the >50% bin exhibit only a small diurnal variation. Emissions from units in the 15-50% bin are lower during the overnight hours and build to relatively constant levels during business hours from 8am to 8pm. Emissions from units in the <15% bin have a pronounced diurnal variation, with relatively low emissions during the overnight hours building progressively to peak emissions in the late afternoon.

Figure 4-2 shows how February 2007 NOx emissions vary by time-of-day for units in each of the three classification bins. The February time-of-day patterns for units in the >50% bin are relatively constant and similar to the annual pattern. The February time-of-day pattern for units in the 15-50% bin shows mid-morning and late-afternoon peaks. The February pattern differs from the annual pattern for these units with lower emissions in the noon-4pm period. The February pattern for units the <15% bin is similar to the February pattern for the units in the 15-50% bin, i.e., mid-morning and late-afternoon peaks with a lull during the noon-4pm period.

Figure 4-3 shows how August 2007 NOx emissions vary by time-of-day for units in each of the three classification bins. The August time-of-day patterns for units in the >50% bin show more variation that the annual or February patterns for these units. There is more diurnal variation with emissions gradually building during the afternoon hours and decreasing overnight. The August time-of-day patterns for units in both the 15-50% and <15% bin show a more pronounced diurnal pattern as emissions increase through the day, peak around 3pm, then gradually decrease.



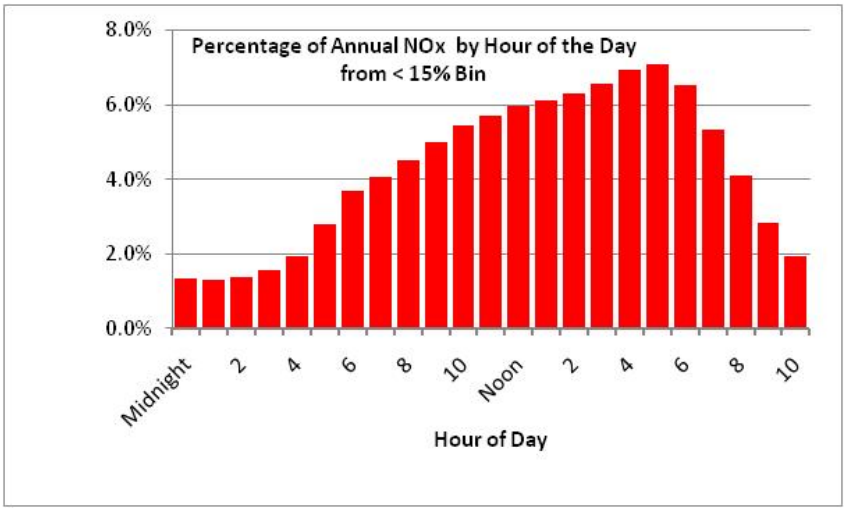




**Figure 4-1.** Percentage of Annual NOx Emissions by Time of Day and % Operating Time.

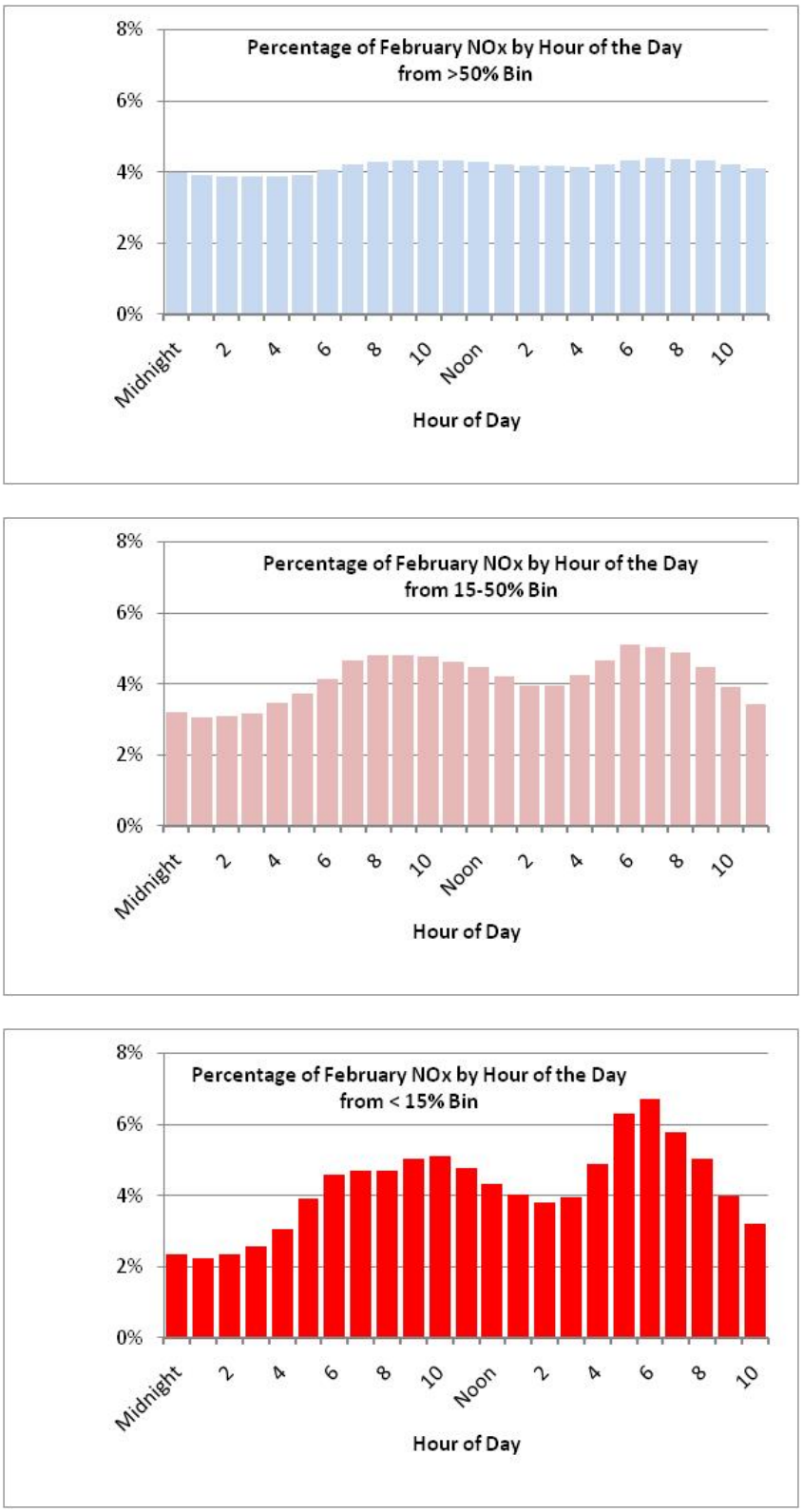
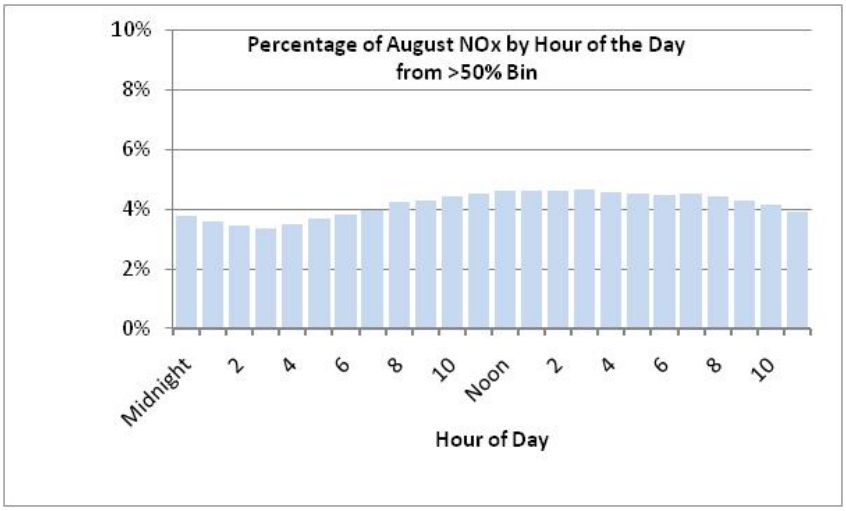
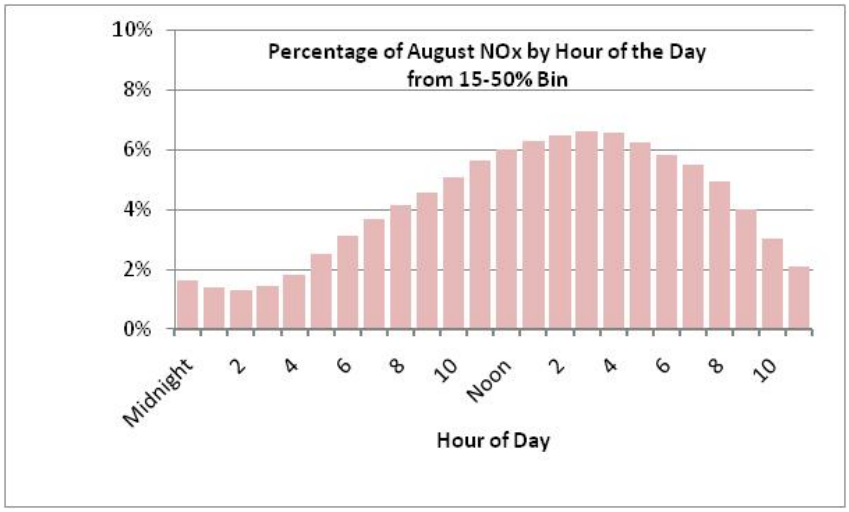



**Figure 4-2.** Percentage of February NOx Emissions by Time of Day and % Operating Time.



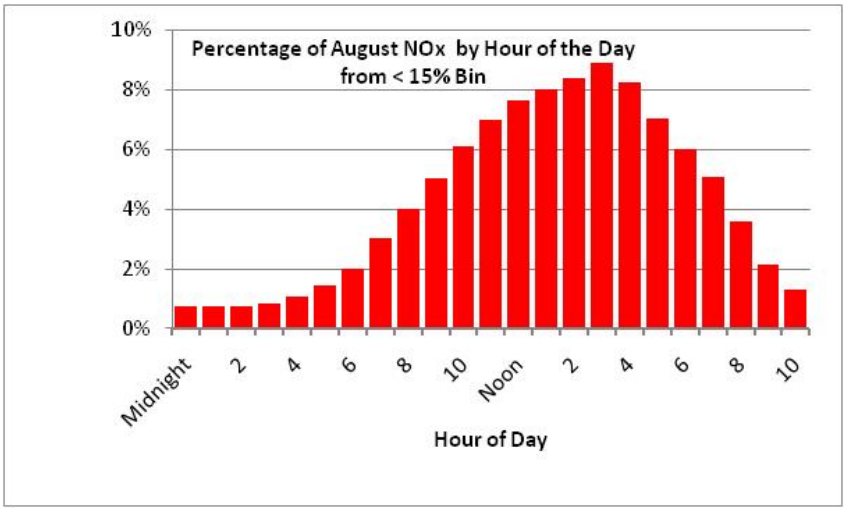




**Figure 4-3.** Percentage of August NOx Emissions by Time of Day and % Operating Time.

# 5 Variability in Emissions by Operating Time

***How variable are emissions from units in the largest classification? Do emissions from these units increase on peak days, or are they the same that operate 15 to 50% of the time? In comparison again, how variable are emissions from units that only operate less than 15% of the time?***

Figure 5-1 shows the variability in daily NOx emissions from units in each of the three classification bins. Daily emissions from units in the >50% bin show a marked decrease during the ozone season. But there is considerable variability in daily emissions from units in this bin even during the ozone season. Daily emissions from units in the 15-50% and <15% bin fluctuate widely from day-to-day.

Figures 5-2 and 5-3 zoom in on the daily emissions in February and August. During both months, daily emissions from units in the >50% bin exhibit some variability, but are reasonably constant from day-to-day. Daily emissions from units in the 15-50% and <15% bin fluctuate widely from day-to-day during both months.

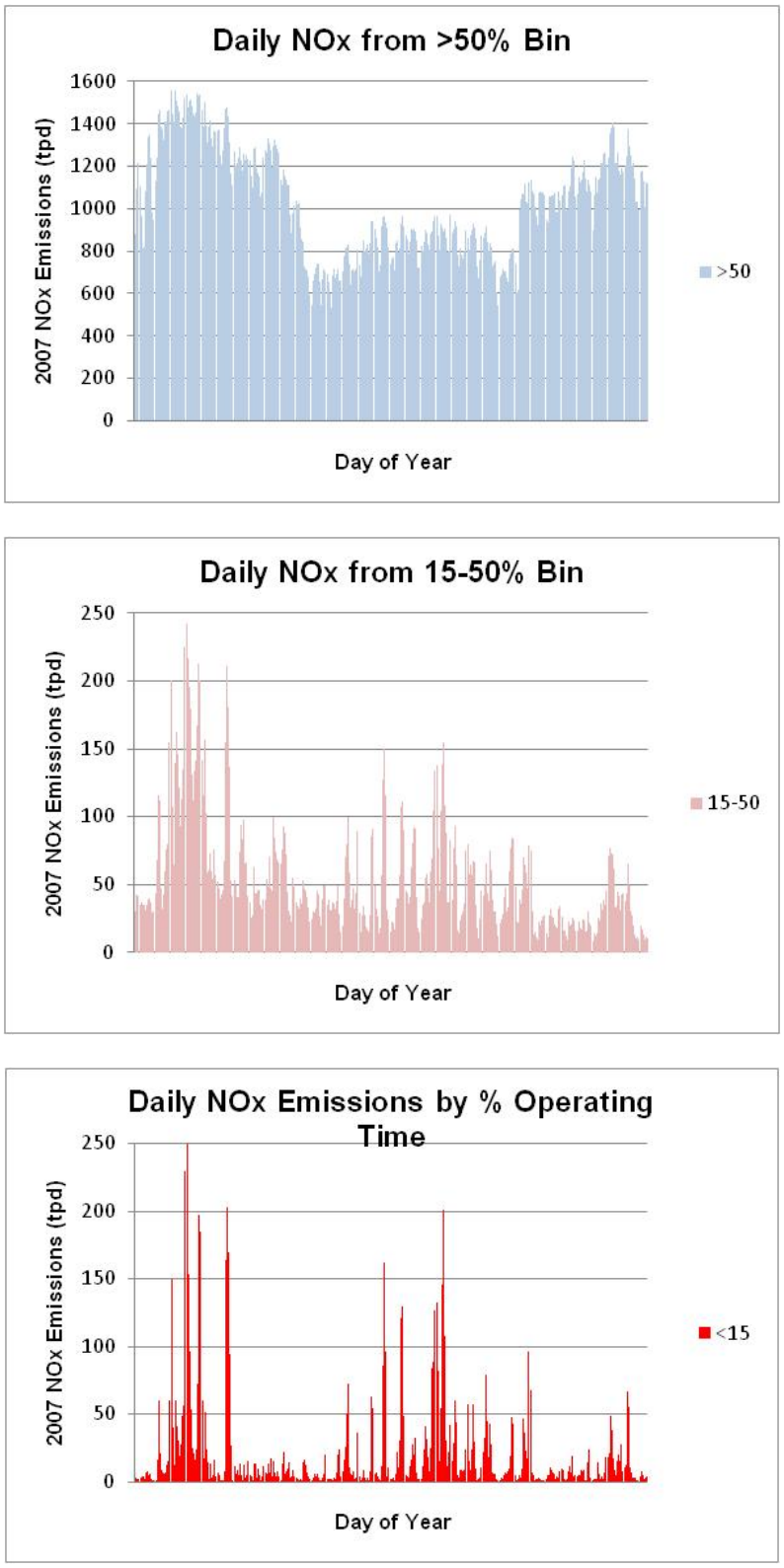
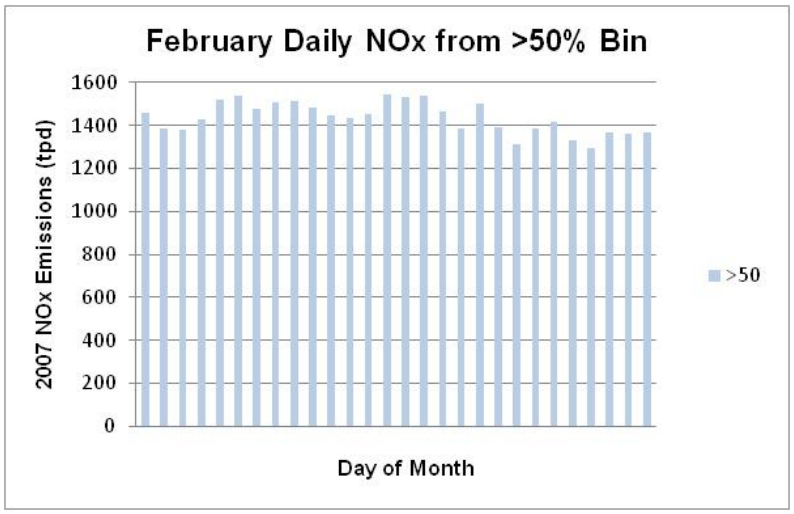
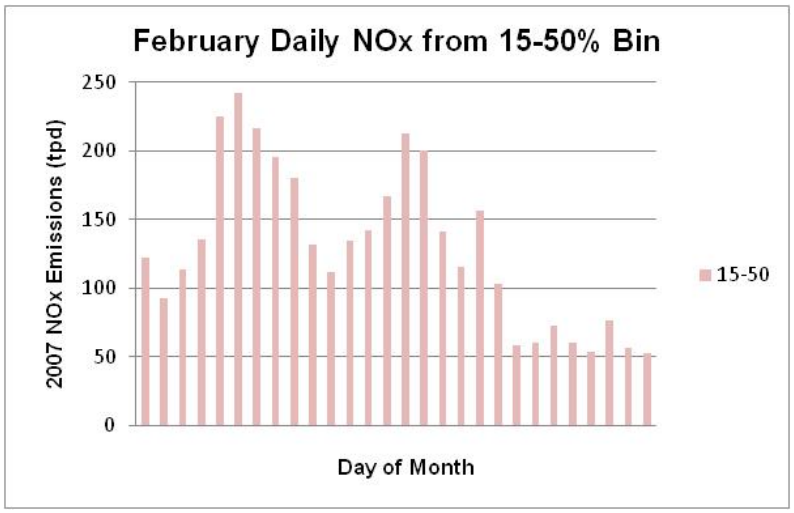



**Figure 5-1.** Daily NOx Emissions (tons) by % Operating Time.



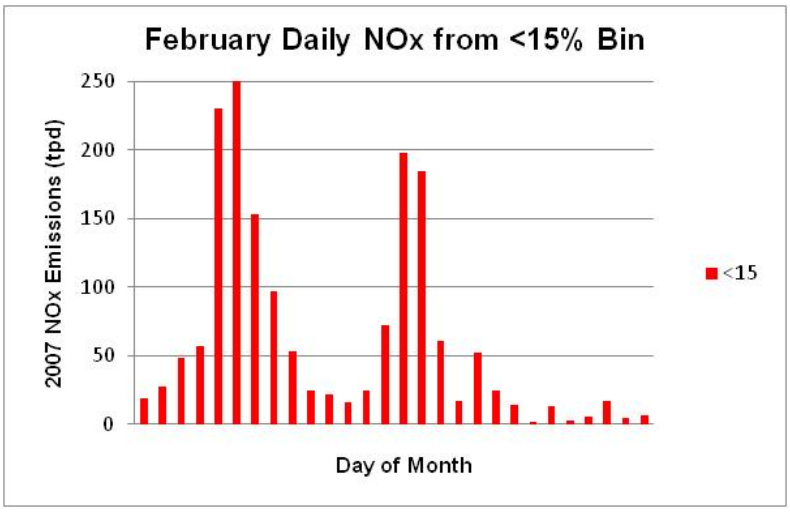
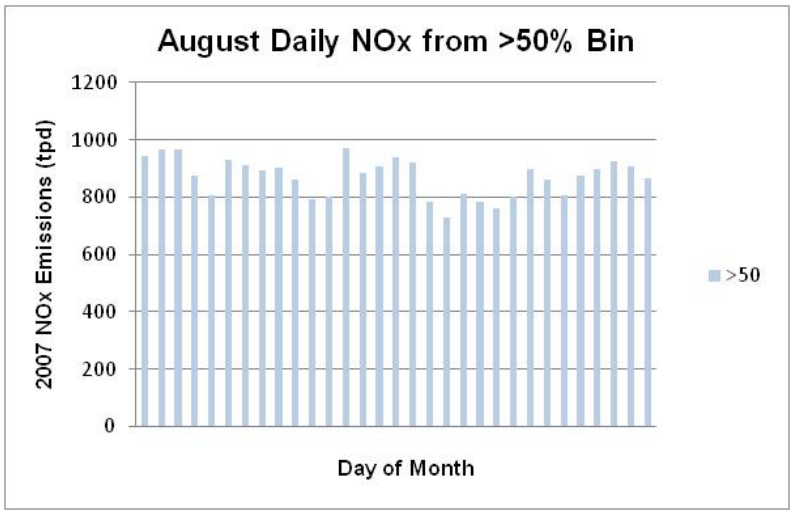
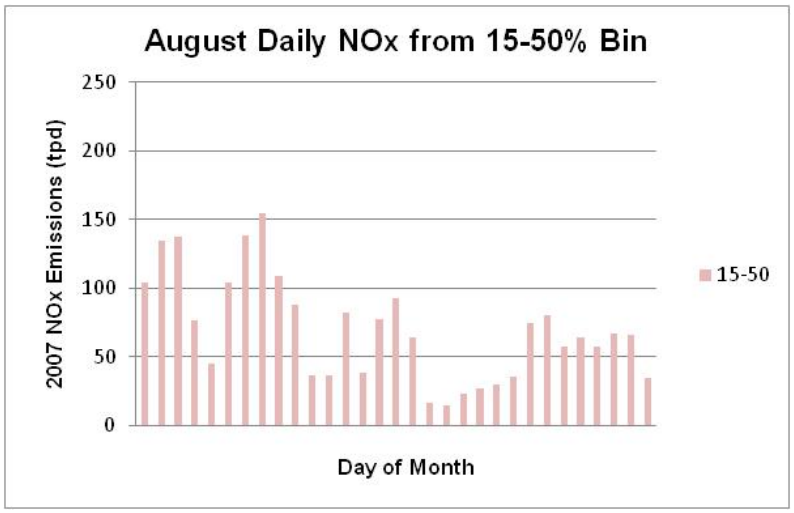




**Figure 5-2.** February Daily NOx Emissions (percentage) by % Operating Time.



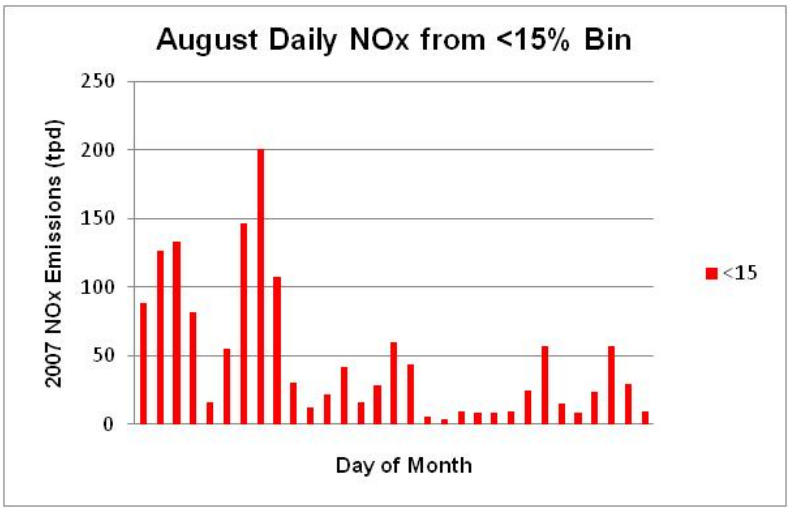




**Figure 5-3.** August Daily NOx Emissions (percentage) by % Operating Time.

## 6 Identification of Peak Ozone Periods

***Do the peak emission periods shift geographically? For example, are the peak days for units in the Baltimore-Washington area the same as the peak days for units in the Philadelphia area and for the New York area and for the Boston area?***

Table 6-1 list the date when each State recorded its maximum 8-hour ozone concentration in 2007, the State maximum value, other States that exceeded 75 ppb on that date, and a map showing ozone concentrations in the Northeast / Mid-Atlantic region. Many States recorded their maximum 8-hour ozone concentration on the same days, as follows:

- July 9 (Monday) - five States recorded their 8-hour maximum ozone concentration for 2007 on this date – MD, PA, CT, DE and MA. The concentrations measured on this date were the highest measured throughout the region during 2007. Four other States had values over 75 ppb on July 9. As shown in the ozone map, the area of high ozone values extended over a wide geographic area along the I-95 corridor from northern Virginia to New England.

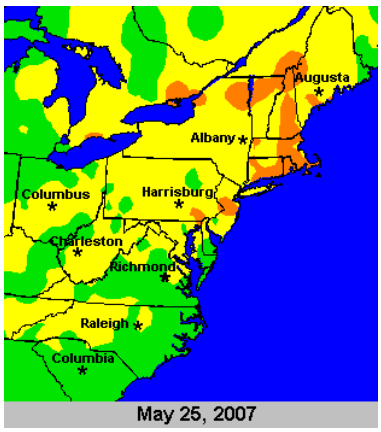
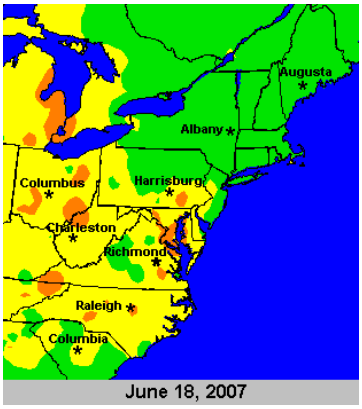
- May 24/25(Thursday/Friday) – three States recorded their 8-hour maximum ozone concentration for 2007 on these two dates – NY, RI and VT. The peak concentrations measured on this date were lower than those measured on July 9, but all 13 States measured values over 75 ppb on May 25. As shown in the ozone map, the values in the northern part of the region – New York and New England – experienced higher ozone concentrations than States in the southern part of the region.

- June 26/27 (Tuesday/Wednesday) – two States recorded their 8-hour maximum ozone concentration for 2007 on these two dates – NJ and ME. The peak concentrations measured on this date were lower than those measured on July 9, but 11 of 13 States measured values over 75 ppb on May 25. As shown in the ozone map, the area of high ozone values extended over a wide geographic area along the I-95 corridor from northern Virginia to New England, similar to the July 9 episode, but the ozone values were generally not as high as on July 9.

- June 18 (Monday) – two areas recorded their 8-hour maximum ozone concentration for 2007 on this date – the District of Columbia and the northern Virginia region that is part of the OTC. As shown in the ozone map, the values in the southern part of the region experienced higher ozone concentrations than northern States.

- August 3 (Friday) – only one State recorded its maximum ozone concentration for 2007 on this date – New Hampshire. But 10 other States exceeded 75 ppb. As shown in the ozone map, the values in New England were particularly high on this date.

**Table 6- 1.** Dates of Maximum 8-hr Ozone Concentration for Each State in 2007

| **Date** | **State with Yearly Maximum 8-hr Value (ppb) on this Date** | **Other States > 75 ppb on this Date** | **Ozone Map for the Date (Areas in shaded in yellow > 75 ppb, orange > 95 ppb, and red > 105 ppb)** |
|---|---|---|---|
| May 24/25 Thursday/ Friday | NY 104<br>RI 100<br>VT 86 | CT 105<br>MA 94<br>MD 92<br>PA 92<br>NH 91<br>NJ 89<br>DE 86<br>ME 86<br>VA OTC 80<br>DC 78 |  |
| June 18 Monday | VA OTC 95<br>DC 93 | MD 103<br>PA 92<br>DE 81<br>NJ 76 |  |

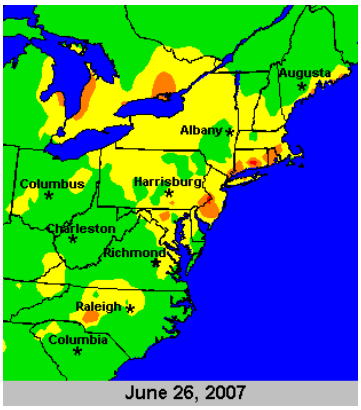
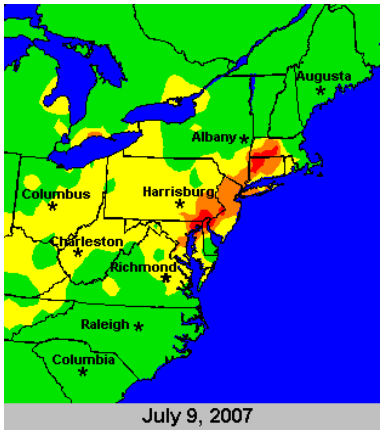
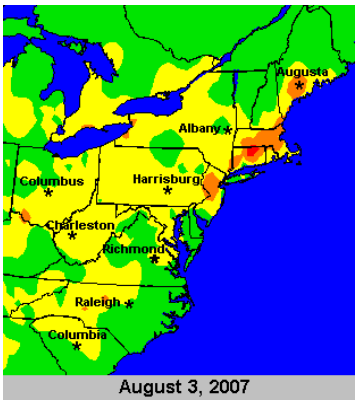
| **Date** | **State with Yearly Maximum 8-hr Value (ppb) on this Date** | **Other States > 75 ppb on this Date** | **Ozone Map for the Date (Areas in shaded in yellow > 75 ppb, orange > 95 ppb, and red > 105 ppb)** |
|---|---|---|---|
| June 26/27 Tuesday/ Wednesday | NJ 107<br>ME 99 | PA 119<br>CT 111<br>NY 95<br>MD 91<br>RI 89<br>MA 86<br>VA OTC 81<br>DE 80<br>DC 77 |  |
| July 9 Monday | MD 125<br>PA 121<br>CT 123<br>DE 117<br>MA 112 | NJ 100<br>NY 97<br>VA OTC 89<br>DC 85 |  |
| August 3 Friday | NH 97 | CT 107<br>MA 103<br>NJ 98<br>ME 94<br>RI 88<br>NY 86<br>PA 86<br>MD 83<br>DC 83<br>VA OTC 78 |  |

Table 6.2 shows the relative importance of the emissions from units in each of the classification bins on the five high ozone days previously shown in Table 6-1. For each of these five days, the percentage of emissions from the <15% bin units is 2 to 4 times higher than the monthly average for these units. Similarly, the percentage of emissions from the 15-50% bin units on these five days is 1.5 to 2 times higher than the monthly average for these same units.

**Table 6- 2.** Comparison of MANE-VU+VA Daily NOx Emissions Percentages on High Ozone Days versus Monthly Average Emission Percentages.

| Date | Max 8-hour Ozone (ppb) | State where Max Occurred | Percent of MANE-VU+VA EGU NOx Emissions On this Date | | | Percent of MANE-VU+VA EGU NOx Emissions 2007 Monthly Average | | |
|---|---|---|---|---|---|---|---|---|
| | | | >50% | 15-50% | <15% | >50% | 15-50% | <15% |
| May 25 | 105 | CT | 91 | 6 | 3 | 95 | 4 | 1 |
| June 18 | 103 | MD | 86 | 7 | 7 | 92 | 5 | 3 |
| June 26 | 119 | PA | 80 | 10 | 10 | 92 | 5 | 3 |
| July 9 | 125 | MD | 78 | 9 | 13 | 92 | 5 | 3 |
| August 3 | 107 | CT | 77 | 10 | 12 | 89 | 7 | 5 |

In addition, for days when ozone exceeded 75 ppb anywhere in the OTC, 88 percent of the region-wide NOx emissions were from units in the >50% bin, 6 percent from the 15-50% bin, and 6 percent from the <15% bin.

Figure 6-1 shows how MANE-VU+VA daily NOx emissions from units in each of the three classification bins vary compared to the MANE-VU+VA daily maximum ozone concentrations in 2007 (for those days when the ozone value exceeded 75 ppb).

Daily emissions from units in the >50% bin tend to increase somewhat when the ozone value increases. Daily emissions from units in the 15-50% and <15% bins tend to show a higher level of correlation with high ozone days.

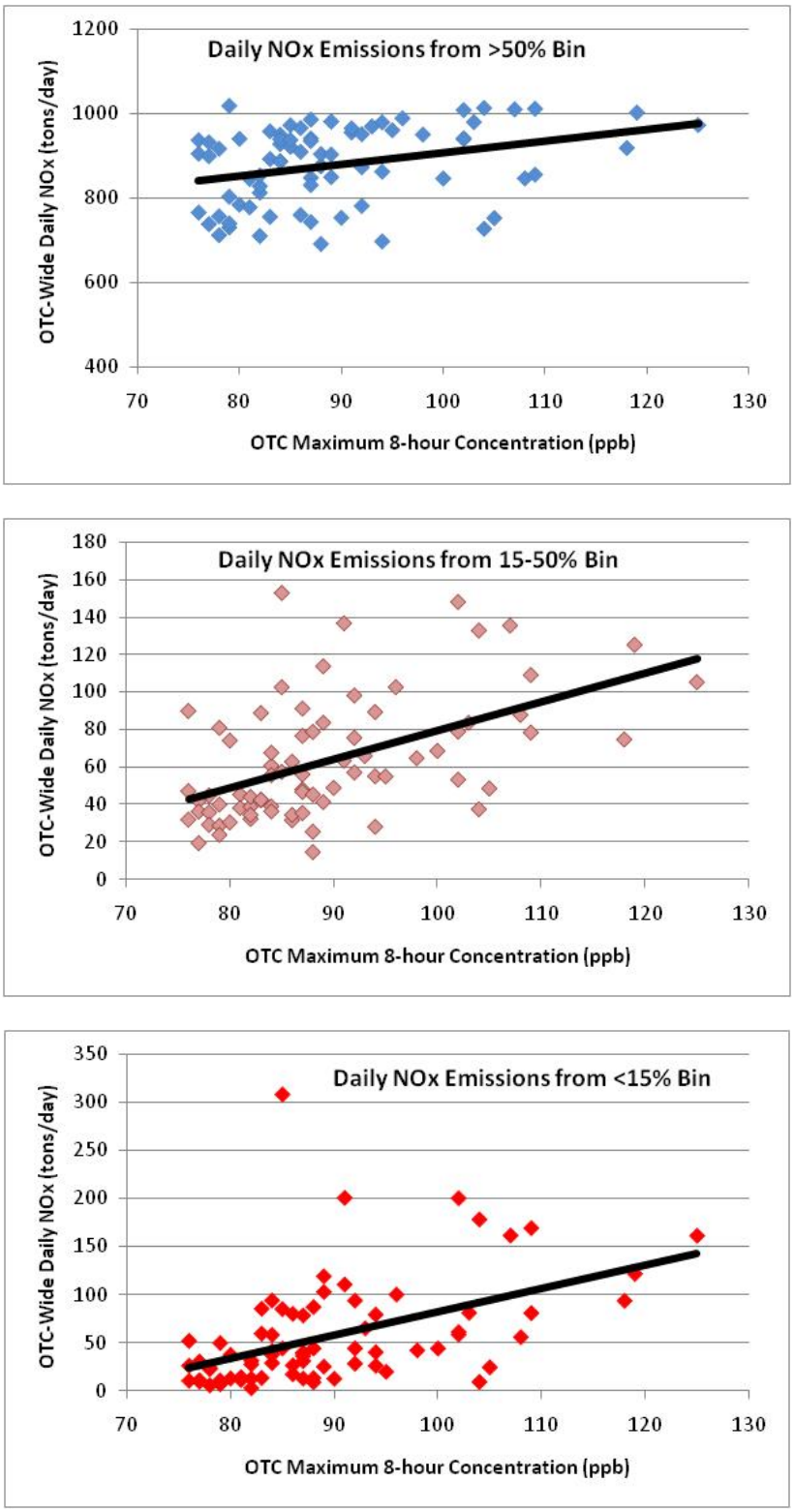



**Figure 6-1.** MANE-VU+VA Daily NOx Emissions versus MANE-VU+VA Maximum 8-hour Ozone Concentration on Days when Maximum Ozone Exceeded 75 ppb.

# 7 Daily Emissions by Fuel Type and Combustion Technology

***Is there a disproportionate use of a particular fuel or technology (e.g., combustion turbines) during hot periods in the summer that is contributing high emissions? MARAMA will identify peak ozone days for 2007.***

Figure 7-1 shows the MANE-VU+VA NOx daily emissions from CAMD units by fuel type, sorted from lowest emission day to highest emission day for the period May 1 to September 30, 2007. On a region-wide basis, coal is clearly the dominant fuel type, accounting for about 84 percent of the regional NOx emissions from CAMD units. NOx emissions from residual oil combustion average about 6 percent of the regional NOx emissions. On the 10-highest NOx emission days, however, coal accounts for 61-75 percent and residual oil accounts for 12-17 percent.

Figure 7-2 shows the MANE-VU+VA NOx daily emissions from CAMD units by fuel type for six high ozone days in 2007. On the six high ozone days, coal accounts for 68-85 percent, residual oil for 5-17 percent, diesel oil for 3-6 percent, and natural gas for 6-10 percent.

Figure 7-3 shows the MANE-VU+VA NOx daily emissions from CAMD units by combustion unit type, sorted from lowest emission day to highest emission day for the period May 1 to September 30, 2007. On a region-wide basis, boilers are clearly the dominant combustion unit type, accounting for about 92 percent of the regional NOx emissions. On the 10-highest NOx emission days, however, boilers account for 81-91 percent, combined cycle units account for 4-5 percent, and combustion turbines account for 4-14 percent.

Figure 7-4 shows the MANE-VU+VA NOx daily emissions from CAMD units by combustion unit type for six high ozone days in 2007. On the six high ozone days, boilers account for 87-92 percent, combined cycle units for 4-5 percent, and combustion turbines for 2-7 percent.

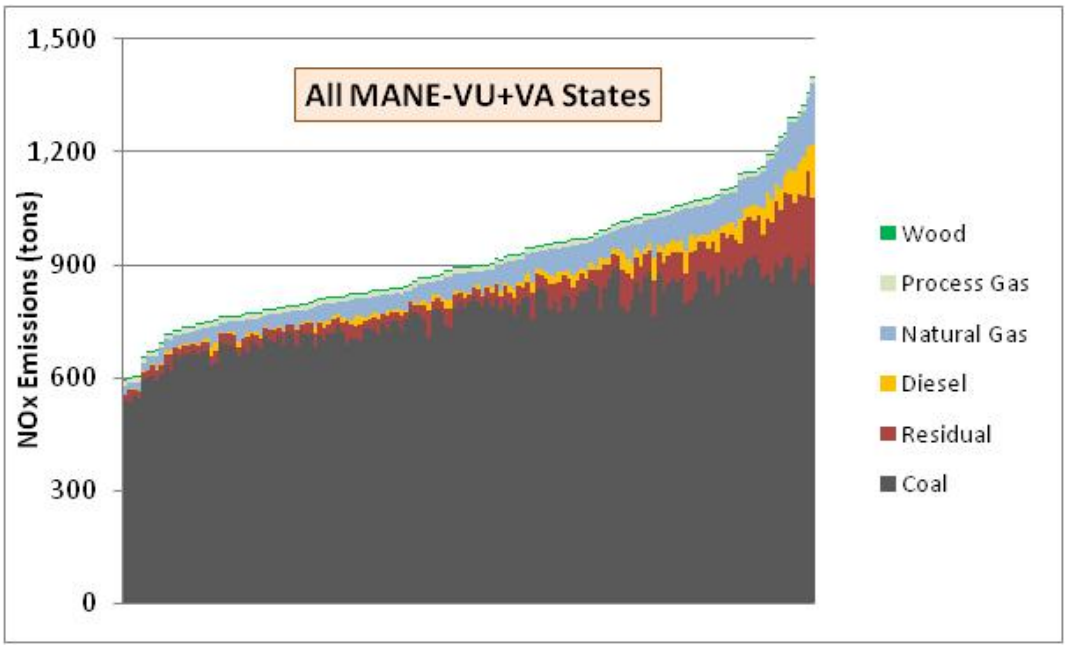



**Figure 7-1.** NOx Daily Emissions by Fuel Type
Comprising the Daily NOx Emissions Sorted by Region-Wide NOx Mass
May 1, 2007 – September 30, 2007.

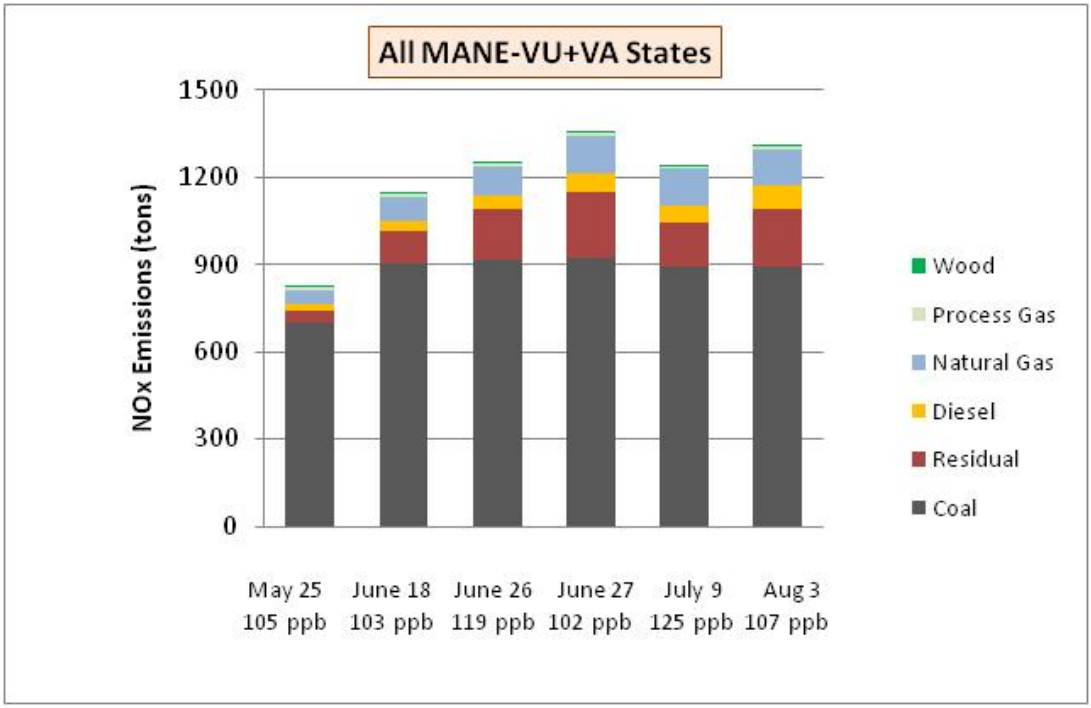



**Figure 7-2.** NOx Daily Emissions by Fuel Type
for 6 High Ozone Episode Days in 2007.

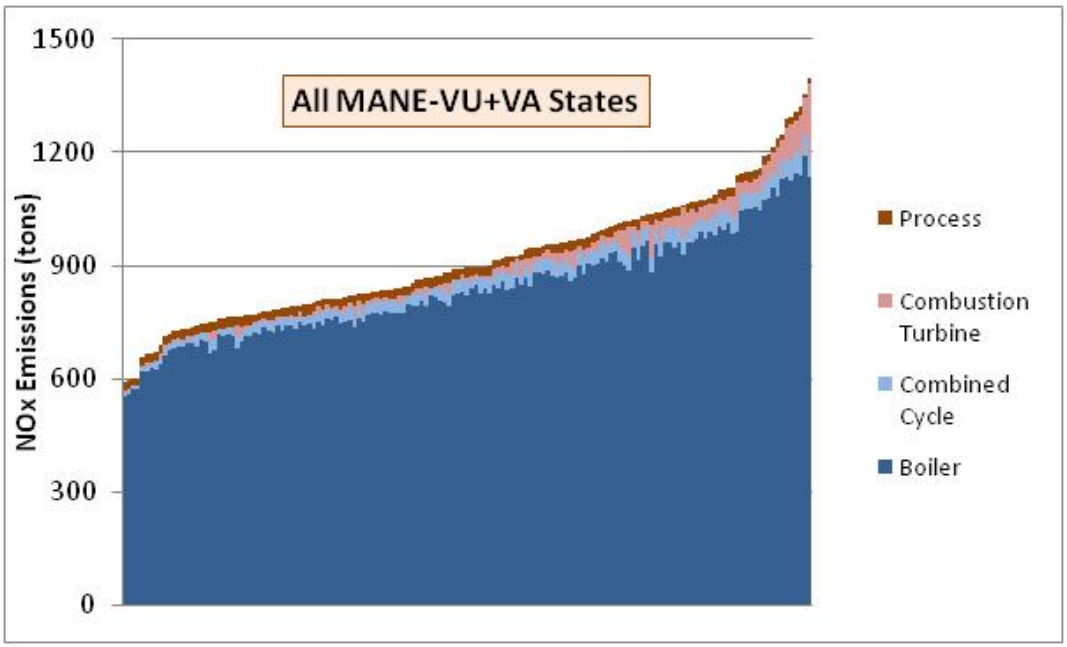



**Figure 7-3.** NOx Daily Emissions by Combustion Type
Comprising the Daily NOx Emissions Sorted by Region-Wide NOx Mass
May 1, 2007 – September 30, 2007.

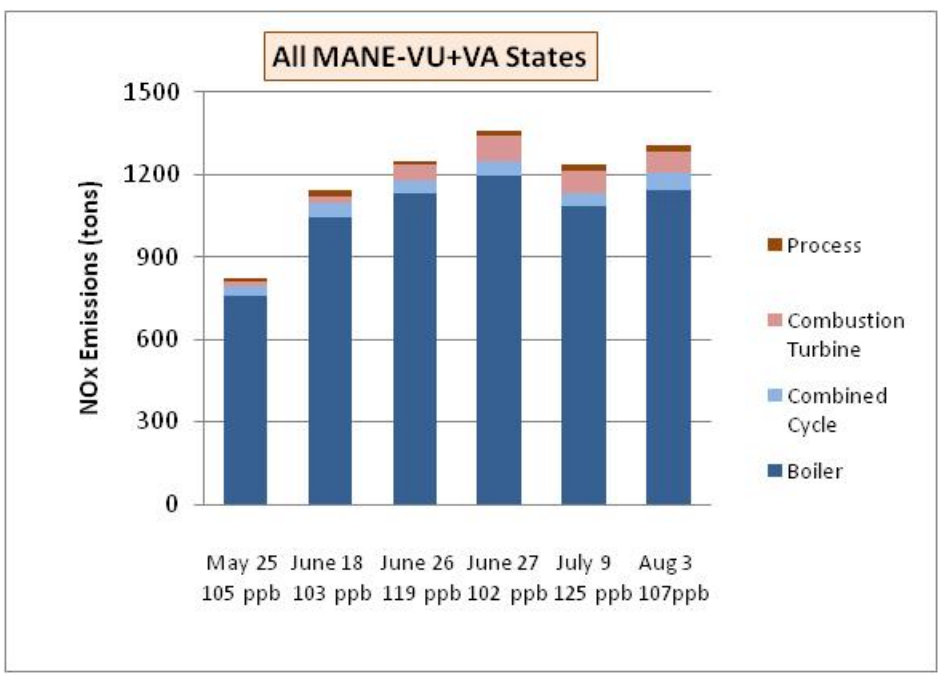



**Figure 7-4.** NOx Daily Emissions by Combustion Type
for 6 High Ozone Episode Days in 2007.

# 8 Geographic Variation in Fuel Types and Combustion Technology

***Do the patterns in Question 7 vary by State?***

The previous section showed MANE-VU+VA variations in NOx emissions by fuel type and combustion type. This sections provides that same analysis but subdivides the MANE-VU+VA region into three parts – USEPA Region 1 States (CT, MA, ME, NH, RI, VT), Region 2 States (NJ, NY), and Region 3 States (DC, DE, MD, PA, all of VA, but excludes WV).

Figure 8-1 shows the NOx daily emissions by fuel type, sorted from lowest emission day to highest emission day for the period May 1 to September 30, 2007. On a relative basis, the NOx emissions in the Region 1 and 2 States result from a mix of coal, residual oil, diesel, and natural gas. The dominant fuel in the Region 3 States is coal. On the lowest emission days in Region 1, coal is the dominant fuel type. On the highest NOx emission days in Region 1, NOx emissions from residual oil combustion exceed the emissions from coal combustion. Region 2 States see increases in NOx emissions from residual oil, diesel oil and natural gas during high NOx emission days. Region 3 States also see increases in NOx emissions from residual oil during high NOx emission days, but the emissions on high NOx emission days still are dominated by coal combustion.

The above patterns are shown more clearly in Figure 8-2, which shows the NOx daily emissions by fuel type for six high ozone days in 2007. Region 1 States have relatively high emissions from residual fuel units on high ozone days. All four fuel types have relatively important contributions in Region 2 States on high ozone days. Region 3 States have some contribution from residual oil on high ozone days, but coal still predominates.

Figure 8-3 shows the NOx daily emissions by combustion unit type, sorted from lowest emission day to highest emission day for the period May 1 to September 30, 2007. NOx emissions from combustion turbines in Region 2 States become more important on high NOx emission days.

Figure 8-4 shows the NOx daily emissions by combustion unit type for six high ozone days in 2007. Again, NOx emissions from combustion turbines in Region 2 States become more important on high ozone days.

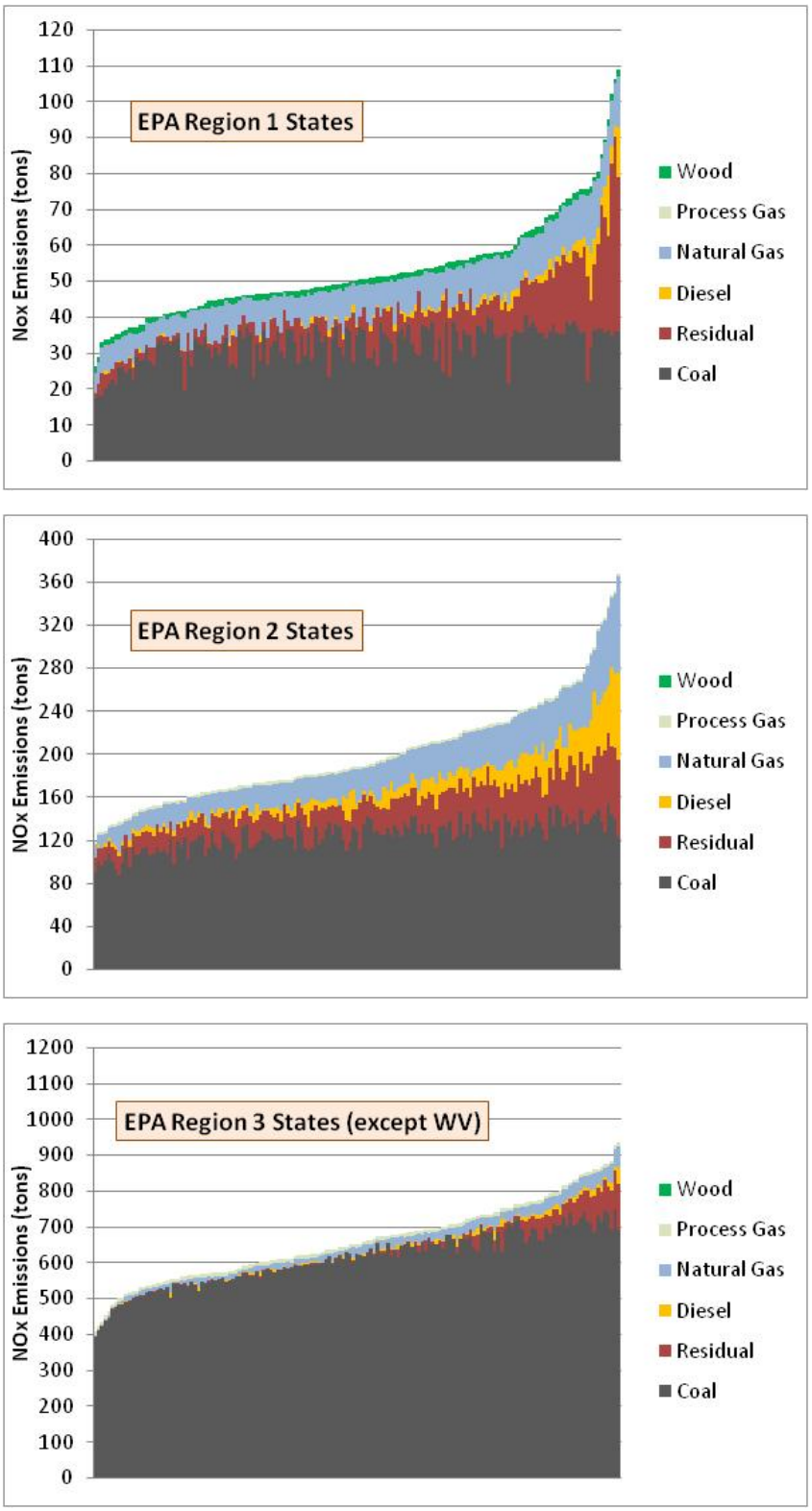



**Figure 8-1.** NOx Daily Emissions by Fuel Type
May 1, 2007 – September 30, 2007.

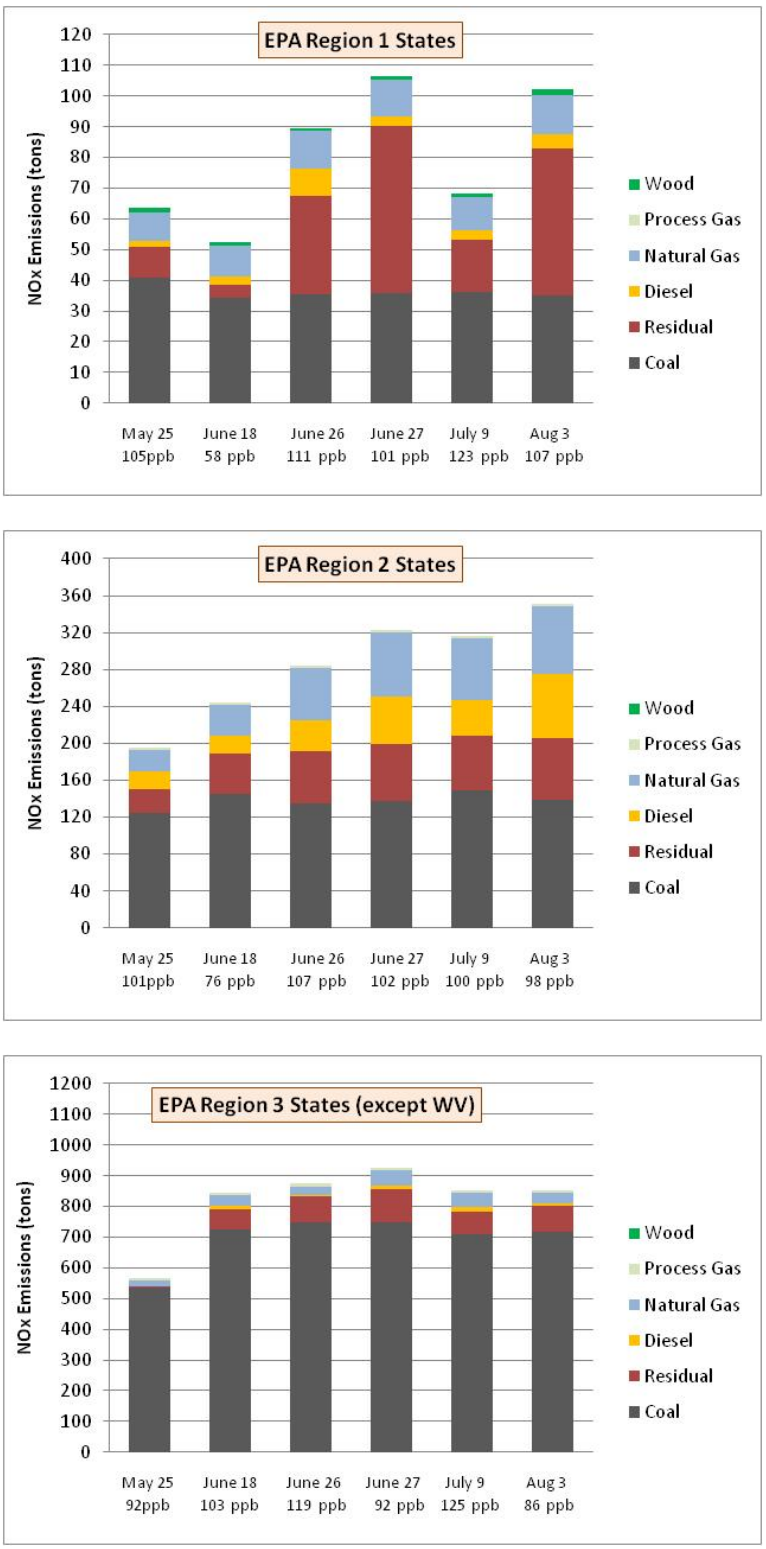



**Figure 8-2.** NOx Daily Emissions by Fuel Type
for 6 High Ozone Episode Days in 2007.

(ozone values shown above are the maximum 8-hour value in the group of States depicted)

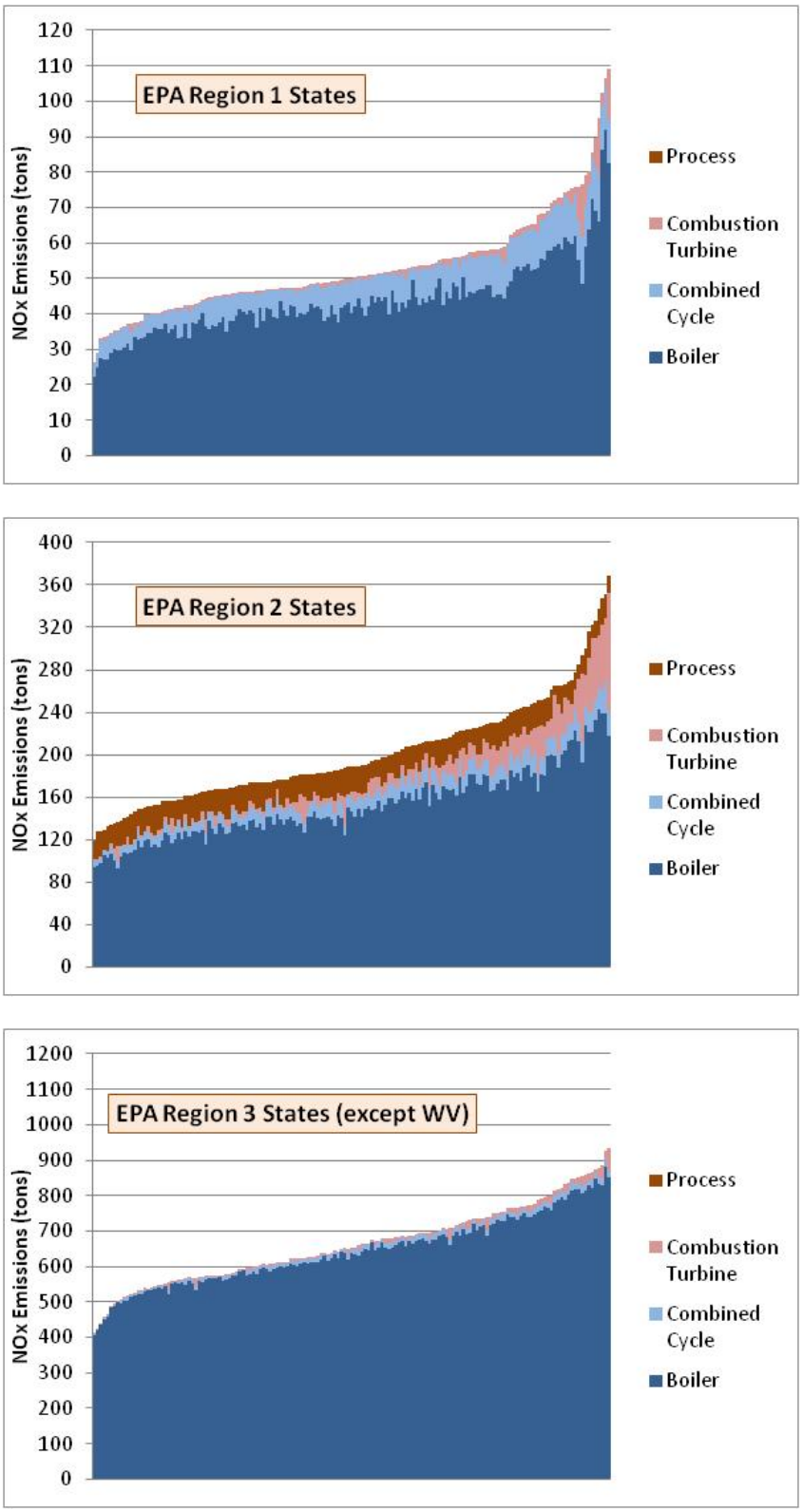



**Figure 8-3.** NOx Daily Emissions by Combustion Type
May 1, 2007 – September 30, 2007.

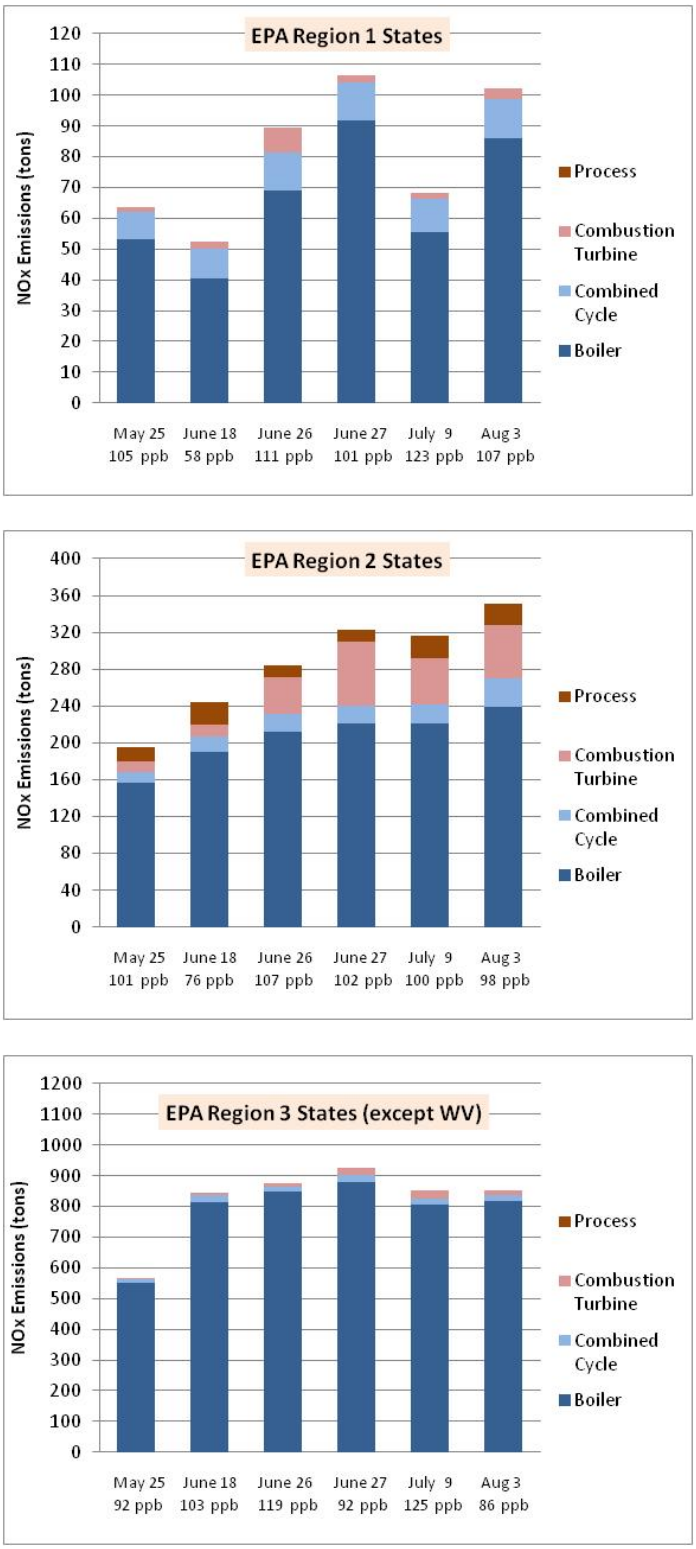



**Figure 8-4.** NOx Daily Emissions by Combustion Type for 6 High Ozone Episode Days in 2007.

(ozone values shown above are the maximum 8-hour value in the group of States depicted)

## 9 Hourly Emissions During Ozone Episode Periods

***For ozone episode periods, what are the amount of emissions and the proportion of emissions coming from the three classifications? How do the emissions/proportions vary by hour of the day, geographical location and classification for the episode(s)?***

MARAMA provided daily maximum 8-hour ozone concentrations by day and State for 2007. We identified 7-day periods centered on the dates of the State maximum 8-hour values in the OTC for analysis previously identified in Question 6.

May 22-28, 2007; OTC 8-hr maximum ozone concentration of 105 ppb

Table 9-1 provides the maximum 8-hour ozone concentration in each OTC State for each day during the period. On Thursday, May 24, an 8-hour value of 104 ppb was recorded in New York. On Friday, May 25, an 8-hour value of 105 ppb was recorded in Connecticut. All MANE-VU+VA States exceeded the 75 ppb NAAQS on that day.

Figure 9-1a shows the hourly NOx emissions in the entire MANE-VU+VA region during the period from units in the three classification bins. On a region-wide basis, the relative contribution of hourly emissions from units in the 15-50% and <15% bin is relatively small, ranging from less than 1 percent to 14 percent of total hourly emissions from CAMD units.

The relative contribution of the emissions in each of the classification bins does vary by geographic region. Figures 9-1b to 9-1e show NOx emissions for the Boston, New York City, Philadelphia-Wilmington, and Baltimore-Washington metropolitan areas, respectively.

In the metro Boston CSA, the emissions from the units in the <15% and 15-50% operating bins were very small compared to the emissions from the 50% bin for this episode.

In the metro New York CSA, the emissions from units in the <15% operating time bin at times exceed the emissions from the units in the >50% operating time bin. Emissions from units in the <15% bin vary rapidly, rising from near zero in the overnight hours to as much as 9.5 tons/hour by early afternoon, then falling back to near zero by midnight.

In the metro Philadelphia CSA, the emissions from the units in the <15% and 15-50% operating bins were very small compared to the emissions from the 50% bin.

In the DC/Baltimore/Northern VA CSA, the emissions from units in the <15% operating time bin tend to be less important than in the New York Metro area. At times, however,

the relative contribution of emissions from units in the 15-50% and <15% can be as high as 25 percent of total hourly emissions from CAMD units in the CSA.

**Table 9-1.** Ozone Daily Maximum 8-hour Concentrations May 22-28, 2007

| | 5/22/07 Tue | 5/23/07 Wed | 5/24/07 Thu | 5/25/07 Fri | 5/26/07 Sat | 5/27/07 Sun | 5/28/07 Mon |
|---|---|---|---|---|---|---|---|
| **OTC Max** | 0.078 | 0.082 | **0.104** | **0.105** | 0.094 | 0.088 | 0.077 |
| **# States>0.075** | **1** | **4** | **9** | **13** | **7** | **5** | **1** |
| **ME** | 0.047 | 0.048 | 0.080 | 0.086 | 0.069 | 0.056 | 0.059 |
| **VT** | 0.049 | 0.067 | 0.077 | 0.086 | 0.051 | 0.050 | 0.048 |
| **NH** | 0.052 | 0.074 | 0.086 | 0.091 | 0.067 | 0.062 | 0.061 |
| **MA** | 0.055 | 0.078 | 0.083 | 0.094 | 0.094 | 0.065 | 0.075 |
| **RI** | 0.055 | 0.055 | 0.079 | 0.100 | 0.061 | 0.050 | 0.077 |
| **CT** | 0.057 | 0.067 | 0.080 | **0.105** | 0.074 | 0.076 | 0.072 |
| **NY** | 0.056 | 0.082 | **0.104** | 0.101 | 0.072 | 0.075 | 0.073 |
| **NJ** | 0.059 | 0.076 | 0.081 | 0.089 | 0.094 | 0.086 | 0.071 |
| **PA** | 0.073 | 0.081 | 0.098 | 0.092 | 0.077 | 0.088 | 0.071 |
| **DE** | 0.062 | 0.059 | 0.072 | 0.086 | 0.084 | 0.081 | 0.075 |
| **MD** | 0.078 | 0.071 | 0.074 | 0.092 | 0.091 | 0.080 | 0.070 |
| **DC** | 0.063 | 0.058 | 0.063 | 0.078 | 0.079 | 0.073 | 0.059 |
| **VA-OTC** | 0.075 | 0.064 | 0.068 | 0.080 | 0.083 | 0.072 | 0.062 |

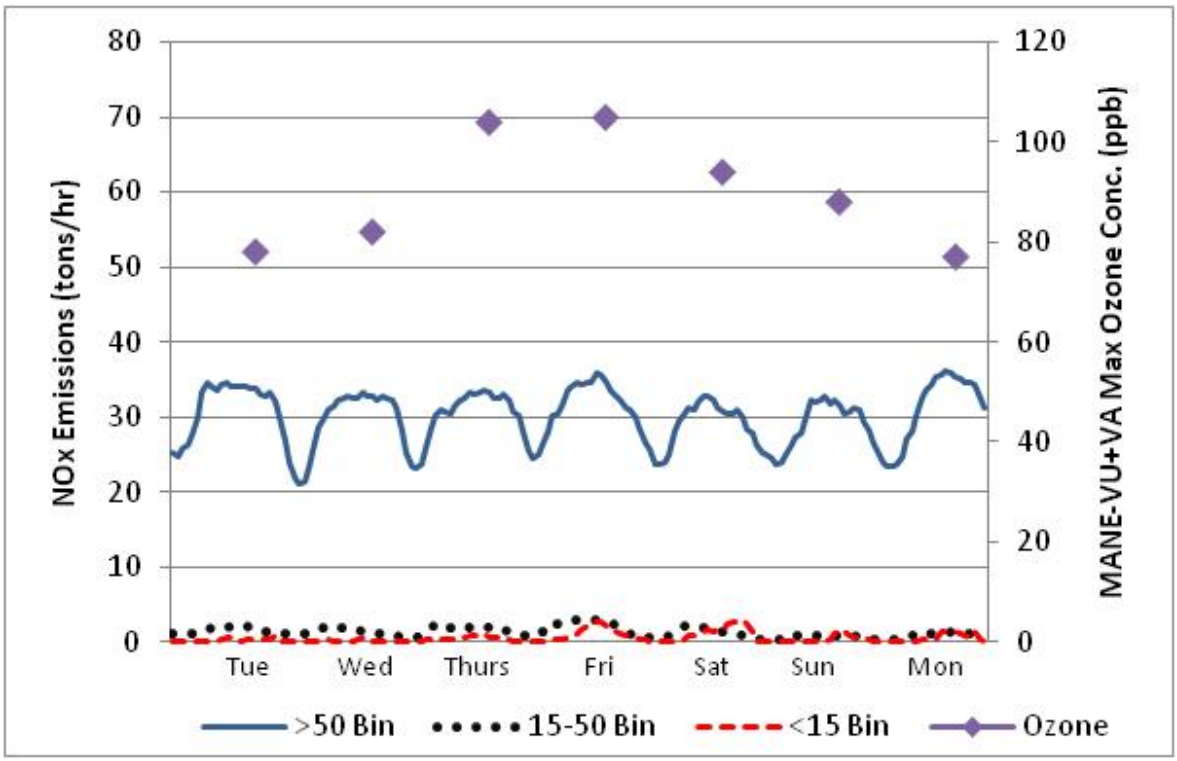



**Figure 9-1a.** MANE-VU+VA Hourly NOx Emissions by % Operating Time and MANE-VU+VA Daily Maximum 8-hour Concentration; May 22-28, 2007.

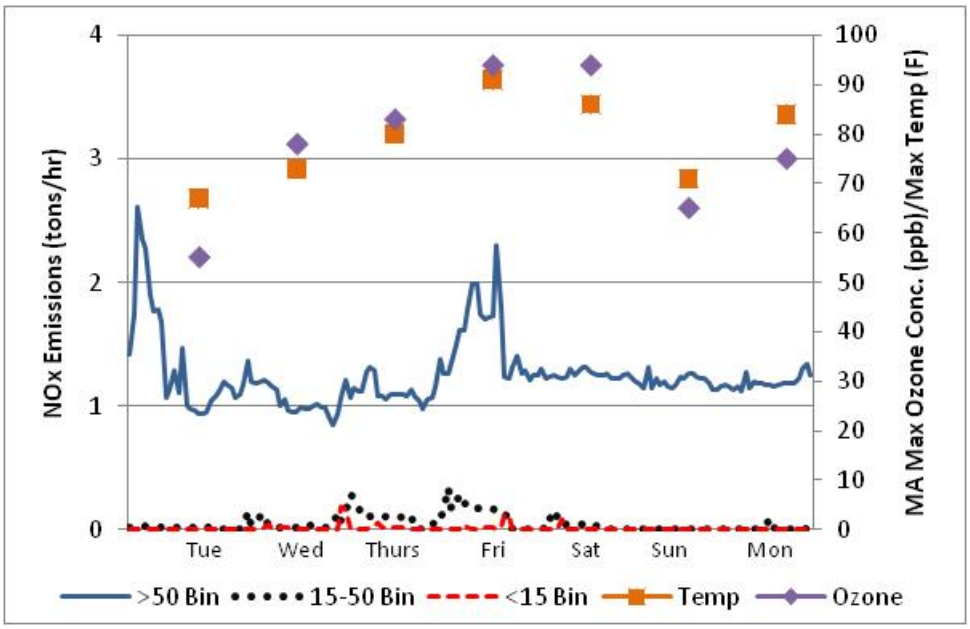



**Figure 9-1b.** Hourly NOx Emissions by % Operating Time and
MA Daily Max Temperature/8-hr Ozone Conc.; May 22-28, 2007.
CSA: Boston-Worcester-Manchester, MA-RI-NH

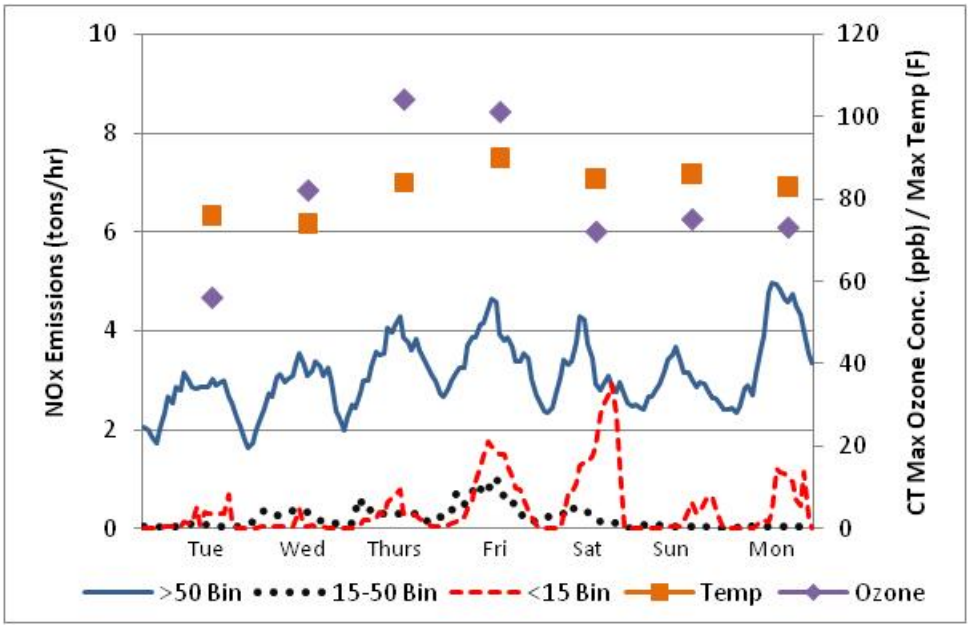



**Figure 9-1c.** Hourly NOx Emissions by % Operating Time and
CT Daily Max Temperature/8-hr Ozone Conc.; May 22-28, 2007.
CSA: New York-Newark-Bridgeport, NY-NJ-CT-PA

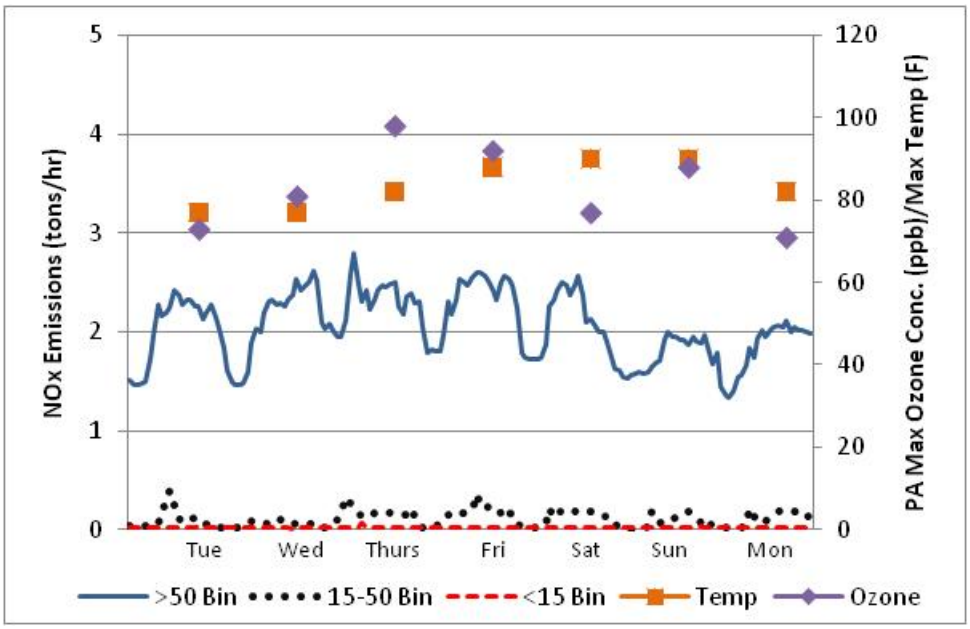



**Figure 9-1d.** Hourly NOx Emissions by % Operating Time and PA Daily Max Temperature/8-hr Ozone Conc.; May 22-28, 2007. CSA: Philadelphia-Camden-Wilmington, DE-MD-NJ-PA

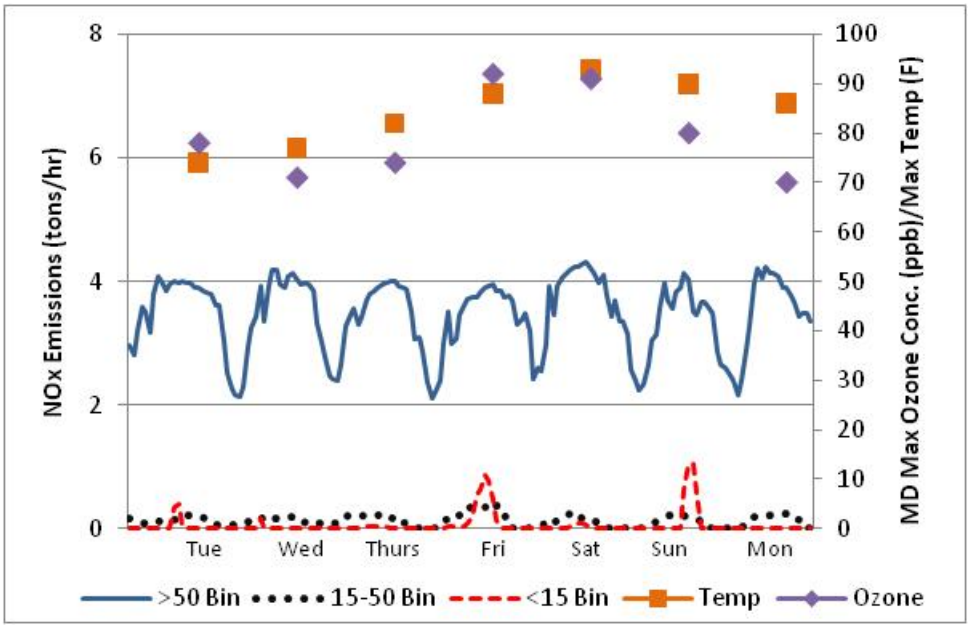



**Figure 9-1e.** Hourly NOx Emissions by % Operating Time and MD Daily Max Temperature/8-hr Ozone Conc.; May 22-28, 2007. CSA: Washington-Baltimore-Northern Virginia, DC-MD-VA-WV

June 24-30, 2007; OTC 8-hr maximum ozone concentration of 119 ppb

Table 9-2 provides the maximum 8-hour ozone concentration in each OTC State for each day during the period. On Tuesday, June 26, an 8-hour value of 119 ppb was recorded in Pennsylvania. Eleven of the MANE-VU+VA States exceeded the 75 ppb NAAQS on that day. Connecticut and New Jersey also recorded values above 100 ppb on June 26.

Figure 9-2a shows the hourly NOx emissions in the entire MANE-VU+VA region during the period from units in the three classification bins. On a region-wide basis, the relative contribution of emissions from units in the 15-50% and <15% bin varies significantly, from less than 1% of total hourly emissions to as high as 37 percent of total hourly emissions. On Wednesday, June 27, emissions from units in the 15-50% and <15% bin represent about 27 percent of the regional total NOx emissions from CAMD units.

The relative contribution of the emissions in each classification bin does vary by geographic region. Figures 9-2b to 9-2e show NOx emissions for the Boston, New York City, Philadelphia-Wilmington, and Baltimore-Washington metropolitan areas, respectively.

In the metro Boston CSA, the contribution from units in the 15-50% and <15% can be as high as 56 percent of total hourly emissions.

In the metro New York CSA, the emissions from units in the <15% bin at times exceed the emissions from the units in the >50% bin. Emissions from units in the <15% bin vary rapidly, rising from near zero in the overnight hours to as much as 9.5 tons/hour by early afternoon, then falling back to near zero by midnight.

In the Philadelphia and DC/Baltimore/Northern VA CSAs, the emissions from units in the <15% bin tend to be less important than in the New York Metro area. At times, however, the contribution from units in the 15-50% and <15% bins can be as high as 49 percent of total hourly emissions from CAMD units in the CSA.

**Table 9-2.** Ozone Daily Max Temperature/8-hr Ozone Conc. June 24-30, 2007

| | 6/24/07 Sun | 6/25/07 Mon | 6/26/07 Tue | 6/27/07 Wed | 6/28/07 Thu | 6/29/07 Fri | 6/30/07 Sat |
|---|---|---|---|---|---|---|---|
| **OTC Max (ppb)** | 73 | 95 | **119** | 102 | 89 | 54 | 69 |
| **# States> 75** | **0** | **7** | **11** | **10** | **6** | **0** | **0** |
| **ME** | 39 | 68 | 93 | 99 | 60 | 36 | 39 |
| **VT** | 38 | 64 | 71 | 59 | 41 | 36 | 31 |
| **NH** | 39 | 79 | 68 | 91 | 61 | 43 | 34 |
| **MA** | 57 | 90 | 86 | 96 | 78 | 43 | 59 |
| **RI** | 48 | 81 | 89 | 91 | 85 | 40 | 50 |
| **CT** | 53 | 95 | 111 | 101 | 89 | 45 | 54 |
| **NY** | 56 | 89 | 95 | 83 | 82 | 53 | 54 |
| **NJ** | 66 | 59 | 107 | 102 | 83 | 38 | 60 |
| **PA** | 67 | 81 | **119** | 83 | 77 | 54 | 64 |
| **DE** | 65 | 56 | 80 | 68 | 68 | 42 | 54 |
| **MD** | 73 | 80 | 91 | 92 | 73 | 43 | 62 |
| **DC** | 70 | 61 | 77 | 68 | 59 | 38 | 65 |
| **VA-OTC** | 69 | 73 | 81 | 81 | 63 | 39 | 69 |

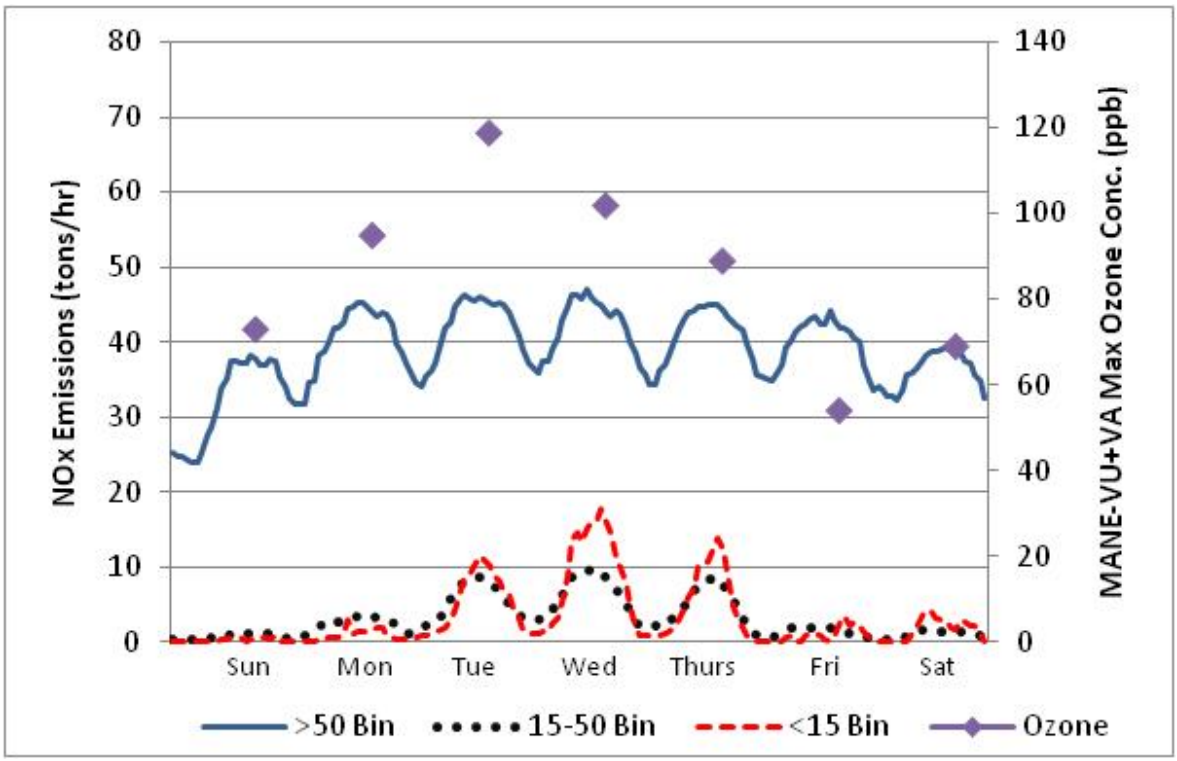



**Figure 9-2a.** MANE-VU+VA Hourly NOx Emissions by % Operating Time and MANE-VU+VA Daily Max Temperature/8-hr Ozone Conc.; June 24-30, 2007.

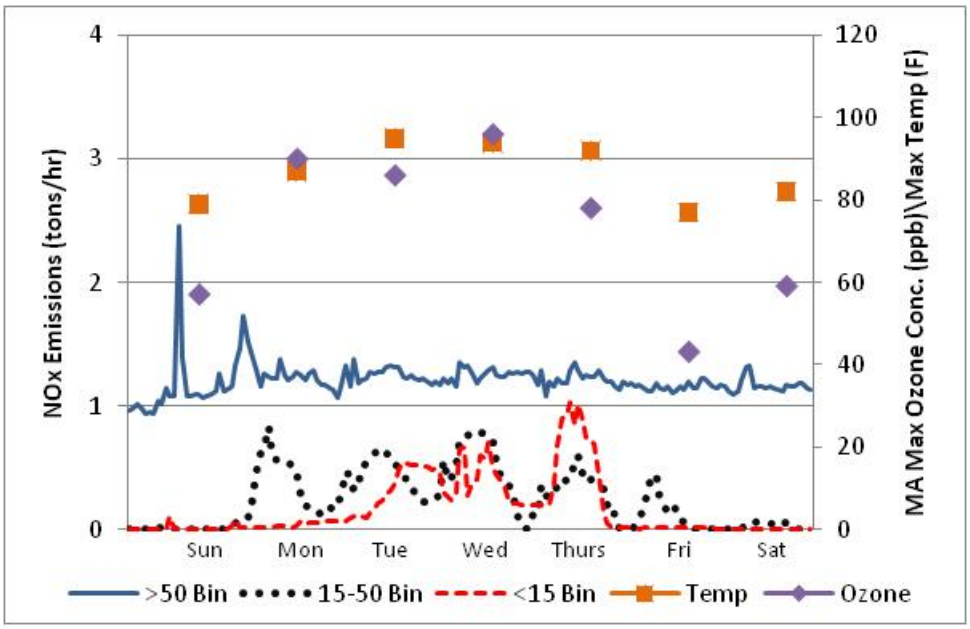



**Figure 9-2b.** Hourly NOx Emissions by % Operating Time and MA Daily Max Temperature/8-hr Ozone Conc.; June 24-30, 2007. CSA: Boston-Worcester-Manchester, MA-RI-NH

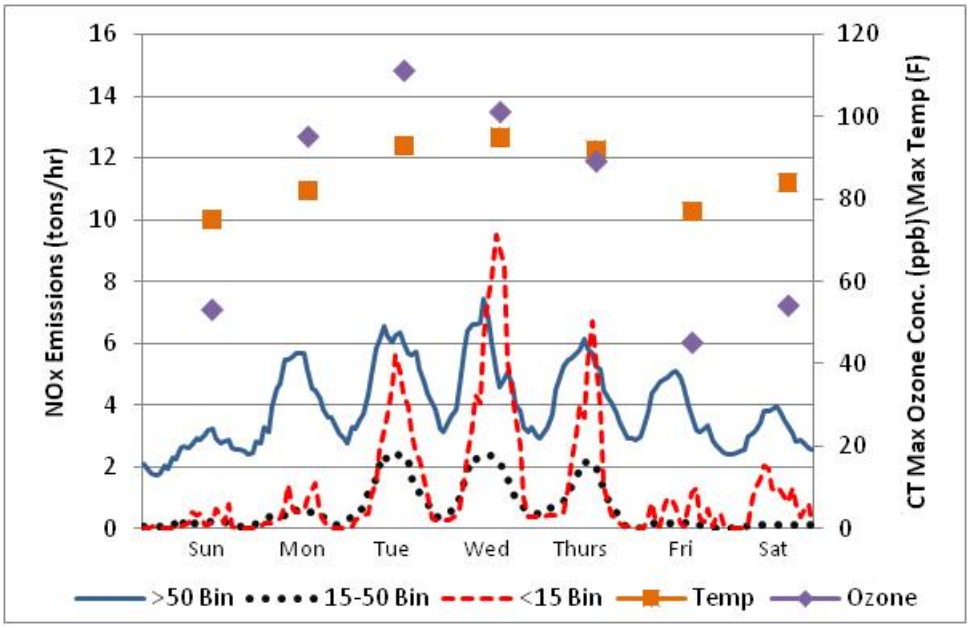



**Figure 9-2c.** Hourly NOx Emissions by % Operating Time and CT Daily Max Temperature/8-hr Ozone Conc.; June 24-30, 2007. CSA: New York-Newark-Bridgeport, NY-NJ-CT-PA

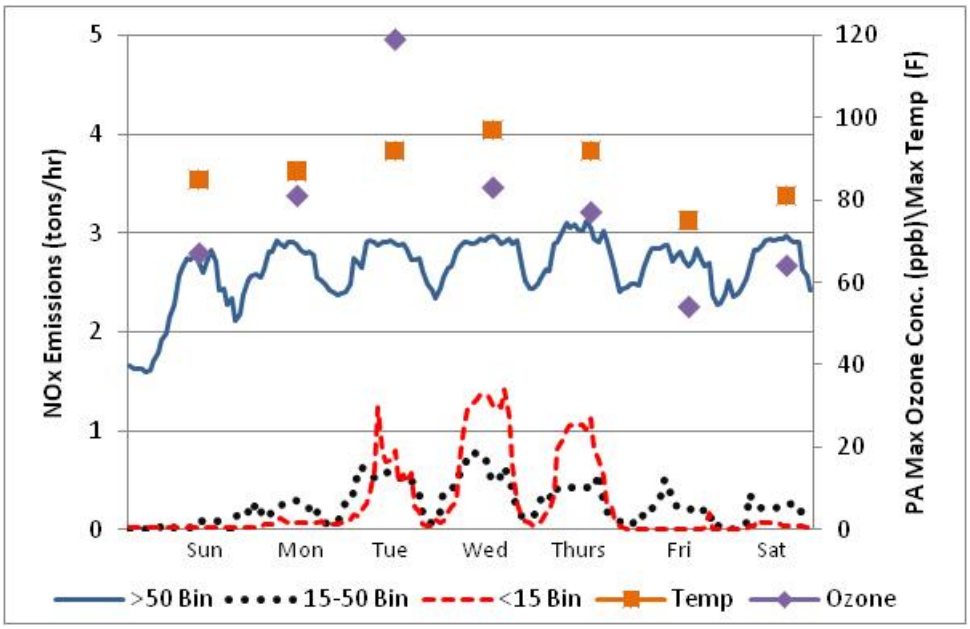



**Figure 9-2d.** Hourly NOx Emissions by % Operating Time and PA Daily Max Temperature/8-hr Ozone Conc.; June 24-30, 2007. CSA: Philadelphia-Camden-Wilmington, DE-MD-NJ-PA

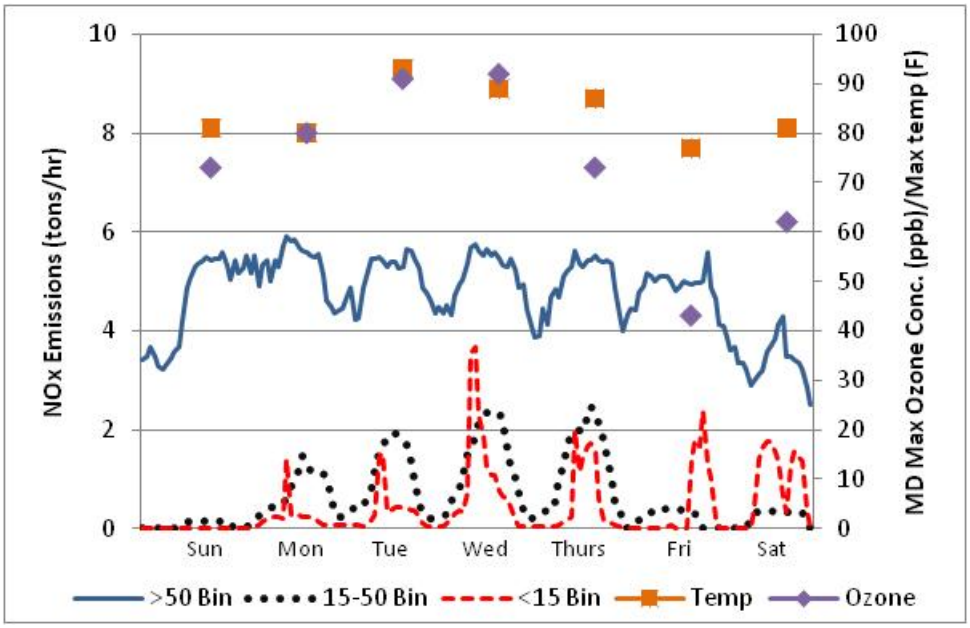



**Figure 9-2e.** Hourly NOx Emissions by % Operating Time and MD Daily Max Temperature/8-hr Ozone Conc.; June 24-30, 2007. CSA: Washington-Baltimore-Northern Virginia, DC-MD-VA-WV

July 6-12, 2007; OTC 8-hr maximum ozone concentration of 125 ppb

Table 9-3 provides the maximum 8-hour ozone concentration in each OTC State for each day during the period. On Monday, July 9, an 8-hour value of 125 ppb was recorded in Maryland. Nine of the MANE-VU+VA States exceeded the 75 ppb NAAQS on that day. Connecticut, Delaware, Massachusetts, New Jersey and Pennsylvania also recorded values above 100 ppb on July 9.

Figure 9-3a shows the hourly NOx emissions in the entire MANE-VU+VA region during the period from units in the three classification bins. On a region-wide basis, the relative contribution of emissions from units in the 15-50% and <15% bin varies significantly, from less than 1 percent of total hourly emissions to as high as 35 percent of total hourly emissions from CAMD units.

The relative contribution of the emissions in each of the classification bins does vary by geographic region. Figures 9-3b to 9-3e show NOx emissions for the Boston, New York City, Philadelphia-Wilmington, and Baltimore-Washington metropolitan areas, respectively.

In the metro Boston CSA, the emissions from the units in the <15% and 15-50% were small compared to the emissions from the 50% bin for this episode.

In the metro New York CSA, the emissions from units in the <15% bin at times exceed the emissions from the units in the >50% bin. Emissions from units in the <15% bin vary rapidly, rising from near zero in the overnight hours to as much as 8.8 tons/hour by early afternoon, then falling back to near zero by midnight. On both Monday and Tuesday, there were hourly periods where the emissions from units in the <15% bin exceeded the emissions from the units in the >50% bin.

In the Philadelphia and DC/Baltimore/Northern VA CSAs, the emissions from units in the <15% bin tend to be less important than in the New York Metro area. At times, however, the relative contribution of emissions from units in the 15-50% and <15% bins is about equal to the contribution from the >50% bin for certain hours of the day.

**Table 9-3.** Ozone Daily Max Temperature/8-hr Ozone Conc. July 6-12, 2007.

| | 7/6/07 Fri | 7/7/07 Sat | 7/8/07 Sun | 7/9/07 Mon | 7/10/07 Tue | 7/11/07 Wed | 7/12/07 Thu |
|---|---|---|---|---|---|---|---|
| **OTC Max (ppb)** | 71 | 81 | 94 | **125** | 109 | 83 | 65 |
| **# States> 75** | **0** | **2** | **8** | **9** | **8** | **1** | **0** |
| **ME** | 58 | 39 | 32 | 42 | 54 | 39 | 35 |
| **VT** | 38 | 36 | 48 | 43 | 69 | 64 | 36 |
| **NH** | 51 | 39 | 51 | 60 | 85 | 83 | 39 |
| **MA** | 63 | 68 | 83 | 112 | 109 | 49 | 55 |
| **RI** | 52 | 66 | 89 | 74 | 81 | 37 | 46 |
| **CT** | 53 | 71 | 94 | 123 | 98 | 46 | 49 |
| **NY** | 61 | 68 | 86 | 97 | 101 | 70 | 54 |
| **NJ** | 66 | 61 | 84 | 100 | 89 | 63 | 65 |
| **PA** | 63 | 70 | 79 | 121 | 90 | 58 | 55 |
| **DE** | 71 | 78 | 81 | 117 | 65 | 55 | 62 |
| **MD** | 70 | 81 | 91 | **125** | 76 | 69 | 59 |
| **DC** | 62 | 71 | 69 | 85 | 52 | 44 | 56 |
| **VA-OTC** | 63 | 69 | 68 | 89 | 70 | 50 | 56 |

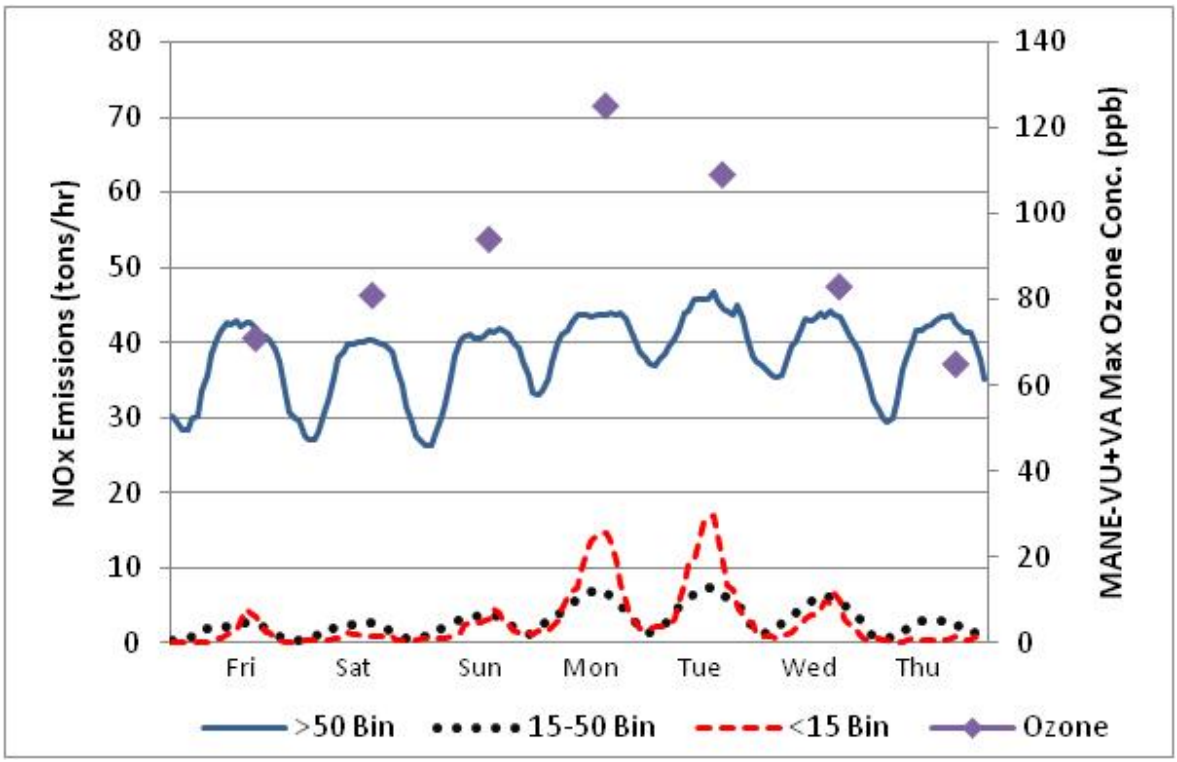



**Figure 9-3a.** MANE-VU+VA Hourly NOx Emissions by % Operating Time and MANE-VU+VA Daily Max Temperature/8-hr Ozone Conc.; July 6-12, 2007.

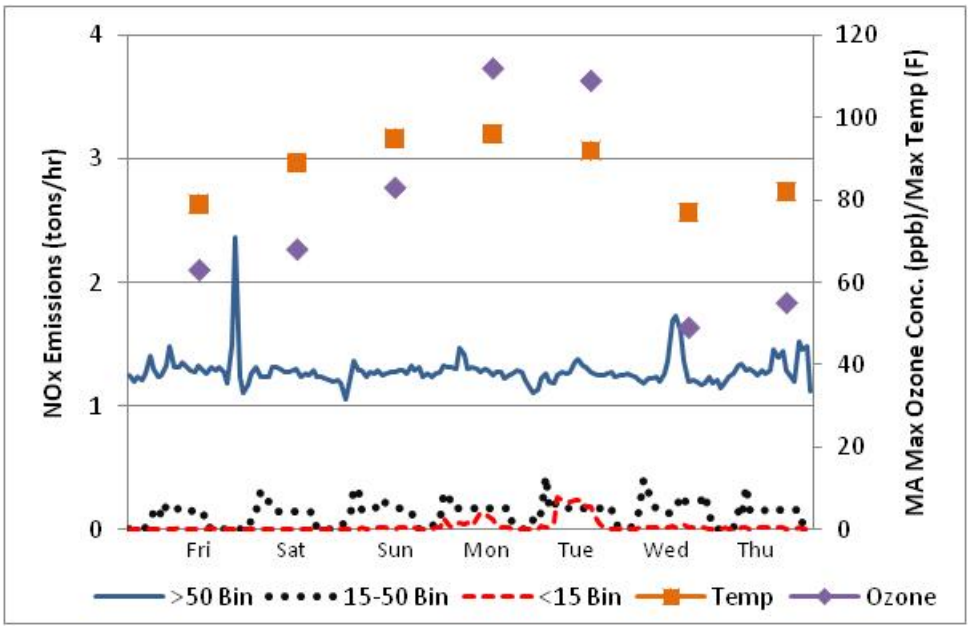



**Figure 9-3b.** Hourly NOx Emissions by % Operating Time and MA Daily Max Temperature/8-hr Ozone Conc.; July 6-12, 2007. CSA: Boston-Worcester-Manchester, MA-RI-NH

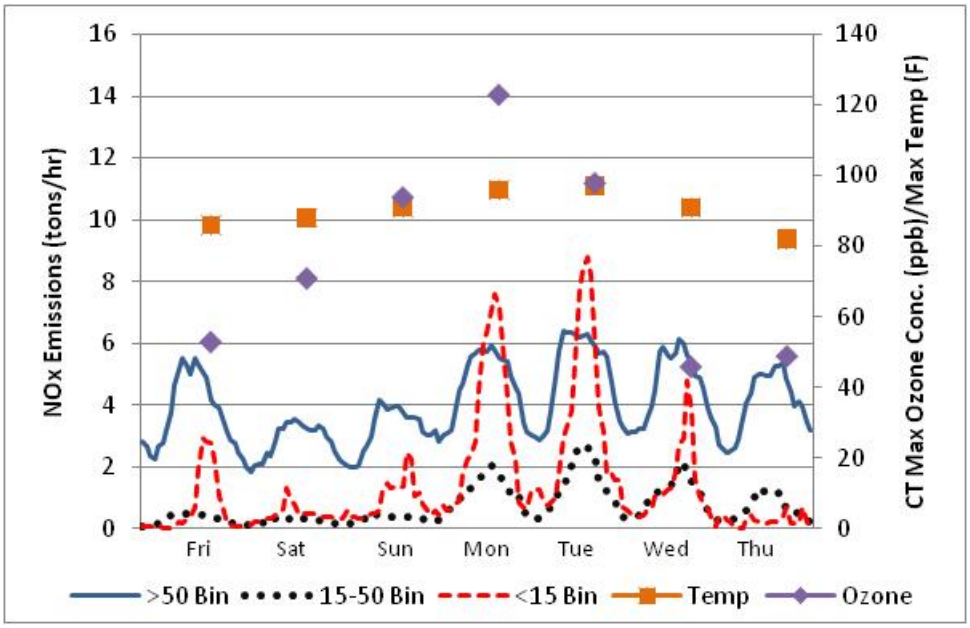



**Figure 9-3c.** Hourly NOx Emissions by % Operating Time and CT Daily Max Temperature/8-hr Ozone Conc.; July 6-12, 2007. CSA: New York-Newark-Bridgeport, NY-NJ-CT-PA CSA

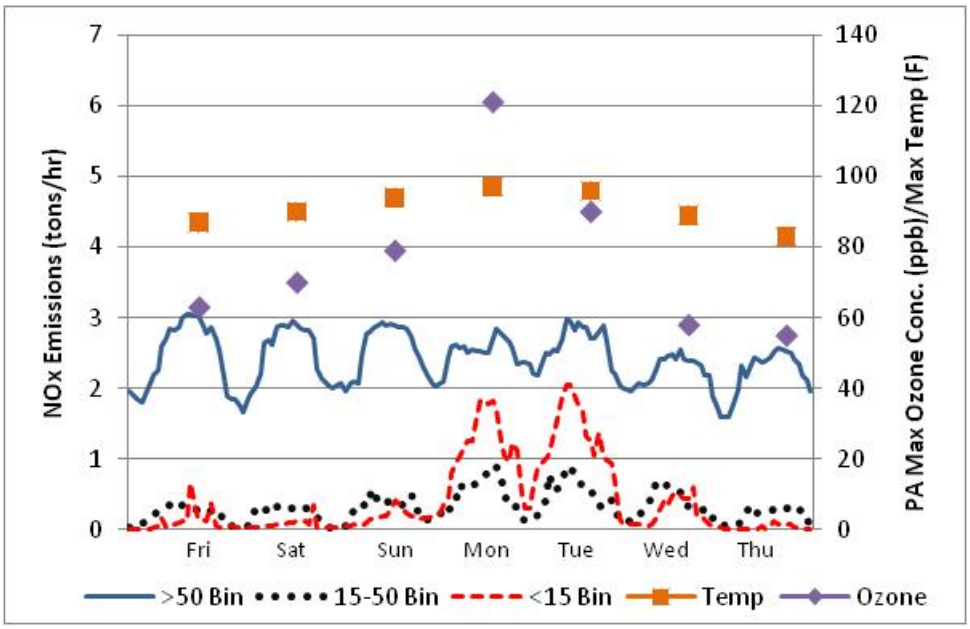



**Figure 9-3d.** Hourly NOx Emissions by % Operating Time and PA Daily Max Temperature/8-hr Ozone Conc.; July 6-12, 2007. CSA: Philadelphia-Camden-Wilmington, DE-MD-NJ-PA

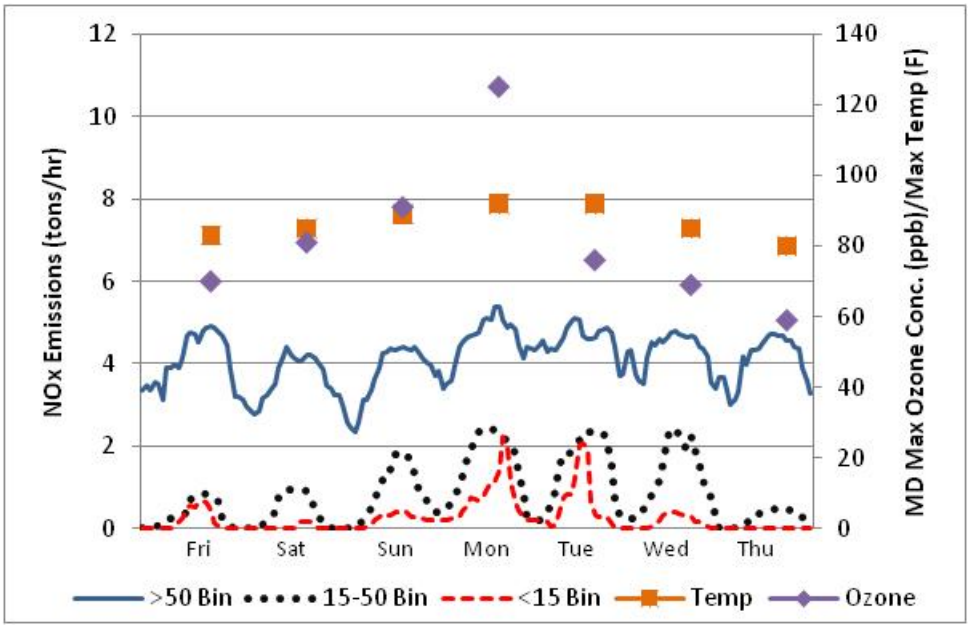



**Figure 9-3e.** Hourly NOx Emissions by % Operating Time and MD Daily Max Temperature/8-hr Ozone Conc.; July 6-12, 2007. CSA: Washington-Baltimore-Northern Virginia, DC-MD-VA-WV

July 31 – August 6, 2007; OTC 8-hr maximum ozone concentration of 118 ppb

Table 9-4 provides the maximum 8-hour ozone concentration in each OTC State for each day during the period. On Saturday, August 4, an 8-hour value of 118 ppb was recorded in Maryland. Nine of the MANE-VU+VA States exceeded the 75 ppb NAAQS on that day. Connecticut and New Jersey also recorded values above 100 ppb on July 9.

Figure 9-4a shows the hourly NOx emissions in the entire MANE-VU+VA region during the period from units in the three classification bins. On a region-wide basis, the relative contribution of emissions from units in the 15-50% and <15% bin varies significantly, from less than 1 percent to as high as 38 percent of total hourly emissions from CAMD units.

The relative contribution of the emissions in each of the classification bins does vary by geographic region. Figures 9-4b to 9-4e show NOx emissions for the Boston, New York City, Philadelphia-Wilmington, and Baltimore-Washington metropolitan areas, respectively.

In the metro New York CSA, there were some unexplained rapid variations in NOx emissions from units in the >50% bin. The large spikes in the hourly NOx emissions from units in the >50% bin are caused by a single unit – the Charles Poletti diesel oil-fired dry-bottom wall-fired boiler (ORIS 2491). On August 1, for example, NOx emissions in hour 9 were reported as 1.2 tons in the CAMD database, spiked to 5.4 tons in hour 10, dropped back to 0.8 tons in hour 11, and spiked again to 5.3 tons in hour 12. It is not known if these spikes are real or if it is a data quality issue. Excluding these spikes, the pattern for the >50% units is similar to the other episodes examined previously, there are times when the emissions from units in the <15% bin exceed the emissions from the units in the >50% operating time bin. Emissions from units in the <15% bin vary rapidly, rising from near zero in the overnight hours to as much as 8.7 tons/hour by early afternoon, then falling back to near zero by midnight.

In the metro Philadelphia CSA, the hourly emissions from the units in the <15% bin are important on August 2 and 3. The relative contribution of emissions from units in the 15-50% and <15% bins can be as high as 51 percent of total hourly emissions from CAMD units in the CSA.

In the DC/Baltimore/Northern VA CSA, the relative contribution of emissions from units in the 15-50% and <15% bins can be as high as 51 percent of total hourly emissions from CAMD units.

**Table 9-4.** Ozone Daily Maximum 8-hour Concentrations July 31-August 6, 2007.

| | 7/31/07 Tue | 8/1/07 Wed | 8/2/07 Thu | 8/3/07 Fri | 8/4/07 Sat | 8/5/07 Sun | 8/6/07 Mon |
|---|---|---|---|---|---|---|---|
| **OTC Max (ppb)** | 84 | 96 | 104 | 0.107 | **118** | 82 | 85 |
| **# States> 75** | **5** | **7** | **12** | **11** | **9** | **2** | **1** |
| **ME** | 55 | 37 | 78 | 94 | 58 | 34 | 42 |
| **VT** | 35 | 34 | 48 | 64 | 45 | 37 | 41 |
| **NH** | 55 | 41 | 77 | 97 | 68 | 45 | 53 |
| **MA** | 60 | 52 | 82 | 103 | 68 | 47 | 60 |
| **RI** | 70 | 60 | 83 | 88 | 78 | 50 | 60 |
| **CT** | 75 | 82 | 93 | 107 | 101 | 53 | 62 |
| **NY** | 77 | 91 | 95 | 86 | 96 | 58 | 66 |
| **NJ** | 84 | 88 | 102 | 98 | 103 | 66 | 70 |
| **PA** | 75 | 83 | 104 | 86 | 85 | 71 | 68 |
| **DE** | 80 | 81 | 88 | 73 | 81 | 56 | 67 |
| **MD** | 82 | 96 | 103 | 83 | **118** | 79 | 85 |
| **DC** | 65 | 75 | 78 | 83 | 89 | 69 | 61 |
| **VA-OTC** | 77 | 85 | 91 | 78 | 88 | 82 | 67 |

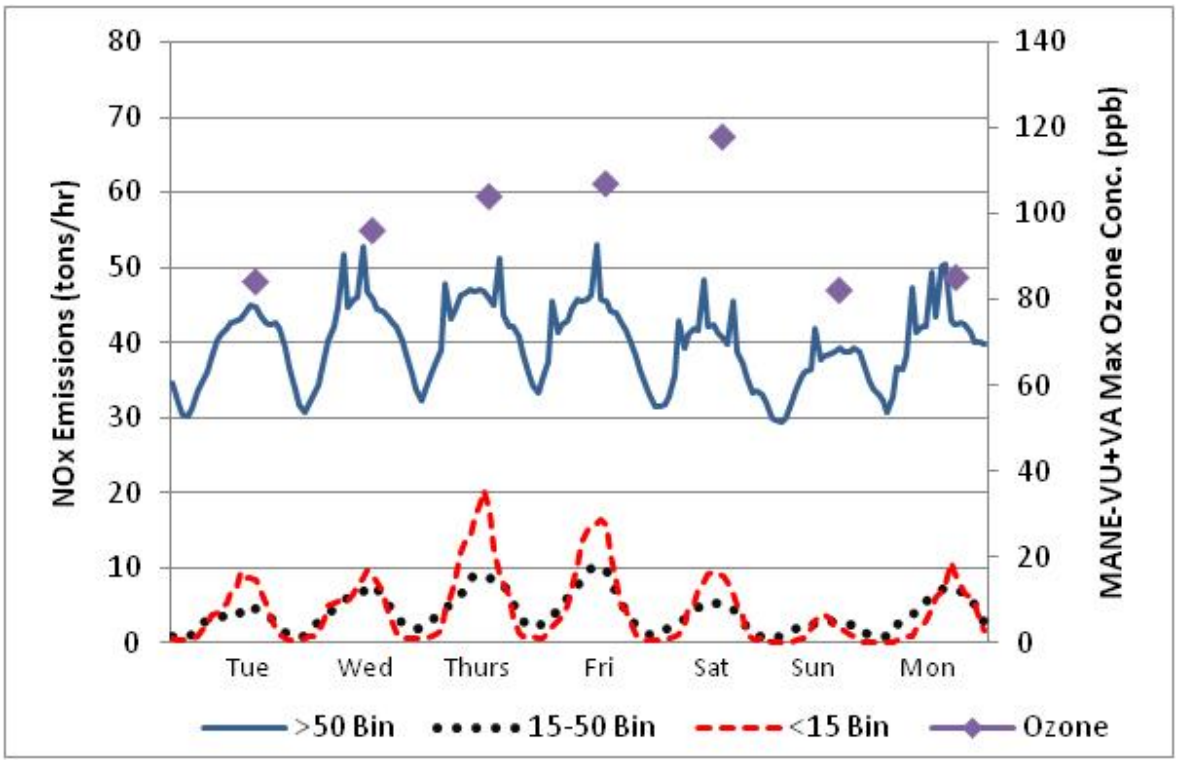



**Figure 9-4a.** MANE-VU+VA Hourly NOx Emissions by % Operating Time and MANE-VU+VA Daily Maximum 8-hour Concentration; July 31-August 6, 2007.

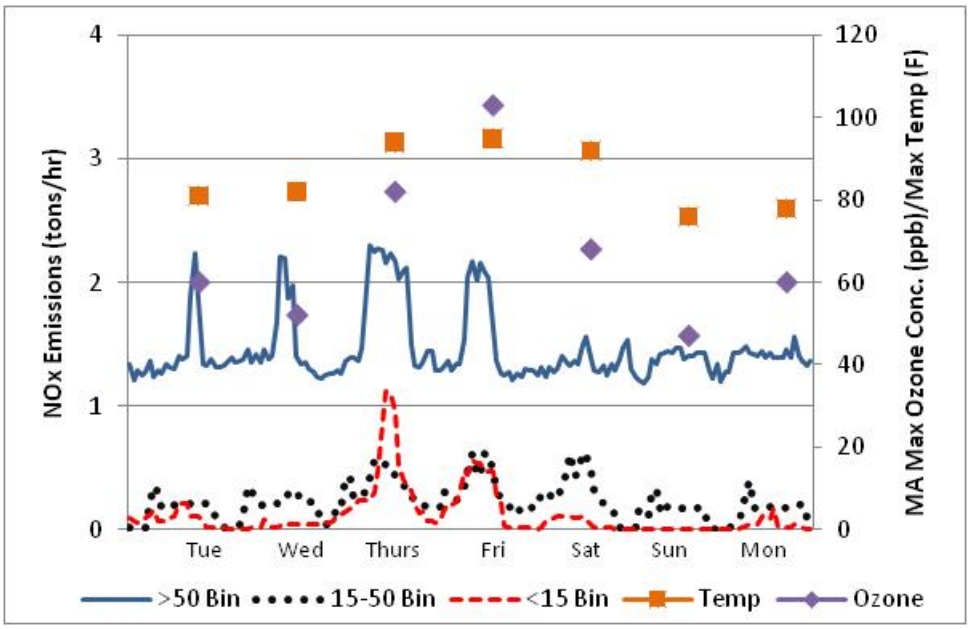



**Figure 9-4b.** Hourly NOx Emissions by % Operating Time and
MA Daily Max Temperature/8-hr Ozone Conc.; July 31-August 6, 2007.
CSA: Boston-Worcester-Manchester, MA-RI-NH

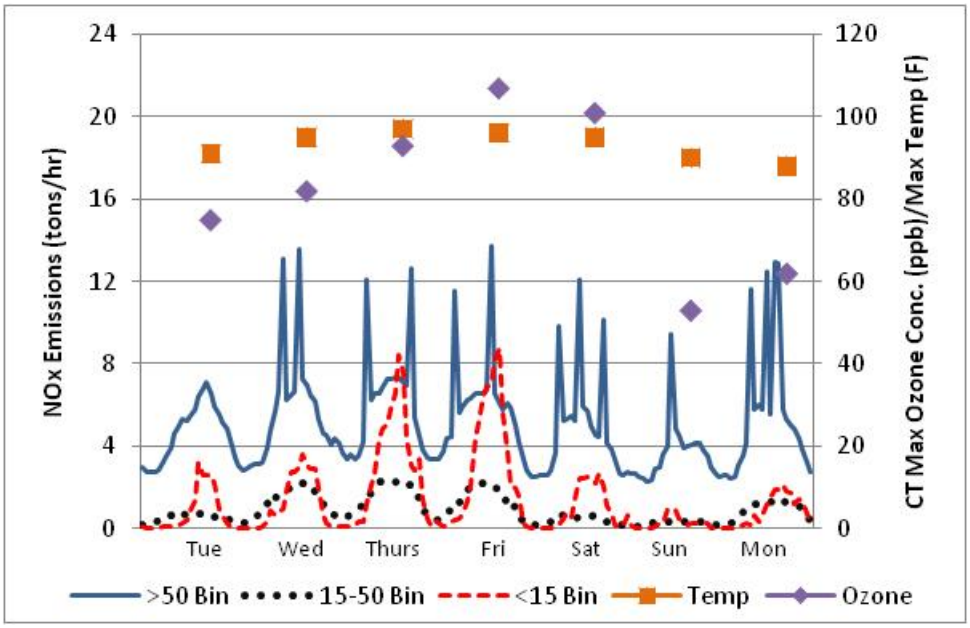



**Figure 9-4c.** Hourly NOx Emissions by % Operating Time and
CT Daily Max Temperature/8-hr Ozone Conc.; July 31-August 6, 2007.
CSA: New York-Newark-Bridgeport, NY-NJ-CT-PA CSA

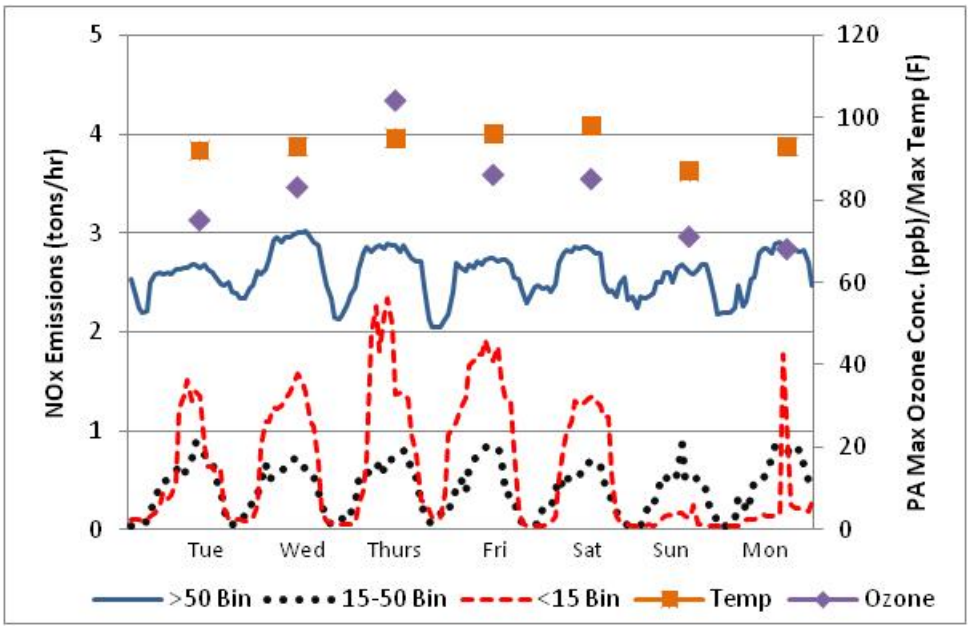



**Figure 9-4d.** Hourly NOx Emissions by % Operating Time and
PA Daily Max Temperature/8-hr Ozone Conc.; July 31-August 6, 2007.
CSA: Philadelphia-Camden-Wilmington, DE-MD-NJ-PA

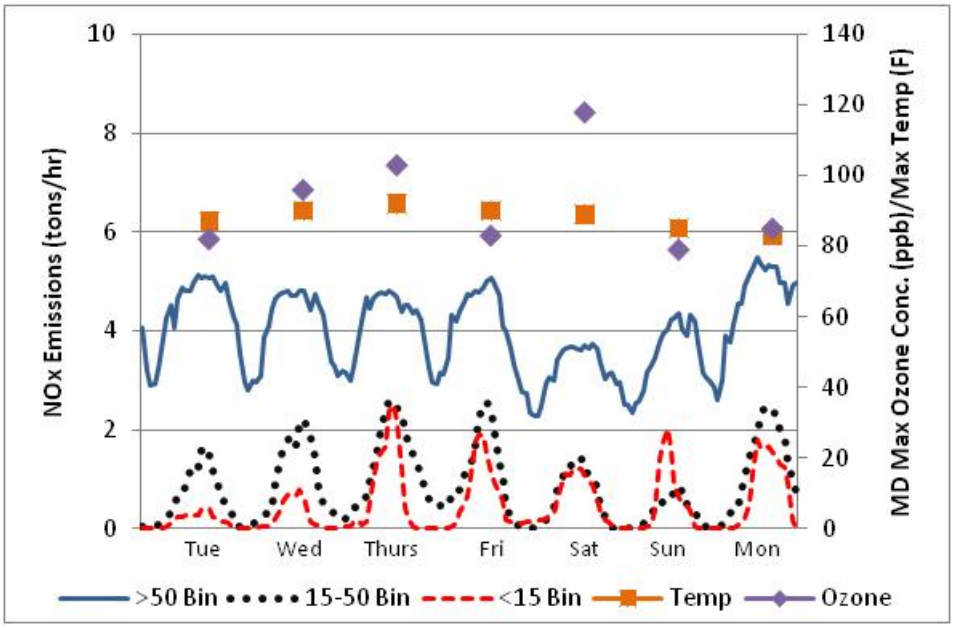



**Figure 9-4e.** Hourly NOx Emissions by % Operating Time and
MD Daily Max Temperature/8-hr Ozone Conc.; July 31-August 6, 2007.
CSA: Washington-Baltimore-Northern Virginia, DC-MD-VA-WV

## 10 Emission Comparison 2005-2008

***How variable are emissions from 2005, 2006, 2007, 2008 for these units? Are emissions in 2007 generally similar to emissions in other years? What sorts of differences stand out, if any? Are there units that were not operating in 2007 that were operating in other years? On what time frames could this analysis be performed?***

Using CAMD annually reported CEM data for calendar years 2005, 2006, 2007 and 2008, we compared NOx, $SO_2$ and heat input values to determine variances in year-to-year activity from CEM reporting units. Generally, on a regional and State basis, emissions and heat input for 2007 were in expected ranges compared to 2005 through 2008. While heat input in 2007 was typically higher in each of the three easternmost RPOs compared to 2005/06 and 2008, NOx emissions showed downward trends in each of the regions from 2005 through 2008 as the result of implementation of controls associated with the NBP, CAIR and other consent decree agreements. For VISTAS and MRPO, $SO_2$ also showed this downward trend from 2005 through 2008. In MANE-VU, however, $SO_2$ emissions increased in 2007 consistent with the increase in heat input during that time. These RPO level trends can be seen in Figures 10-1, 10-2 and 10-3 below.

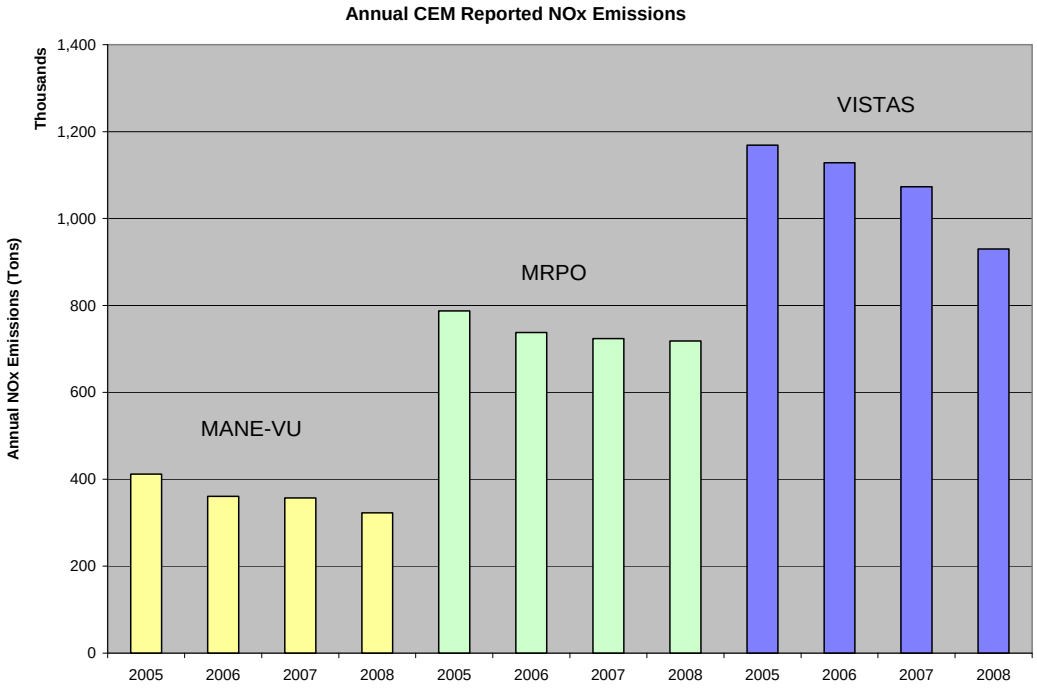



**Figure 10-1.** Annual CEM Reported NOx Emissions.

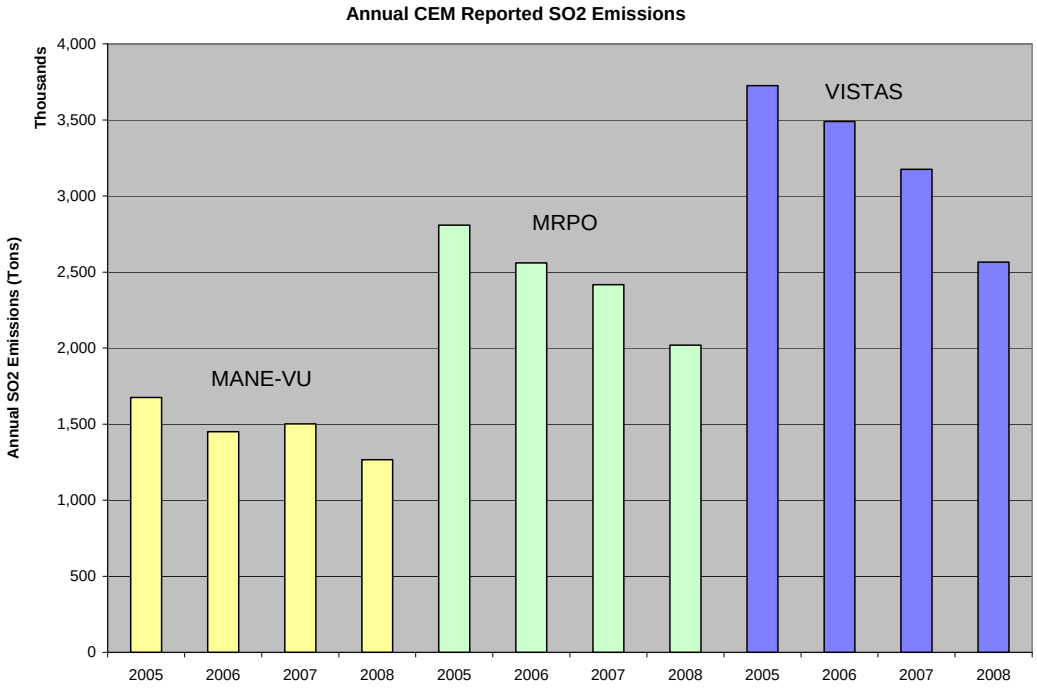



**Figure 10-2.** Annual CEM Reported $SO_2$ Emissions.

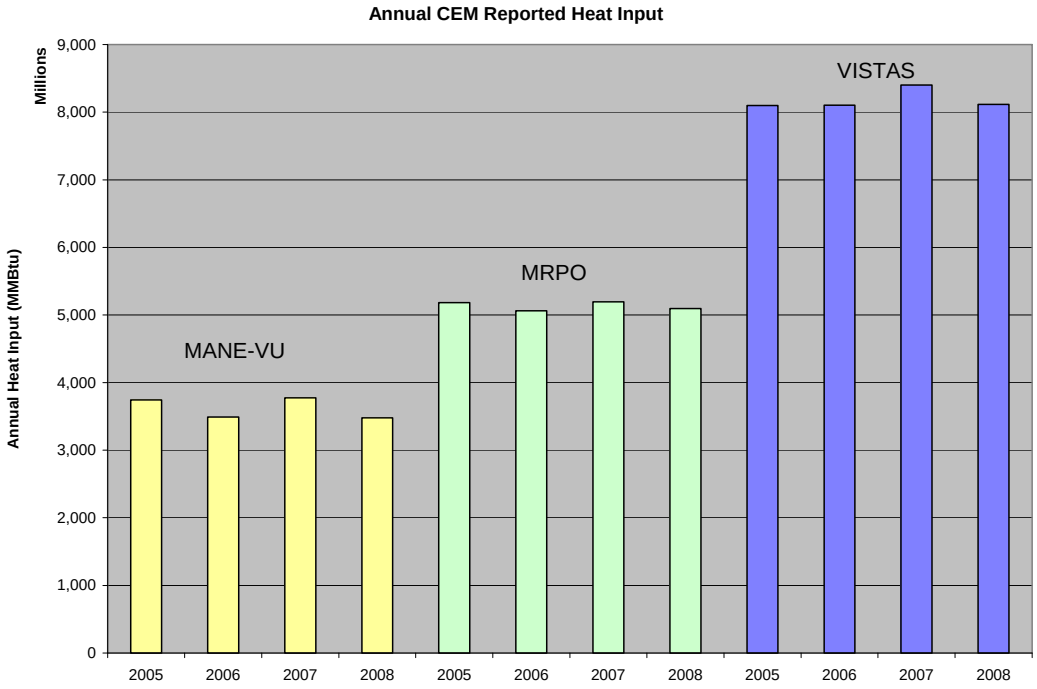



**Figure 10-3.** Annual CEM Reported Heat Input.

In the MANE-VU States, 2007 reported heat input was high compared to either 2006 or 2008. Reported NOx and $SO_2$ emissions for 2007 varied from State to State when compared to 2006 or 2008 reported values. These values can be seen in Tables 10-1, 10-2 and 10-3 below. Years with the highest annual reported value are highlighted. Graphical representation of these same State level values can be seen in Figures 10-5, 10-6 and 10-7 below.

| | NOx (Tons) | | | |
|---|---|---|---|---|
| **State** | **2005** | **2006** | **2007** | **2008** |
| CT | 7,059 | 5,366 | 4,927 | 4,130 |
| DC | 427 | 210 | 246 | 274 |
| DE | 14,572 | 11,996 | 13,105 | 11,545 |
| MA | 22,464 | 13,412 | 11,207 | 9,999 |
| MD | 65,141 | 57,927 | 54,553 | 40,327 |
| ME | 1,235 | 536 | 760 | 680 |
| NH | 8,778 | 7,261 | 4,752 | 4,650 |
| NJ | 30,148 | 22,659 | 17,377 | 15,399 |
| NY | 78,775 | 58,034 | 58,569 | 47,418 |
| PA | 182,676 | 182,435 | 190,352 | 187,519 |
| RI | 469 | 401 | 487 | 462 |
| VA | 64,502 | 56,036 | 60,302 | 50,887 |
| VT | 297 | 343 | 377 | 296 |

**Table 10-1.** Annual CEM Reported NOx Emissions [highest value highlighted].

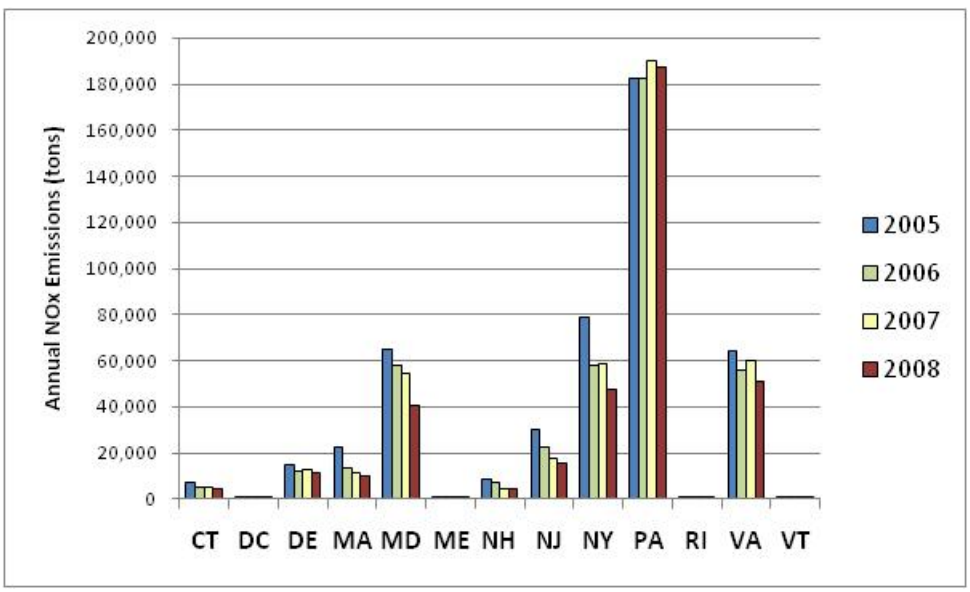



**Figure 10-4.** Annual CEM Reported NOx Emissions.

| | $SO_2$ (Tons) | | | |
|---|---|---|---|---|
| **State** | **2005** | **2006** | **2007** | **2008** |
| CT | 7,523 | 4,871 | 4,782 | 3,955 |
| DC | 834 | 311 | 316 | 212 |
| DE | 30,580 | 28,762 | 32,813 | 31,808 |
| MA | 81,864 | 50,984 | 53,863 | 46,347 |
| MD | 281,753 | 276,271 | 272,879 | 227,198 |
| ME | 3,886 | 323 | 1,671 | 1,041 |
| NH | 51,400 | 40,293 | 42,520 | 36,895 |
| NJ | 54,054 | 46,054 | 34,189 | 21,204 |
| NY | 177,349 | 108,686 | 107,210 | 65,427 |
| PA | 985,508 | 894,193 | 951,186 | 831,915 |
| RI | 14 | 11 | 13 | 18 |
| VA | 207,748 | 171,943 | 172,685 | 125,985 |
| VT | 10 | 12 | 6 | 2 |

**Table 10-2.** Annual CEM Reported $SO_2$ Emissions [highest value highlighted].

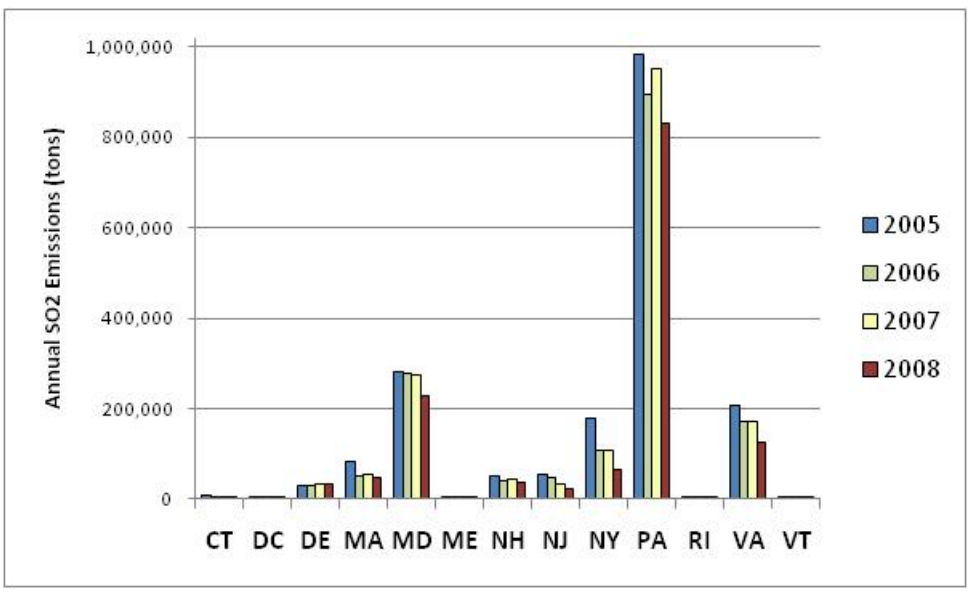



**Figure 10-5.** Annual CEM Reported $SO_2$ Emissions.

| | Heat Input (MMBtu) | | | |
|---|---|---|---|---|
| **State** | **2005** | **2006** | **2007** | **2008** |
| CT | 148,447,375 | 144,543,799 | 135,944,707 | 118,848,911 |
| DC | 4,035,158 | 2,219,268 | 2,699,277 | 2,198,756 |
| DE | 133,138,765 | 141,730,218 | 284,223,927 | 210,439,749 |
| MA | 352,210,946 | 317,040,769 | 339,747,783 | 286,094,379 |
| MD | 345,958,119 | 308,272,478 | 318,768,319 | 288,937,676 |
| ME | 73,688,819 | 57,637,773 | 58,282,287 | 61,863,689 |
| NH | 111,357,385 | 92,833,567 | 94,792,321 | 96,387,737 |
| NJ | 307,853,613 | 287,055,753 | 308,214,052 | 308,985,360 |
| NY | 832,493,418 | 727,663,648 | 750,232,478 | 667,156,750 |
| PA | 1,383,880,400 | 1,362,379,583 | 1,424,333,313 | 1,378,766,983 |
| RI | 48,407,975 | 44,387,053 | 53,455,848 | 55,392,442 |
| VA | 481,176,129 | 419,256,021 | 473,992,803 | 445,542,787 |
| VT | 3,569,808 | 4,266,215 | 4,503,086 | 4,214,041 |

**Table 10-3.** Annual CEM Reported Heat Input [highest value highlighted].

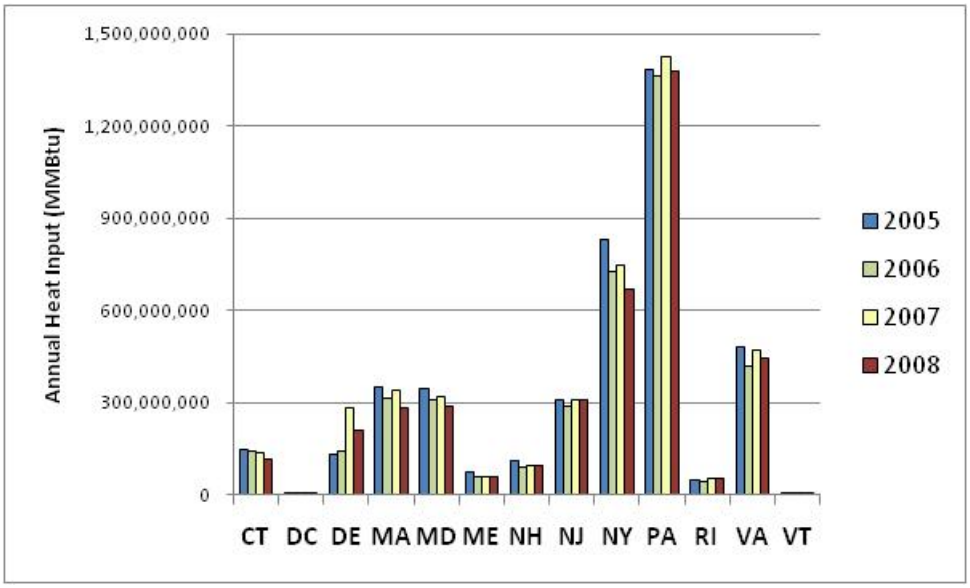



**Figure 10-6.** Annual CEM Reported Heat Input.

While there were a handful of units outside of the MANE-VU State domain where operation occurred in 2007 but not in 2005, 2006 or 2008, there were no units identified within the MANE-VU State domain that meet this constraint. Additionally, no units were identified which were not in operation in 2007, yet operated in 2005, 2006 or 2008 within the MANE-VU domain.

On a unit-by-unit basis, we reviewed the annual NOx and heat input data and compared 2007 values to the average 2005-2008 values for the same variable. In the following Figures, values reported >100% represent units where the 2007 value was greater than the average of 2005-2008 for that unit and variable. Many units are not required to report $SO_2$ emissions, so similar analysis for $SO_2$ was not made.

The box and whisker plots shown in the Figures below display the distribution of CEM reported data by State. In Figure 10-7, the distribution of 2007 CEM reported NOx emissions relative to the average annual CEM reported NOx emissions for 2005 through 2008 is shown along with the number of CEM reporting units within each State (noted at the top of the chart).

Each data set is divided into four equal parts. The middle two quartiles represent half of all units and are bounded by the white rectangle, each showing the comparison ratio of 2007 values to averaged 2005-2008 values.

The line above the top of each rectangle shows the range of the fourth or top quartile of data. The line below the bottom of the rectangle shows the range of the first or lowest quartile. The red triangle shows the median ratio of 2007 to averaged 2005-2008 NOx emissions or middle observation in the dataset. This median is not the average of the ratios within the group, but is the observation where half of the calculated ratios are greater and half the calculated ratios are lower. Finally, the green “x” and the purple square represent the maximum and minimum ratios for the data set, respectively.

In cases where the majority of the white rectangle is above the 100% line, the majority of units reporting CEMs data within that State have a higher NOx emission value in 2007 than the average of NOx emissions from 2005 through 2008. This can be seen in Pennsylvania, Rhode Island and Vermont and is confirmed with comparisons to Table 10-1 and Figure 10-4 above. States which show a minimum value of 0% in the two following figures reflect CEM reporting units which are shutdown or mothballed during the periods of this analysis. In these cases, 2005, 2006, 2007 and 2008 values are all reported as zero.

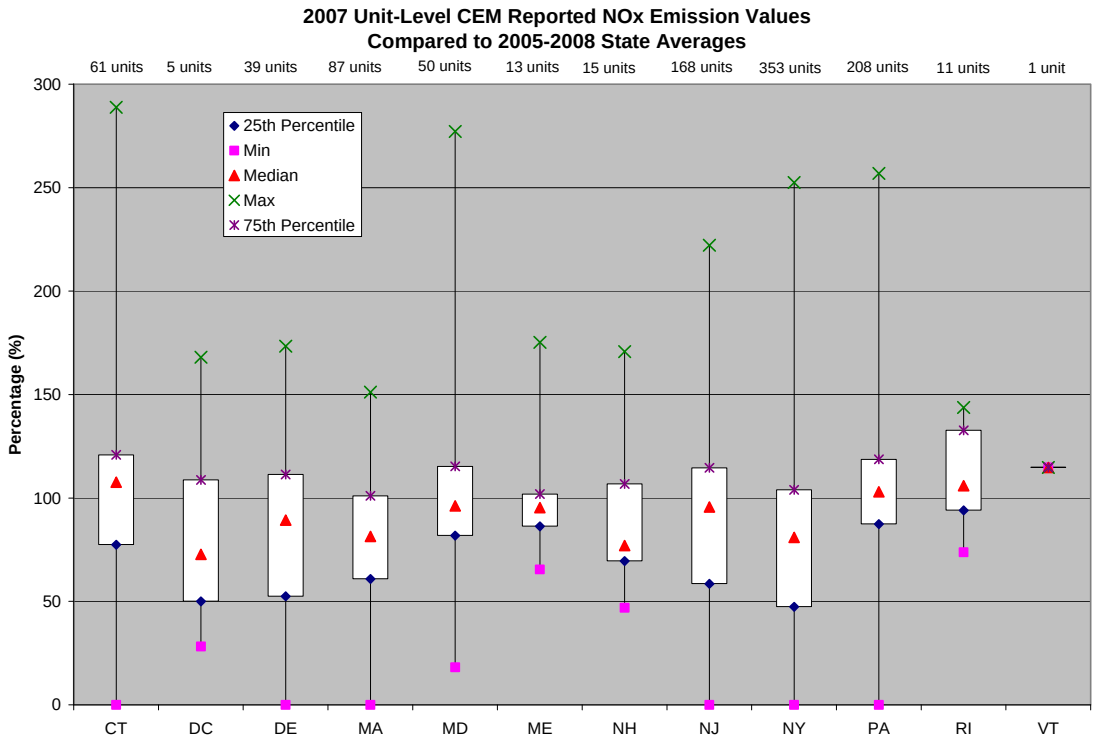



**Figure 10-7.** Box and whisker plot of 2007 NOx emissions relative to 2005-2008 averages.

Figure 10-8 presents the same box and whisker plot using heat input as the variable of analysis. As can be seen in this Figure (and confirmed in Table 10-3 and Figure 10-6), 2007 CEM reported heat input in Delaware, Pennsylvania and Vermont all exceed 2005-2008 averages for this variable.

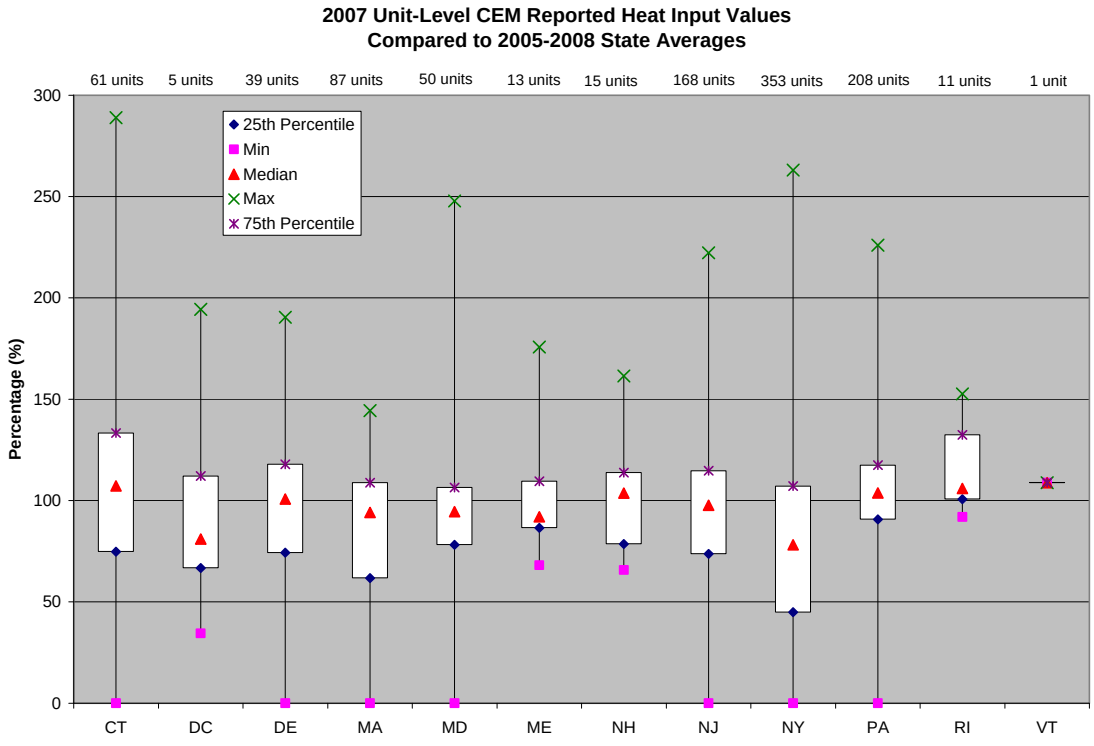



**Figure 10-8.** Box and whisker plot of 2007 heat input relative to 2005-2008 averages.

## 11 Emissions by Urban/Rural Classification

***Are emissions in urban areas (CSA's) much different from non urban areas?***

Figure 11-1 shows the geographic location of units included in this analysis, along with a graphical representation of the 2007 annual NOx emissions. Figures 11-2 to 11-4 shows the locations of the units in the >50%, 15-50%, and <15% bins, respectively.

Units in the CAMD database for calendar year 2007 were assigned to geographic areas based on the following definitions currently used by the U.S. Census Bureau:

- Core Based Statistical Areas (CBSAs) is a term that became effective in 2000 and is a collective term for both metro and micro areas:
  - A metro statistical area contains a core urban area of 50,000 or more population,
  - A micro statistical area contains an urban core of at least 10,000 (but less than 50,000) population;
- Combined Statistical Areas (CSAs) represent multiple metropolitan or micropolitan areas that have a moderate degree of employment interchange. CSAs often represent regions with overlapping labor and media markets.

Each metro or micro area consists of one or more counties (or county equivalents) and includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core. A complete list of CBSAs/CSAs is provided in Appendix A.

Table 11-1 summarizes annual NOx and $SO_2$ emissions from CAMD units using the above definitions of metropolitan areas. Figure 11-5 summarizes the same information graphically. About 56 percent of the 2007 NOx emissions from CAMD reporting units in the MANEVU+VA region were emitted in CSAs. About 55 percent of the $SO_2$ emissions were emitted in CSAs. CSAs are generally the large urban areas in the region. About 14 percent of both the NOx and $SO_2$ emissions were emitted in CBSA-metro areas, generally smaller urban areas in the region. The remaining 30 percent of the NOx and 31 percent of the $SO_2$ was emitting in areas more rural in nature.

Figure 11-6 compares the NOx emissions emitted along the I-95 corridor (from Portland ME to northern Virginia) to other geographic areas in the Northeast / Mid-Atlantic regions. About 31 percent of the annual NOx in 2007 was emitted in the I-95 corridor. About 25 percent was emitted in other CSAs not in the I-95 corridor such as Albany, Pittsburgh, and York. Figure 11-7 compares the $SO_2$ emissions along the I-95 corridor to other areas. About 27 percent of the $SO_2$ in 2007 was emitted in the I-95 corridor. Another 27 percent was emitted in other CSAs not in the I-95 corridor.

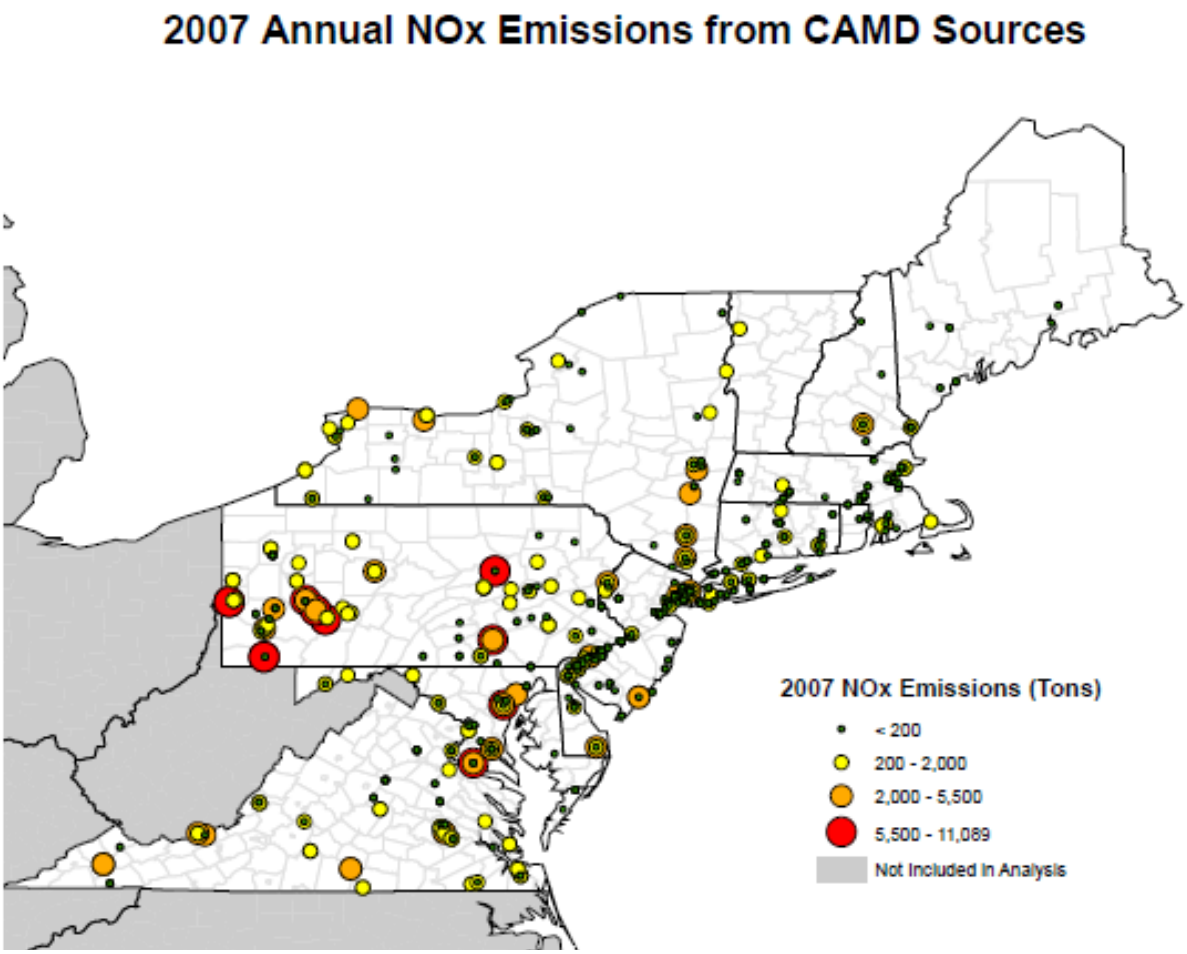



**Figure 11-1.** Geographic Location of All CAMD Reporting Units.

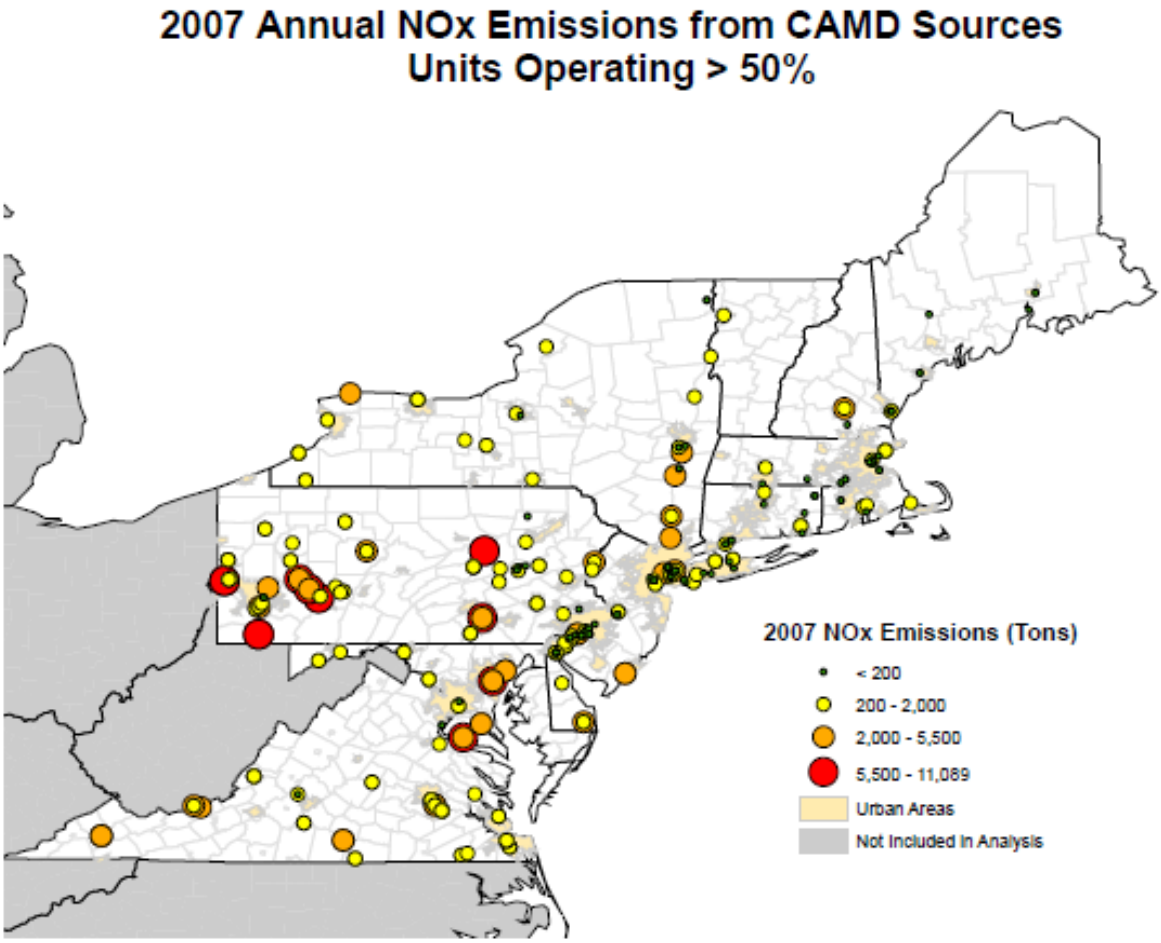



**Figure 11- 2.** Geographic Location of CAMD Units in the >50% Bin.

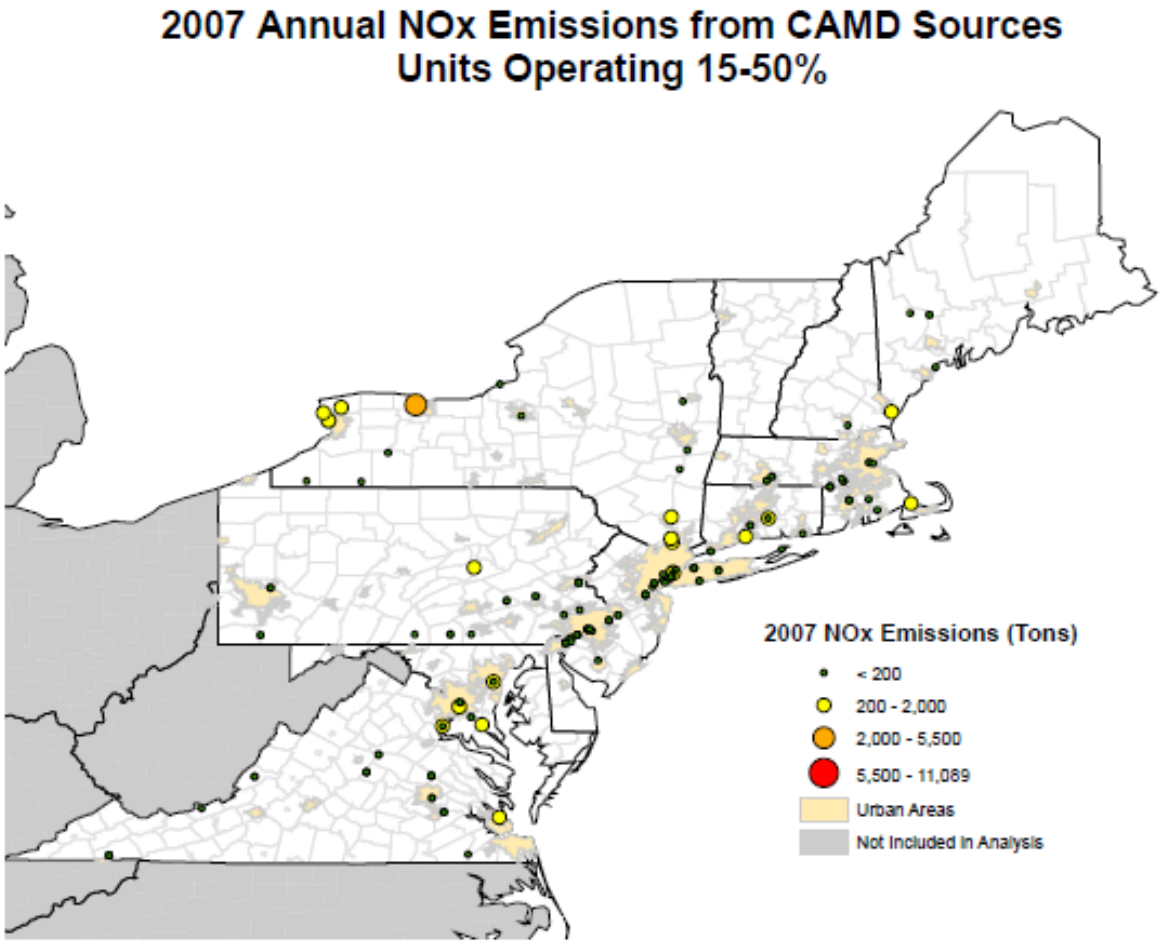



**Figure 11-3.** Geographic Location of CAMD Units in the 15-50% Bin.

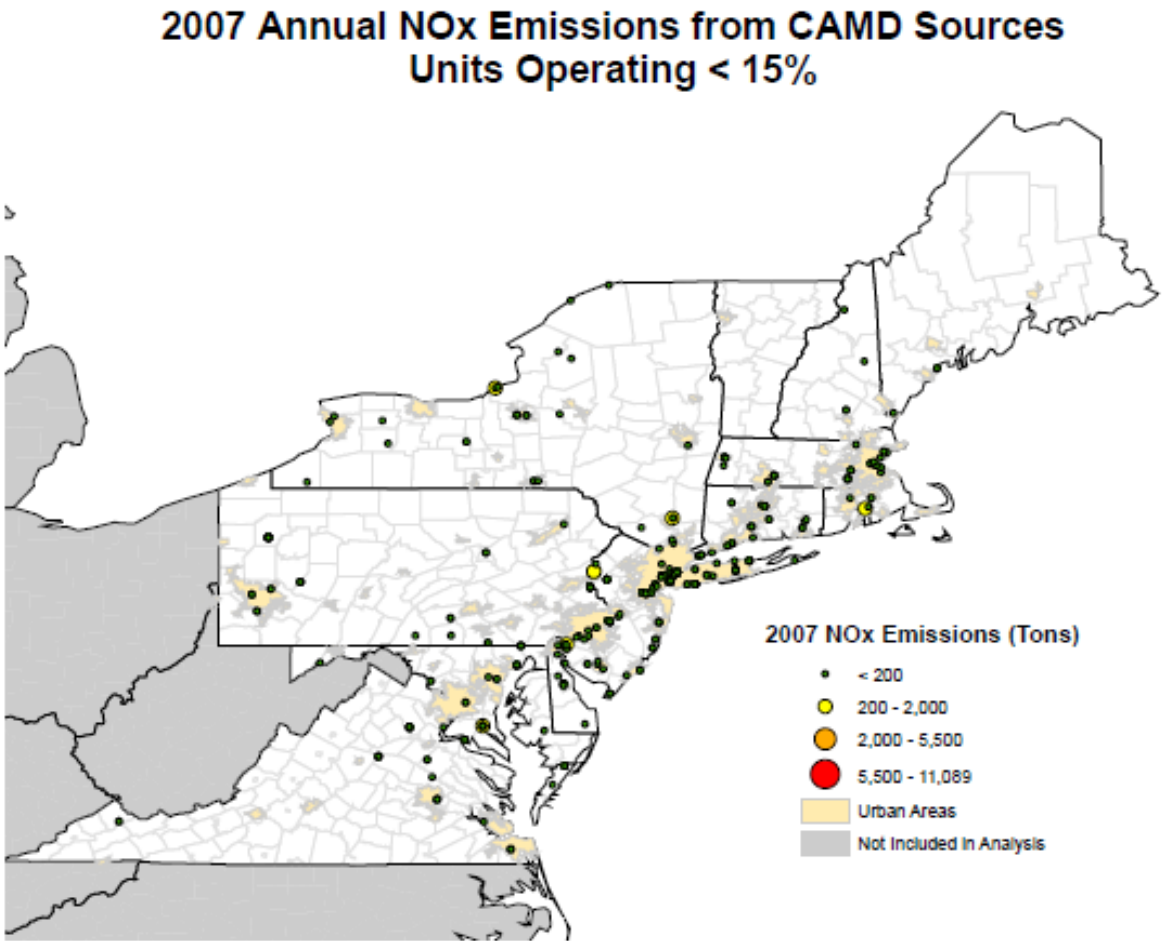
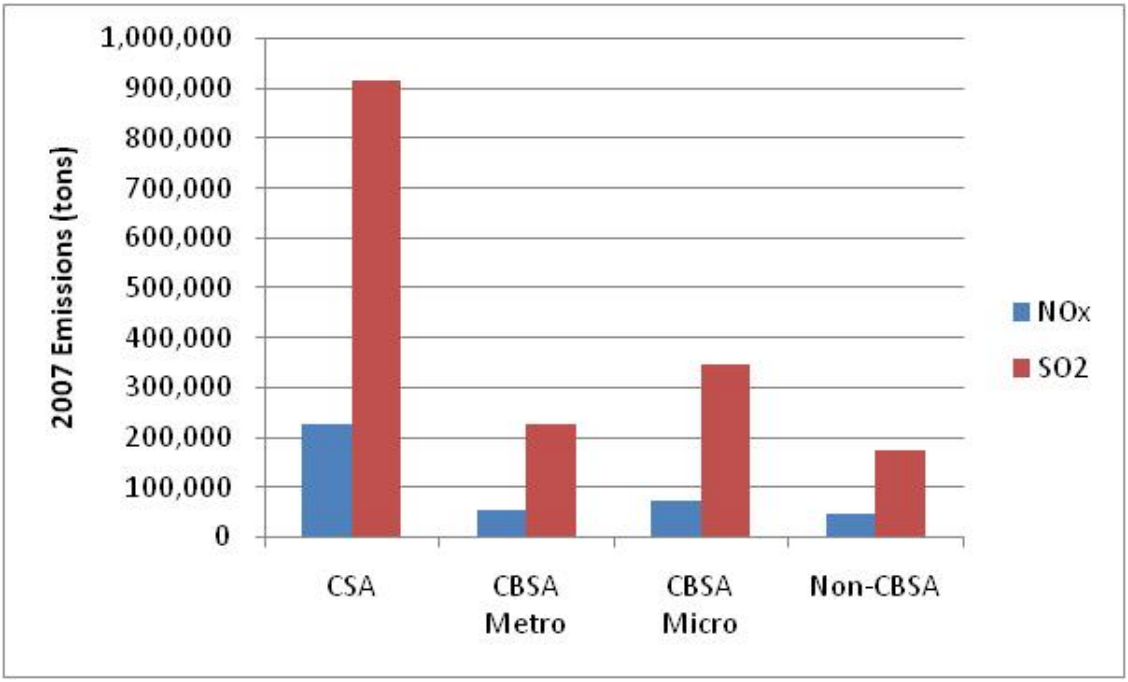



**Figure 11-4.** Geographic Location of CAMD Units in the <15% Bin.

**Table 11-1.** Annual NOx and $SO_2$ Emissions from CAMD Units by Metropolitan Area.

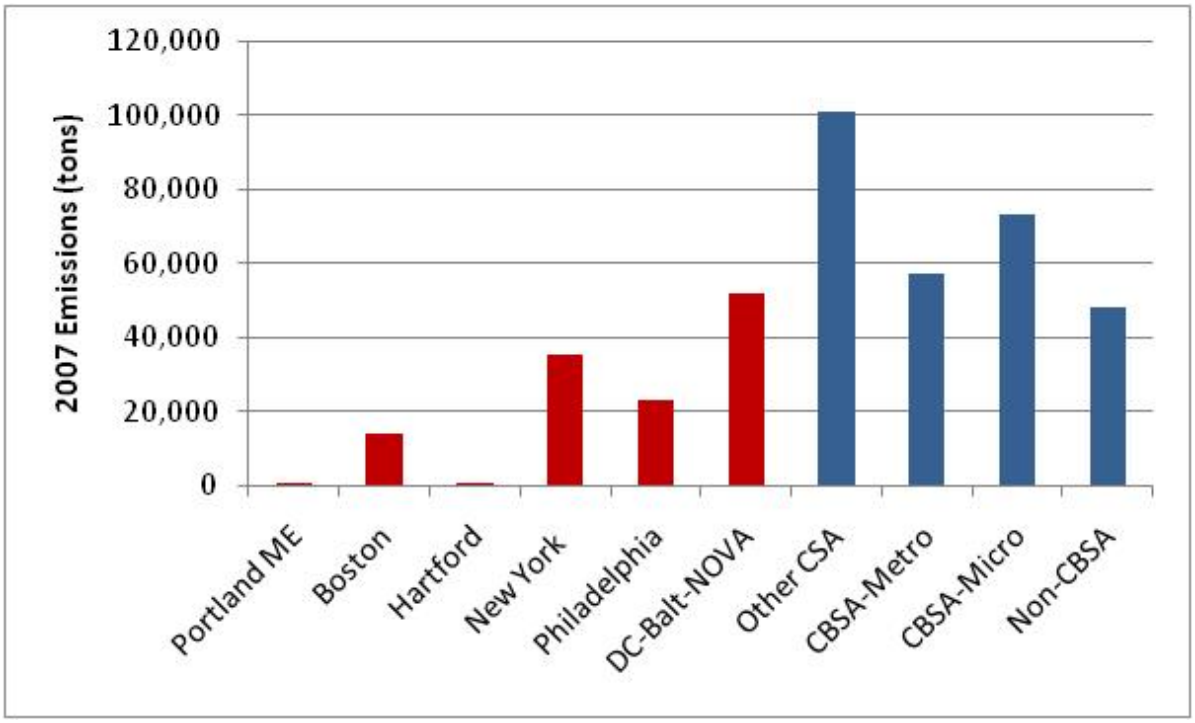
| Area Name | 2007 Annual NOx (tons) | 2007 Annual $SO_2$ (tons) |
|---|---|---|
| **Combined Statistical Area (CSA)** | | |
| Albany-Schenectady-Amsterdam, NY | 5,797 | 8 |
| Boston-Worcester-Manchester, MA-RI-NH | 14,292 | 84,494 |
| Buffalo-Niagara-Cattaraugus, NY | 8,105 | 15,419 |
| Harrisburg-Carlisle-Lebanon, PA | 140 | 5 |
| Hartford-West Hartford-Willimantic, CT | 1,024 | 522 |
| Ithaca-Cortland, NY | 2,575 | 3,660 |
| Johnson City-Kingsport-Bristol (Tri-Cities), TN-VA | 73 | 1 |
| New York-Newark-Bridgeport, NY-NJ-CT-PA | 35,385 | 63,486 |
| Philadelphia-Camden-Vineland, PA-NJ-DE-MD | 23,145 | 36,759 |
| Pittsburgh-New Castle, PA | 56,055 | 280,623 |
| Portland-Lewiston-South Portland, ME | 387 | 1,659 |
| Rochester-Batavia-Seneca Falls, NY | 5,358 | 21,719 |
| Sunbury-Lewisburg-Selinsgrove, PA | 4,061 | 30,309 |
| Syracuse-Auburn, NY | 1,626 | 1,482 |
| Washington-Baltimore-Northern Virginia, DC-MD-VA-WV | 52,181 | 272,974 |
| York-Hanover-Gettysburg, PA | 17,467 | 106,151 |
| **CSA Subtotal** | **227,671** | **919,271** |
| **CBSA Metropolitan Statistical Areas (not in a CSA)** | | |
| Allentown-Bethlehem-Easton, PA-NJ | 8,310 | 47,719 |
| Bangor, ME | 102 | 4 |
| Barnstable Town, MA | 1,057 | 6,675 |
| Binghamton, NY | 949 | 7,931 |
| Blacksburg-Christiansburg-Radford, VA | 3,451 | 11,491 |
| Burlington-South Burlington, VT | 377 | 6 |
| Charlottesville, VA | 3,540 | 10,456 |
| Cumberland, MD-WV | 3,978 | 0 |
| Dover, DE | 553 | 99 |
| Hagerstown-Martinsburg, MD-WV | 1,398 | 5,536 |
| Johnstown, PA | 2,134 | 0 |
| Lynchburg, VA | 611 | 80 |
| Norwich-New London, CT | 913 | 127 |
| Ocean City, NJ | 4,376 | 12,733 |
| Pittsfield, MA | 10 | 0 |
| Richmond, VA | 11,821 | 71,408 |
| Scranton--Wilkes-Barre, PA | 907 | 3,674 |

| **Area Name** | **2007 Annual NOx (tons)** | **2007 Annual $SO_2$ (tons)** |
|---|---|---|
| Springfield, MA | 1,022 | 5,228 |
| Utica-Rome, NY | 4 | 0 |
| Virginia Beach-Norfolk-Newport News, VA-NC | 11,935 | 44,567 |
| **Metro Statistical Area Subtotal** | **57,445** | **227,733** |
| **CBSA Micropolitan Statistical Area (not in a CSA)** | | |
| Bloomsburg-Berwick, PA | 13,418 | 127,780 |
| Cambridge, MD | 63 | 395 |
| Chambersburg, PA | 51 | 0 |
| DuBois, PA | 7,357 | 49,065 |
| Indiana, PA | 39,308 | 135,647 |
| Jamestown-Dunkirk-Fredonia, NY | 3,456 | 13,428 |
| Ogdensburg-Massena, NY | 3 | 0 |
| Oil City, PA | 782 | 1 |
| Plattsburgh, NY | 217 | 0 |
| Pottsville, PA | 1,097 | 231 |
| Seaford, DE | 7,111 | 23,569 |
| Watertown-Fort Drum, NY | 484 | 0 |
| **Micro Statistical Area Subtotal** | **73,346** | **350,116** |
| **Not in a Metropolitan Area** | | |
| Not in a CBSA | **48,324** | **177,012** |
| **Total** | **406,786** | **1,674,131** |




| | |
|---|---|
| CSA | Combined Statistical Area |
| CBSA Metro | Core based statistical area with an urban core area of 50,000 or more population |
| CBSA Micro | Core based statistical area with an urban core area of at least 10,000 (but less than 50,000) population |
| Non-CBSA | County that is not in a CBSA or CSA |

**Figure 11-5.** Annual NOx and $SO_2$ Emissions by Type of Metropolitan Area.

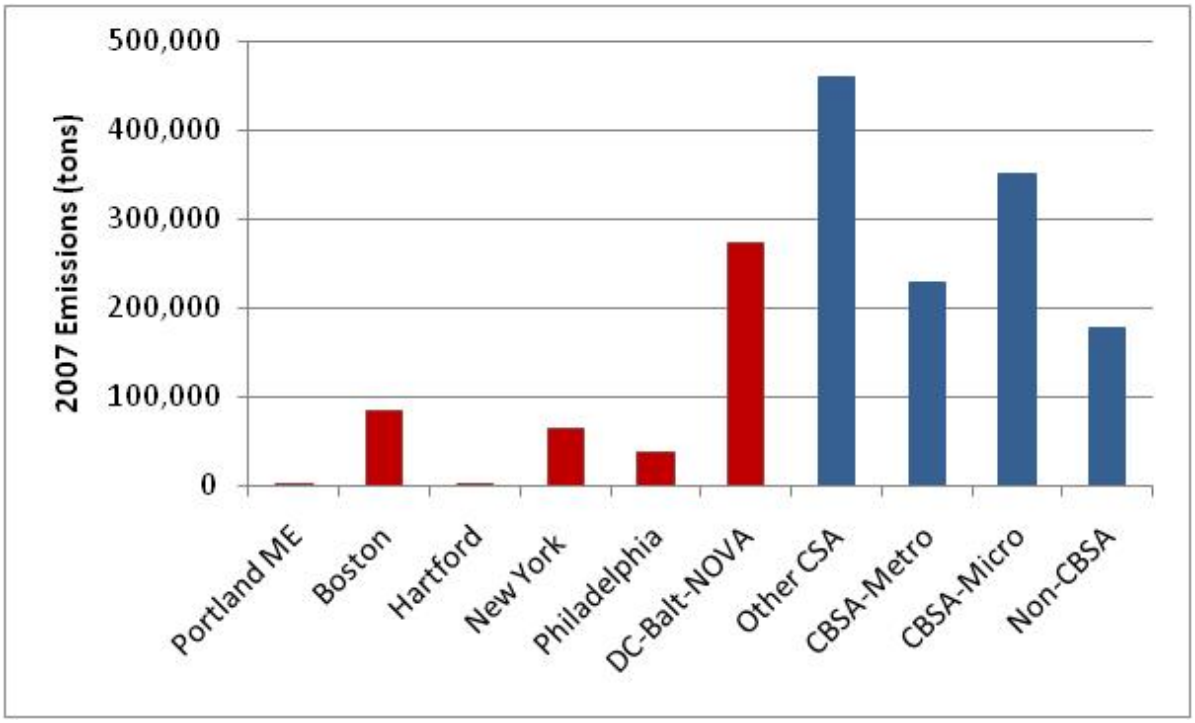



I-95 Corridor Areas are shown in red fill and include the following six CSAs:

Portland-Lewiston-South Portland, ME
Boston-Worcester-Manchester, MA-RI-NH
Hartford-West Hartford-Willimantic, CT
New York-Newark-Bridgeport, NY-NJ-CT-PA
Philadelphia-Camden-Vineland, PA-NJ-DE-MD
Washington-Baltimore-Northern Virginia, DC-MD-VA-WV

**Figure 11-6.** Annual NOx Emitted in I-95 Corridor Areas

Compared to Other Geographical Areas in the Northeast / Mid-Atlantic Region.




I-95 Corridor Areas are shown in red fill and include the following six CSAs:

Portland-Lewiston-South Portland, ME
Boston-Worcester-Manchester, MA-RI-NH
Hartford-West Hartford-Willimantic, CT
New York-Newark-Bridgeport, NY-NJ-CT-PA
Philadelphia-Camden-Vineland, PA-NJ-DE-MD
Washington-Baltimore-Northern Virginia, DC-MD-VA-WV

**Figure 11-7.** Annual $SO_2$ Emitted in I-95 Corridor Areas

Compared to Other Geographical Areas in the Northeast / Mid-Atlantic Region.

## 12 Analysis of Unit Downtime

***For units that operated more than 50% of the time in 2007, identify units that (a) did not operate during any day in any air pollution episodes (was down for an entire day) or (b) that operated at less than 33% of the 2007 average daily heat input rate for that unit during any day in any air pollution episodes (i.e., unit was operating at an abnormally low rate).***

We reviewed the 2007 CAMD hourly data for each unit in the MANE-VU+VA region to determine which ones were non-operational or operating at an abnormally low rate relative to average daily heat input rates. To be included in the analyses, units must have operated for more than 182.5 days (based on 4380 hours per year). Units that may have operated on more than 182.5 days of the year but for less than 4380 hours were not included in these analyses.

Using the data and calculations noted above, we identified numerous units the MANE-VU+VA region where units online for more than 50% of the hours of the calendar year 2007 were shut down for entire days at a time or operated at levels lower than 33% of the average daily heat input rate. The list provided in Table 12-1 below indicates the number of units in each State meeting these constraints. Table 12-2 provides the individual units and the number of days for which they meet these constraints. Table 12-3 provides the individual units and calendar days for which these units met the constraints.

**Table 12-1.** State counts of non- or low-operating units in 2007 based on CEM heat input.

| | **Units with Days** | |
|---|---|---|
| **State** | **<33% Average Daily Heat Input** | **Zero Operation** |
| CT | 14 | 14 |
| DC | 1 | 1 |
| DE | 16 | 16 |
| MA | 28 | 28 |
| MD | 16 | 16 |
| ME | 6 | 6 |
| NH | 8 | 8 |
| NJ | 34 | 32 |
| NY | 87 | 87 |
| PA | 87 | 87 |
| RI | 3 | 3 |
| VA | 36 | 36 |
| VT | 1 | 1 |
| **Total** | **337** | **335** |

**Table 12-2.** State counts of non- or low operating units in 2007 based on CEM heat input.

| | | | | Number of Days | |
|---|---|---|---|---|---|
| **State** | **ORIS ID** | **Facility Name** | **UNIT ID** | **Daily Heat Input < 33% Average Daily Heat Input** | **No Operation (zero heat input)** |
| CT | 10567 | Algonquin Power Windsor Locks | GT1 | 5 | 5 |
| CT | 10675 | AES Thames | UNITA | 39 | 35 |
| CT | 10675 | AES Thames | UNITB | 33 | 30 |
| CT | 54236 | Pfizer | 5 | 175 | 174 |
| CT | 54605 | Pratt & Whitney, East Hartford | 001 | 111 | 94 |
| CT | 54657 | Cascades Boxboard Group-Connect | 1 | 104 | 95 |
| CT | 55042 | Bridgeport Energy | BE1 | 85 | 79 |
| CT | 55042 | Bridgeport Energy | BE2 | 64 | 61 |
| CT | 55126 | Milford Power Company LLC | CT01 | 63 | 56 |
| CT | 55126 | Milford Power Company LLC | CT02 | 71 | 60 |
| CT | 55149 | Lake Road Generating Company | LRG1 | 66 | 64 |
| CT | 55149 | Lake Road Generating Company | LRG2 | 107 | 101 |
| CT | 55149 | Lake Road Generating Company | LRG3 | 84 | 79 |
| CT | 568 | Bridgeport Harbor Station | BHB3 | 84 | 69 |
| DC | 880004 | GSA Central Heating | 4 | 141 | 137 |
| DE | 10030 | NRG Energy Center Dover | 1 | 27 | 23 |
| DE | 52193 | Delaware City Refinery | 42H123 | 26 | 22 |
| DE | 52193 | Delaware City Refinery | CATCOB | 15 | 13 |
| DE | 52193 | Delaware City Refinery | COKCOB | 24 | 20 |
| DE | 52193 | Delaware City Refinery | DCPP1 | 14 | 14 |
| DE | 52193 | Delaware City Refinery | DCPP2 | 38 | 35 |
| DE | 52193 | Delaware City Refinery | DCPP3 | 27 | 25 |
| DE | 52193 | Delaware City Refinery | DCPP4 | 36 | 33 |
| DE | 52193 | Delaware City Refinery | MECCU1 | 116 | 98 |
| DE | 52193 | Delaware City Refinery | MECCU2 | 80 | 71 |
| DE | 593 | Edge Moor | 3 | 94 | 77 |
| DE | 593 | Edge Moor | 4 | 15 | 10 |
| DE | 594 | Indian River | 1 | 12 | 8 |
| DE | 594 | Indian River | 2 | 80 | 69 |
| DE | 594 | Indian River | 3 | 17 | 9 |
| DE | 594 | Indian River | 4 | 131 | 105 |
| MA | 10029 | General Electric Aircraft | 3 | 46 | 41 |
| MA | 1588 | Mystic | 7 | 95 | 67 |
| MA | 1588 | Mystic | 81 | 34 | 31 |
| MA | 1588 | Mystic | 82 | 57 | 48 |
| MA | 1588 | Mystic | 93 | 45 | 32 |
| MA | 1588 | Mystic | 94 | 78 | 72 |
| MA | 1595 | Kendall Square | 4 | 28 | 27 |
| MA | 1599 | Canal Station | 1 | 52 | 44 |
| MA | 1606 | Mount Tom | 1 | 27 | 20 |
| MA | 1613 | Somerset | 8 | 52 | 31 |
| MA | 1619 | Brayton Point | 1 | 19 | 8 |

| | | | | Number of Days | |
|---|---|---|---|---|---|
| **State** | **ORIS ID** | **Facility Name** | **UNIT ID** | **Daily Heat Input < 33% Average Daily Heat Input** | **No Operation (zero heat input)** |
| MA | 1619 | Brayton Point | 2 | 38 | 28 |
| MA | 1619 | Brayton Point | 3 | 36 | 18 |
| MA | 1626 | Salem Harbor | 1 | 70 | 63 |
| MA | 1626 | Salem Harbor | 2 | 67 | 61 |
| MA | 1626 | Salem Harbor | 3 | 109 | 99 |
| MA | 54907 | MIT Central Utility Plant | 1 | 89 | 82 |
| MA | 55041 | Berkshire Power | 1 | 133 | 126 |
| MA | 55079 | Millennium Power Partners | 1 | 87 | 71 |
| MA | 55211 | ANP Bellingham Energy Project | 1 | 120 | 107 |
| MA | 55211 | ANP Bellingham Energy Project | 2 | 63 | 56 |
| MA | 55212 | ANP Blackstone Energy Company | 1 | 85 | 78 |
| MA | 55212 | ANP Blackstone Energy Company | 2 | 66 | 56 |
| MA | 55317 | Fore River Station | 11 | 104 | 90 |
| MA | 55317 | Fore River Station | 12 | 106 | 99 |
| MA | 880023 | Kneeland Station | K1 | 157 | 137 |
| MA | 880023 | Kneeland Station | K2 | 57 | 50 |
| MA | 880023 | Kneeland Station | K3 | 15 | 13 |
| MD | 10678 | AES Warrior Run | 001 | 25 | 23 |
| MD | 1552 | C P Crane | 1 | 108 | 84 |
| MD | 1552 | C P Crane | 2 | 40 | 26 |
| MD | 1554 | Herbert A Wagner | 2 | 55 | 49 |
| MD | 1554 | Herbert A Wagner | 3 | 44 | 32 |
| MD | 1570 | R. Paul Smith Power Station | 11 | 35 | 21 |
| MD | 1570 | R. Paul Smith Power Station | 9 | 68 | 64 |
| MD | 1571 | Mirant Chalk Point | 1 | 45 | 38 |
| MD | 1571 | Mirant Chalk Point | 2 | 56 | 52 |
| MD | 1572 | Mirant Dickerson | 1 | 65 | 54 |
| MD | 1572 | Mirant Dickerson | 2 | 67 | 55 |
| MD | 1572 | Mirant Dickerson | 3 | 71 | 62 |
| MD | 1573 | Mirant Morgantown | 1 | 98 | 83 |
| MD | 1573 | Mirant Morgantown | 2 | 58 | 49 |
| MD | 602 | Brandon Shores | 1 | 101 | 86 |
| MD | 602 | Brandon Shores | 2 | 21 | 13 |
| ME | 50243 | Bucksport Clean Energy | GEN4 | 36 | 32 |
| ME | 55031 | Androscoggin Energy | CT01 | 141 | 139 |
| ME | 55068 | Maine Independence Station | 1 | 107 | 104 |
| ME | 55068 | Maine Independence Station | 2 | 116 | 111 |
| ME | 55294 | Westbrook Energy Center | 1 | 92 | 83 |
| ME | 55294 | Westbrook Energy Center | 2 | 113 | 105 |
| NH | 2364 | Merrimack | 1 | 8 | 6 |
| NH | 2364 | Merrimack | 2 | 54 | 46 |
| NH | 2367 | Schiller | 4 | 8 | 5 |
| NH | 2367 | Schiller | 5 | 56 | 43 |
| NH | 2367 | Schiller | 6 | 55 | 49 |

| | | | | Number of Days | |
|---|---|---|---|---|---|
| State | ORIS ID | Facility Name | UNIT ID | Daily Heat Input < 33% Average Daily Heat Input | No Operation (zero heat input) |
| NH | 55170 | Granite Ridge Energy | 0001 | 175 | 169 |
| NH | 55661 | NAEA Newington Energy LLC | 1 | 38 | 34 |
| NH | 55661 | NAEA Newington Energy LLC | 2 | 39 | 35 |
| NJ | 10043 | Logan Generating Plant | 1001 | 39 | 26 |
| NJ | 10566 | Carneys Point | 1001 | 29 | 23 |
| NJ | 10566 | Carneys Point | 1002 | 7 | 5 |
| NJ | 10805 | E F Kenilworth, Inc. | 002001 | 5 | 2 |
| NJ | 2378 | B L England | 1 | 78 | 57 |
| NJ | 2378 | B L England | 2 | 120 | 93 |
| NJ | 2384 | Deepwater | 8 | 48 | 39 |
| NJ | 2398 | Bergen | 1101 | 85 | 78 |
| NJ | 2398 | Bergen | 1201 | 62 | 50 |
| NJ | 2398 | Bergen | 1301 | 35 | 30 |
| NJ | 2398 | Bergen | 1401 | 20 | 12 |
| NJ | 2398 | Bergen | 2101 | 78 | 69 |
| NJ | 2398 | Bergen | 2201 | 76 | 67 |
| NJ | 2403 | Hudson Generating Station | 2 | 111 | 104 |
| NJ | 2408 | Mercer Generating Station | 1 | 15 | 13 |
| NJ | 2408 | Mercer Generating Station | 2 | 112 | 102 |
| NJ | 50006 | Linden Cogeneration Facility | 004001 | 35 | 33 |
| NJ | 50006 | Linden Cogeneration Facility | 005001 | 80 | 75 |
| NJ | 50006 | Linden Cogeneration Facility | 006001 | 77 | 71 |
| NJ | 50006 | Linden Cogeneration Facility | 007001 | 78 | 70 |
| NJ | 50006 | Linden Cogeneration Facility | 008001 | 31 | 25 |
| NJ | 50006 | Linden Cogeneration Facility | 009001 | 32 | 26 |
| NJ | 50628 | Valero Paulsboro Refinery | 748001 | 15 | 13 |
| NJ | 50628 | Valero Paulsboro Refinery | 749001 | 41 | 36 |
| NJ | 50628 | Valero Paulsboro Refinery | 751001 | 14 | 13 |
| NJ | 50628 | Valero Paulsboro Refinery | 752001 | 14 | 10 |
| NJ | 50628 | Valero Paulsboro Refinery | 780001 | 7 | 6 |
| NJ | 55113 | Sunoco, Inc. (R&S) Eagle Point | 034101 | 2 | 1 |
| NJ | 55113 | Sunoco, Inc. (R&S) Eagle Point | 034201 | 2 | 0 |
| NJ | 55113 | Sunoco, Inc. (R&S) Eagle Point | 034301 | 6 | 5 |
| NJ | 55113 | Sunoco, Inc. (R&S) Eagle Point | 034401 | 13 | 9 |
| NJ | 55113 | Sunoco, Inc. (R&S) Eagle Point | 088001 | 7 | 4 |
| NJ | 880016 | Bayway Refinery | 010002 | 4 | 1 |
| NJ | 880016 | Bayway Refinery | 010003 | 6 | 0 |
| NY | 10025 | Eastman Kodak - Kodak Park | 3B | 87 | 85 |
| NY | 10025 | Eastman Kodak - Kodak Park | 4A | 124 | 123 |
| NY | 10025 | Eastman Kodak - Kodak Park | 4B | 8 | 7 |
| NY | 10464 | Black River Generation, LLC | E0001 | 31 | 26 |
| NY | 10464 | Black River Generation, LLC | E0002 | 17 | 12 |
| NY | 10464 | Black River Generation, LLC | E0003 | 24 | 17 |
| NY | 10725 | Selkirk Cogen Partners | CTG101 | 81 | 77 |

| | | | | Number of Days | |
|---|---|---|---|---|---|
| **State** | **ORIS ID** | **Facility Name** | **UNIT ID** | **Daily Heat Input < 33% Average Daily Heat Input** | **No Operation (zero heat input)** |
| NY | 10725 | Selkirk Cogen Partners | CTG201 | 54 | 54 |
| NY | 10725 | Selkirk Cogen Partners | CTG301 | 63 | 62 |
| NY | 2480 | Dynegy Danskammer | 3 | 28 | 12 |
| NY | 2480 | Dynegy Danskammer | 4 | 49 | 40 |
| NY | 2490 | Arthur Kill | 20 | 147 | 126 |
| NY | 2490 | Arthur Kill | 30 | 143 | 129 |
| NY | 2491 | Charles Poletti | 001 | 112 | 91 |
| NY | 2493 | East River | 1 | 59 | 55 |
| NY | 2493 | East River | 2 | 35 | 30 |
| NY | 2493 | East River | 60 | 152 | 144 |
| NY | 2493 | East River | 70 | 123 | 111 |
| NY | 2496 | Hudson Avenue | BLR081 | 157 | 155 |
| NY | 2500 | Ravenswood Generating Station | 10 | 122 | 99 |
| NY | 2500 | Ravenswood Generating Station | 30 | 141 | 131 |
| NY | 2500 | Ravenswood Generating Station | UCC001 | 112 | 102 |
| NY | 2503 | 59th Street | BLR114 | 125 | 100 |
| NY | 2503 | 59th Street | BLR115 | 128 | 108 |
| NY | 2503 | 59th Street | BLR116 | 114 | 98 |
| NY | 2503 | 59th Street | BLR117 | 116 | 102 |
| NY | 2503 | 59th Street | BLR118 | 114 | 99 |
| NY | 2504 | 74th Street | 121 | 95 | 86 |
| NY | 2511 | E F Barrett | 10 | 64 | 57 |
| NY | 2511 | E F Barrett | 20 | 81 | 72 |
| NY | 2513 | Far Rockaway | 40 | 183 | 167 |
| NY | 2516 | Northport | 1 | 39 | 27 |
| NY | 2516 | Northport | 2 | 147 | 142 |
| NY | 2516 | Northport | 3 | 126 | 110 |
| NY | 2516 | Northport | 4 | 74 | 62 |
| NY | 2517 | Port Jefferson Energy Center | 3 | 131 | 118 |
| NY | 2517 | Port Jefferson Energy Center | 4 | 63 | 61 |
| NY | 2526 | AES Westover (Goudey) | 13 | 22 | 15 |
| NY | 2527 | AES Greenidge | 6 | 38 | 25 |
| NY | 2535 | AES Cayuga, LLC | 1 | 29 | 23 |
| NY | 2535 | AES Cayuga, LLC | 2 | 23 | 19 |
| NY | 2539 | Bethlehem Energy Center (Albany | 10001 | 123 | 120 |
| NY | 2539 | Bethlehem Energy Center (Albany | 10002 | 113 | 110 |
| NY | 2539 | Bethlehem Energy Center (Albany | 10003 | 139 | 137 |
| NY | 2549 | Huntley Power | 67 | 74 | 32 |
| NY | 2549 | Huntley Power | 68 | 80 | 67 |
| NY | 2554 | Dunkirk | 1 | 43 | 33 |
| NY | 2554 | Dunkirk | 2 | 45 | 40 |
| NY | 2554 | Dunkirk | 3 | 39 | 28 |
| NY | 2554 | Dunkirk | 4 | 83 | 70 |
| NY | 2629 | Lovett Generating Station | 5 | 47 | 31 |

| | | | | Number of Days | |
|---|---|---|---|---|---|
| State | ORIS ID | Facility Name | UNIT ID | Daily Heat Input < 33% Average Daily Heat Input | No Operation (zero heat input) |
| NY | 2642 | Rochester 7 - Russell Station | 1 | 84 | 75 |
| NY | 2642 | Rochester 7 - Russell Station | 2 | 10 | 6 |
| NY | 2642 | Rochester 7 - Russell Station | 3 | 16 | 7 |
| NY | 2642 | Rochester 7 - Russell Station | 4 | 45 | 34 |
| NY | 2682 | S A Carlson | 12 | 90 | 88 |
| NY | 2682 | S A Carlson | 9 | 86 | 81 |
| NY | 50292 | Bethpage Energy Center | GT4 | 52 | 45 |
| NY | 50651 | Syracuse Energy Corporation | BLR1 | 30 | 22 |
| NY | 50651 | Syracuse Energy Corporation | BLR2 | 38 | 36 |
| NY | 50651 | Syracuse Energy Corporation | BLR3 | 70 | 67 |
| NY | 50651 | Syracuse Energy Corporation | BLR4 | 89 | 84 |
| NY | 50651 | Syracuse Energy Corporation | BLR5 | 67 | 57 |
| NY | 52056 | Nassau Energy Corporation | 00004 | 20 | 16 |
| NY | 54041 | Lockport | 011856 | 178 | 176 |
| NY | 54099 | Ticonderoga Mill | 000044 | 23 | 13 |
| NY | 54114 | KIAC Cogeneration | GT1 | 78 | 59 |
| NY | 54114 | KIAC Cogeneration | GT2 | 82 | 68 |
| NY | 54149 | Nissequogue Cogen | 1 | 36 | 29 |
| NY | 54425 | Project Orange Facility | 002 | 93 | 81 |
| NY | 54574 | Saranac Power Partners, LP | 00001 | 7 | 7 |
| NY | 54574 | Saranac Power Partners, LP | 00002 | 8 | 8 |
| NY | 54914 | Brooklyn Navy Yard Cogeneration | 1 | 14 | 7 |
| NY | 54914 | Brooklyn Navy Yard Cogeneration | 2 | 28 | 22 |
| NY | 55375 | Astoria Energy | CT1 | 46 | 28 |
| NY | 55375 | Astoria Energy | CT2 | 37 | 20 |
| NY | 55405 | Athens Generating Company | 2 | 108 | 101 |
| NY | 55405 | Athens Generating Company | 3 | 118 | 109 |
| NY | 56196 | Poletti 500 MW CC | CTG7A | 25 | 18 |
| NY | 56196 | Poletti 500 MW CC | CTG7B | 30 | 23 |
| NY | 6082 | AES Somerset (Kintigh ) | 1 | 4 | 2 |
| NY | 7314 | Richard M Flynn (Holtsville) | 001 | 127 | 118 |
| NY | 880024 | Momentive Performance Materials | U28006 | 22 | 17 |
| NY | 880043 | Holcim US Inc | 1 | 348* | 62 |
| NY | 8906 | Astoria Generating Station | 30 | 98 | 79 |
| NY | 8906 | Astoria Generating Station | 40 | 171 | 157 |
| NY | 8906 | Astoria Generating Station | 50 | 102 | 83 |
| PA | 10113 | Gilberton Power Company | 031 | 16 | 12 |
| PA | 10113 | Gilberton Power Company | 032 | 21 | 11 |
| PA | 10143 | Colver Power Project | AAB01 | 20 | 17 |
| PA | 10343 | Mt. Carmel Cogeneration | SG-101 | 35 | 29 |
| PA | 10603 | Ebensburg Power Company | 031 | 14 | 10 |
| PA | 10641 | Cambria Cogen | 1 | 9 | 8 |
| PA | 10641 | Cambria Cogen | 2 | 13 | 10 |
| PA | 3098 | Elrama | 1 | 126 | 106 |

| | | | | Number of Days | |
|---|---|---|---|---|---|
| **State** | **ORIS ID** | **Facility Name** | **UNIT ID** | **Daily Heat Input < 33% Average Daily Heat Input** | **No Operation (zero heat input)** |
| PA | 3098 | Elrama | 2 | 135 | 117 |
| PA | 3098 | Elrama | 3 | 92 | 72 |
| PA | 3098 | Elrama | 4 | 100 | 83 |
| PA | 3113 | Portland | 1 | 55 | 34 |
| PA | 3113 | Portland | 2 | 64 | 55 |
| PA | 3115 | Titus | 1 | 6 | 3 |
| PA | 3115 | Titus | 2 | 24 | 20 |
| PA | 3115 | Titus | 3 | 61 | 48 |
| PA | 3118 | Conemaugh | 1 | 24 | 19 |
| PA | 3118 | Conemaugh | 2 | 52 | 50 |
| PA | 3122 | Homer City | 1 | 23 | 20 |
| PA | 3122 | Homer City | 2 | 61 | 58 |
| PA | 3122 | Homer City | 3 | 18 | 12 |
| PA | 3130 | Seward | 1 | 57 | 44 |
| PA | 3130 | Seward | 2 | 59 | 46 |
| PA | 3131 | Shawville | 1 | 20 | 5 |
| PA | 3131 | Shawville | 2 | 26 | 13 |
| PA | 3131 | Shawville | 3 | 69 | 61 |
| PA | 3131 | Shawville | 4 | 13 | 9 |
| PA | 3136 | Keystone | 1 | 13 | 8 |
| PA | 3136 | Keystone | 2 | 88 | 77 |
| PA | 3138 | New Castle | 3 | 77 | 64 |
| PA | 3138 | New Castle | 4 | 50 | 39 |
| PA | 3138 | New Castle | 5 | 124 | 109 |
| PA | 3140 | Brunner Island | 1 | 64 | 48 |
| PA | 3140 | Brunner Island | 2 | 26 | 16 |
| PA | 3140 | Brunner Island | 3 | 23 | 14 |
| PA | 3148 | Martins Creek | 1 | 118 | 116 |
| PA | 3148 | Martins Creek | 2 | 121 | 115 |
| PA | 3149 | Montour | 1 | 33 | 22 |
| PA | 3149 | Montour | 2 | 74 | 65 |
| PA | 3152 | Sunbury | 1A | 74 | 61 |
| PA | 3152 | Sunbury | 1B | 102 | 89 |
| PA | 3152 | Sunbury | 2A | 45 | 33 |
| PA | 3152 | Sunbury | 2B | 56 | 36 |
| PA | 3152 | Sunbury | 3 | 35 | 27 |
| PA | 3159 | Cromby | 1 | 29 | 19 |
| PA | 3161 | Eddystone Generating Station | 1 | 84 | 76 |
| PA | 3161 | Eddystone Generating Station | 2 | 82 | 71 |
| PA | 3176 | Hunlock Power Station | 6 | 28 | 19 |
| PA | 3178 | Armstrong Power Station | 1 | 15 | 9 |
| PA | 3178 | Armstrong Power Station | 2 | 36 | 25 |
| PA | 3179 | Hatfields Ferry Power Station | 1 | 21 | 15 |
| PA | 3179 | Hatfields Ferry Power Station | 2 | 99 | 88 |

| | | | | Number of Days | |
|---|---|---|---|---|---|
| State | ORIS ID | Facility Name | UNIT ID | Daily Heat Input < 33% Average Daily Heat Input | No Operation (zero heat input) |
| PA | 3179 | Hatfields Ferry Power Station | 3 | 29 | 25 |
| PA | 3181 | Mitchell Power Station | 33 | 177 | 161 |
| PA | 50039 | Northeastern Power Company | 031 | 5 | 3 |
| PA | 50397 | P H Glatfelter Company | 034 | 12 | 10 |
| PA | 50397 | P H Glatfelter Company | 035 | 7 | 5 |
| PA | 50397 | P H Glatfelter Company | 036 | 12 | 9 |
| PA | 50410 | Kimberly-Clark Tissue Company | 035 | 30 | 28 |
| PA | 50463 | Procter & Gamble Paper Products | 328001 | 9 | 6 |
| PA | 50611 | WPS Westwood Generation, LLC | 031 | 118 | 114 |
| PA | 50776 | Panther Creek Energy Facility | 1 | 22 | 16 |
| PA | 50776 | Panther Creek Energy Facility | 2 | 21 | 18 |
| PA | 50879 | Wheelabrator - Frackville | GEN1 | 9 | 7 |
| PA | 50888 | Northampton Generating Plant | NGC01 | 31 | 24 |
| PA | 50974 | Scrubgrass Generating Plant | 1 | 25 | 20 |
| PA | 50974 | Scrubgrass Generating Plant | 2 | 21 | 17 |
| PA | 52106 | Philadelphia Refinery | 150137 | 36 | 30 |
| PA | 52106 | Philadelphia Refinery | 150138 | 78 | 75 |
| PA | 52106 | Philadelphia Refinery | 150139 | 120 | 119 |
| PA | 52106 | Philadelphia Refinery | 150140 | 60 | 53 |
| PA | 52149 | Merck & Company - West Point | 040 | 123 | 121 |
| PA | 54144 | Piney Creek Power Plant | 031 | 16 | 11 |
| PA | 54634 | St. Nicholas Cogeneration Proje | 1 | 30 | 20 |
| PA | 54785 | Grays Ferry Cogen Partnership | 25 | 29 | 13 |
| PA | 55298 | Fairless Energy, LLC | 2A | 108 | 106 |
| PA | 55298 | Fairless Energy, LLC | 2B | 105 | 101 |
| PA | 55801 | FPL Energy Marcus Hook, LP | AB01 | 13 | 8 |
| PA | 55801 | FPL Energy Marcus Hook, LP | AB02 | 6 | 3 |
| PA | 55801 | FPL Energy Marcus Hook, LP | AB03 | 10 | 7 |
| PA | 55801 | FPL Energy Marcus Hook, LP | AB04 | 7 | 5 |
| PA | 6094 | Bruce Mansfield | 1 | 52 | 38 |
| PA | 6094 | Bruce Mansfield | 2 | 34 | 26 |
| PA | 6094 | Bruce Mansfield | 3 | 72 | 67 |
| PA | 8226 | Cheswick | 1 | 58 | 50 |
| PA | 880006 | Trigen Energy Corporation-Ediso | 3 | 150 | 138 |
| PA | 880007 | Sunoco Chemicals Frankford Plan | 052 | 41 | 41 |
| RI | 55048 | Tiverton Power | 1 | 87 | 84 |
| RI | 55107 | Rhode Island State Energy Partn | RISEP1 | 65 | 62 |
| RI | 55107 | Rhode Island State Energy Partn | RISEP2 | 86 | 83 |
| VA | 10771 | Hopewell Power Station | 1 | 131 | 105 |
| VA | 10771 | Hopewell Power Station | 2 | 129 | 102 |
| VA | 10773 | Altavista Power Station | 1 | 55 | 30 |
| VA | 10773 | Altavista Power Station | 2 | 60 | 35 |
| VA | 10774 | Southampton Power Station | 1 | 47 | 26 |
| VA | 10774 | Southampton Power Station | 2 | 60 | 39 |

| | | | | Number of Days | |
|---|---|---|---|---|---|
| **State** | **ORIS ID** | **Facility Name** | **UNIT ID** | **Daily Heat Input < 33% Average Daily Heat Input** | **No Operation (zero heat input)** |
| VA | 3775 | Clinch River | 1 | 63 | 50 |
| VA | 3775 | Clinch River | 2 | 69 | 44 |
| VA | 3775 | Clinch River | 3 | 56 | 43 |
| VA | 3776 | Glen Lyn | 51 | 59 | 41 |
| VA | 3776 | Glen Lyn | 52 | 66 | 46 |
| VA | 3776 | Glen Lyn | 6 | 104 | 85 |
| VA | 3788 | Mirant Potomac River | 3 | 158 | 133 |
| VA | 3788 | Mirant Potomac River | 4 | 121 | 103 |
| VA | 3788 | Mirant Potomac River | 5 | 108 | 97 |
| VA | 3796 | Bremo Power Station | 3 | 95 | 87 |
| VA | 3796 | Bremo Power Station | 4 | 56 | 41 |
| VA | 3797 | Chesterfield Power Station | **8A | 114 | 96 |
| VA | 3797 | Chesterfield Power Station | 3 | 93 | 82 |
| VA | 3797 | Chesterfield Power Station | 4 | 91 | 77 |
| VA | 3797 | Chesterfield Power Station | 5 | 24 | 18 |
| VA | 3797 | Chesterfield Power Station | 6 | 43 | 29 |
| VA | 3803 | Chesapeake Energy Center | 1 | 29 | 19 |
| VA | 3803 | Chesapeake Energy Center | 2 | 16 | 6 |
| VA | 3803 | Chesapeake Energy Center | 3 | 69 | 55 |
| VA | 3803 | Chesapeake Energy Center | 4 | 39 | 22 |
| VA | 3804 | Possum Point Power Station | 6A | 81 | 80 |
| VA | 3804 | Possum Point Power Station | 6B | 84 | 82 |
| VA | 3809 | Yorktown Power Station | 1 | 38 | 17 |
| VA | 3809 | Yorktown Power Station | 2 | 87 | 71 |
| VA | 52007 | Mecklenburg Power Station | 1 | 50 | 34 |
| VA | 52007 | Mecklenburg Power Station | 2 | 50 | 33 |
| VA | 52152 | International Paper-Franklin Mi | 003 | 8 | 7 |
| VA | 54304 | Birchwood Power Facility | 001 | 75 | 57 |
| VA | 7213 | Clover Power Station | 1 | 20 | 16 |
| VA | 7213 | Clover Power Station | 2 | 18 | 12 |
| VT | 589 | J C McNeil | 1 | 47 | 18 |

# 13 Installed Control Technologies

***What are the installed control technologies by category, state, fuel?***

Using USEPA 2007 CAMD data files, the attached tables summarize installed control technology by category, state and fuel for NOx and $SO_2$ emissions.

**Table 13-1.** Capacity percentages by State, fuel and NOx control technology.

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| CT | Coal | Low NOx Burner Technology w/ Separated OFA | 4,100 | 66.2% |
| CT | Coal | Other | 2,090 | 33.8% |
| CT | Diesel Oil | | 2,620 | 78.0% |
| CT | Diesel Oil | Water Injection | 741 | 22.0% |
| CT | Other Oil | | 2,499 | 100% |
| CT | Pipeline Natural Gas | | 739 | 3.3% |
| CT | Pipeline Natural Gas | Dry Low NOx Burners Water Injection | 1,560 | 7.0% |
| CT | Pipeline Natural Gas | Dry Low NOx Burners Water Injection Selective Catalytic Reduction | 6,828 | 30.6% |
| CT | Pipeline Natural Gas | Low NOx Burner Technology (Dry Bottom only) | 275 | 1.2% |
| CT | Pipeline Natural Gas | Steam Injection | 555 | 2.5% |
| CT | Pipeline Natural Gas | Water Injection | 1,660 | 7.4% |
| CT | Pipeline Natural Gas | Water Injection Selective Catalytic Reduction | 10,698 | 47.9% |
| CT | Residual Oil | | 20,319 | 73.8% |
| CT | Residual Oil | Overfire Air | 1,295 | 4.7% |
| CT | Residual Oil | Selective Non-catalytic Reduction | 3,552 | 12.9% |
| CT | Residual Oil | Water Injection Selective Non-catalytic Reduction | 2,370 | 8.6% |
| DC | Pipeline Natural Gas | | 1,000 | 75.4% |
| DC | Pipeline Natural Gas | Dry Low NOx Burners | 326 | 24.6% |
| DC | Residual Oil | | 6,460 | 100% |
| DE | Coal | Low NOx Burner Technology w/ Overfire Air | 2,676 | 21.1% |
| DE | Coal | Low NOx Burner Technology w/ Overfire Air Selective Non-catalytic Reduction | 6,995 | 55.3% |
| DE | Coal | Low NOx Burner Technology w/ Separated OFA | 1,867 | 14.8% |
| DE | Coal | Selective Non-catalytic Reduction | 1,117 | 8.8% |
| DE | Diesel Oil | | 1,946 | 25.1% |
| DE | Diesel Oil | Water Injection | 547 | 7.1% |
| DE | Diesel Oil | Water Injection Overfire Air Selective Catalytic Reduction | 5,253 | 67.8% |
| DE | Other Gas | Other Steam Injection | 2,186 | 100% |
| DE | Pipeline Natural Gas | Water Injection | 1,000 | 14.8% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| DE | Pipeline Natural Gas | Water Injection Overfire Air | 5,253 | 77.8% |
| DE | Pipeline Natural Gas | Water Injection Selective Catalytic Reduction | 500 | 7.4% |
| DE | Process Gas | | 6,304 | 87.7% |
| DE | Process Gas | Combustion Modification/Fuel Reburning Low NOx Burner Technology (Dry Bottom only) Steam Inje | 882 | 12.3% |
| DE | Residual Oil | Low NOx Burner Technology (Dry Bottom only) | 450 | 7.1% |
| DE | Residual Oil | Low NOx Burner Technology (Dry Bottom only) Overfire Air | 1,180 | 18.7% |
| DE | Residual Oil | Low NOx Burner Technology w/ Overfire Air | 4,695 | 74.2% |
| MA | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA | 2,250 | 13.7% |
| MA | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA Selective Catalytic Reduction | 2,250 | 13.7% |
| MA | Coal | Low NOx Burner Technology w/ Overfire Air Selective Catalytic Reduction | 5,655 | 34.4% |
| MA | Coal | Overfire Air Low NOx Burner Technology (Dry Bottom only) Selective Catalytic Reduction | 1,480 | 9.0% |
| MA | Coal | Selective Non-catalytic Reduction Combustion Modification/Fuel Reburning | 1,186 | 7.2% |
| MA | Coal | Selective Non-catalytic Reduction Low NOx Burner Technology (Dry Bottom only) | 1,920 | 11.7% |
| MA | Coal | Selective Non-catalytic Reduction Low NOx Burner Technology w/ Overfire Air | 1,696 | 10.3% |
| MA | Diesel Oil | | 4,097 | 40.1% |
| MA | Diesel Oil | Steam Injection | 2,100 | 20.6% |
| MA | Diesel Oil | Water Injection | 2,962 | 29.0% |
| MA | Diesel Oil | Water Injection Dry Low NOx Burners | 1,050 | 10.3% |
| MA | Other Oil | | 330 | 29.4% |
| MA | Other Oil | Water Injection | 792 | 70.6% |
| MA | Pipeline Natural Gas | | 868 | 1.5% |
| MA | Pipeline Natural Gas | Combustion Modification/Fuel Reburning | 1,560 | 2.7% |
| MA | Pipeline Natural Gas | Combustion Modification/Fuel Reburning Other | 600 | 1.0% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| MA | Pipeline Natural Gas | Combustion Modification/Fuel Reburning Water Injection | 349 | 0.6% |
| MA | Pipeline Natural Gas | Dry Low NOx Burners Selective Catalytic Reduction | 10,852 | 18.8% |
| MA | Pipeline Natural Gas | Dry Low NOx Burners Water Injection Selective Catalytic Reduction | 6,002 | 10.4% |
| MA | Pipeline Natural Gas | Low NOx Burner Technology (Dry Bottom only) | 409 | 0.7% |
| MA | Pipeline Natural Gas | Low NOx Burner Technology w/ Overfire Air | 1,834 | 3.2% |
| MA | Pipeline Natural Gas | Low NOx Burner Technology w/ Overfire Air Other | 383 | 0.7% |
| MA | Pipeline Natural Gas | Other | 3,680 | 6.4% |
| MA | Pipeline Natural Gas | Selective Catalytic Reduction | 13,243 | 23.0% |
| MA | Pipeline Natural Gas | Selective Catalytic Reduction Steam Injection | 6,438 | 11.2% |
| MA | Pipeline Natural Gas | Steam Injection | 4,121 | 7.1% |
| MA | Pipeline Natural Gas | Water Injection | 772 | 1.3% |
| MA | Pipeline Natural Gas | Water Injection Selective Catalytic Reduction | 6,536 | 11.3% |
| MA | Residual Oil | | 11,900 | 35.7% |
| MA | Residual Oil | Low NOx Burner Technology (Dry Bottom only) | 9,998 | 3 % |
| MA | Residual Oil | Low NOx Burner Technology w/ Overfire Air Other | 5,450 | 16.4% |
| MA | Residual Oil | Low NOx Burner Technology w/ Overfire Air Overfire Air | 5,973 | 17.9% |
| MD | Coal | Ammonia Injection Selective Non-catalytic Reduction | 2,047 | 4.2% |
| MD | Coal | Low NOx Burner Technology (Dry Bottom only) | 2,186 | 4.5% |
| MD | Coal | Low NOx Burner Technology (Dry Bottom only) Overfire Air | 3,130 | 6.5% |
| MD | Coal | Low NOx Burner Technology (Dry Bottom only) Overfire Air Ammonia Injection Other Selective No | 3,130 | 6.5% |
| MD | Coal | Low NOx Burner Technology w/ Closed-coupled OFA Selective Non-catalytic Reduction | 785 | 1.6% |
| MD | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA | 6,235 | 12.9% |
| MD | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA Ammonia Injection (Began Jun 16, 20 | 5,317 | 11.0% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| MD | Coal | Low NOx Burner Technology w/ Overfire Air Selective Catalytic Reduction | 15,086 | 31.1% |
| MD | Coal | Low NOx Burner Technology w/ Separated OFA | 4,938 | 10.2% |
| MD | Coal | Overfire Air Combustion Modification/Fuel Reburning | 5,000 | 10.3% |
| MD | Coal | Selective Non-catalytic Reduction | 590 | 1.2% |
| MD | Diesel Oil | | 6,056 | 100% |
| MD | Other Oil | | 5,537 | 100% |
| MD | Pipeline Natural Gas | | 5,122 | 19.0% |
| MD | Pipeline Natural Gas | Dry Low NOx Burners | 8,000 | 29.7% |
| MD | Pipeline Natural Gas | Water Injection | 11,572 | 42.9% |
| MD | Pipeline Natural Gas | Water Injection Other | 2,250 | 8.4% |
| MD | Residual Oil | | 9,370 | 58.5% |
| MD | Residual Oil | Overfire Air | 6,638 | 41.5% |
| ME | Pipeline Natural Gas | Dry Low NOx Burners Selective Catalytic Reduction | 3,874 | 20.9% |
| ME | Pipeline Natural Gas | Dry Low NOx Burners Water Injection | 2,082 | 11.2% |
| ME | Pipeline Natural Gas | Selective Catalytic Reduction | 12,612 | 67.9% |
| ME | Residual Oil | Combustion Modification/Fuel Reburning | 6,290 | 72.0% |
| ME | Residual Oil | Low NOx Burner Technology (Dry Bottom only) | 1,260 | 14.4% |
| ME | Residual Oil | Other | 1,190 | 13.6% |
| NH | Coal | Selective Catalytic Reduction | 4,432 | 79.9% |
| NH | Coal | Selective Non-catalytic Reduction Low NOx Burner Technology w/ Overfire Air | 561 | 10.1% |
| NH | Coal | Selective Non-catalytic Reduction Low NOx Burner Technology w/ Overfire Air (Began Apr 04, 20 | 552 | 1 % |
| NH | Diesel Oil | | 260 | 100% |
| NH | Other Oil | | 1,002 | 100% |
| NH | Pipeline Natural Gas | Dry Low NOx Burners Ammonia Injection | 5,698 | 58.1% |
| NH | Pipeline Natural Gas | Dry Low NOx Burners Water Injection Ammonia Injection Selective Catalytic Reduction | 4,115 | 41.9% |
| NH | Residual Oil | | 4,429 | 100% |
| NH | Wood | Selective Non-catalytic Reduction | 720 | 100% |
| NJ | Coal | Low NOx Burner Technology w/ Overfire Air | 1,187 | 5.2% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| NJ | Coal | Low NOx Burner Technology w/ Overfire Air Selective Catalytic Reduction | 5,476 | 24.0% |
| NJ | Coal | Low NOx Burner Technology w/ Overfire Air Selective Non-catalytic Reduction | 6,600 | 28.9% |
| NJ | Coal | Selective Non-catalytic Reduction Overfire Air | 2,900 | 12.7% |
| NJ | Coal | Selective Non-catalytic Reduction Selective Catalytic Reduction | 6,700 | 29.3% |
| NJ | Diesel Oil | | 12,552 | 55.2% |
| NJ | Diesel Oil | Dry Low NOx Burners Water Injection | 500 | 2.2% |
| NJ | Diesel Oil | Water Injection | 9,688 | 42.6% |
| NJ | Pipeline Natural Gas | | 20,888 | 18.1% |
| NJ | Pipeline Natural Gas | Ammonia Injection Steam Injection | 1,981 | 1.7% |
| NJ | Pipeline Natural Gas | Dry Low NOx Burners | 4,618 | 4.0% |
| NJ | Pipeline Natural Gas | Dry Low NOx Burners Ammonia Injection Selective Catalytic Reduction | 6,540 | 5.7% |
| NJ | Pipeline Natural Gas | Dry Low NOx Burners Water Injection | 15,806 | 13.7% |
| NJ | Pipeline Natural Gas | Dry Low NOx Burners Water Injection Selective Catalytic Reduction | 16,829 | 14.6% |
| NJ | Pipeline Natural Gas | Low NOx Burner Technology (Dry Bottom only) Other | 208 | 0.2% |
| NJ | Pipeline Natural Gas | Selective Catalytic Reduction Steam Injection | 11,030 | 9.6% |
| NJ | Pipeline Natural Gas | Steam Injection | 2,800 | 2.4% |
| NJ | Pipeline Natural Gas | Water Injection | 27,510 | 23.8% |
| NJ | Pipeline Natural Gas | Water Injection Other | 1,221 | 1.1% |
| NJ | Pipeline Natural Gas | Water Injection Selective Catalytic Reduction | 4,120 | 3.6% |
| NJ | Pipeline Natural Gas | Water Injection Selective Catalytic Reduction (Retired Sep 30, 2007) | 1,860 | 1.6% |
| NJ | Process Gas | | 1,045 | 18.5% |
| NJ | Process Gas | Low NOx Burner Technology (Dry Bottom only) | 3,192 | 56.6% |
| NJ | Process Gas | Selective Catalytic Reduction | 1,400 | 24.8% |
| NJ | Residual Oil | | 6,575 | 76.7% |
| NJ | Residual Oil | Low NOx Burner Technology w/ Overfire Air | 272 | 3.2% |
| NJ | Residual Oil | Selective Non-catalytic Reduction | 1,720 | 20.1% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| NY | Coal | | 8,653 | 17.5% |
| NY | Coal | Combustion Modification/Fuel Reburning | 2,811 | 5.7% |
| NY | Coal | Low NOx Burner Technology (Dry Bottom only) | 867 | 1.8% |
| NY | Coal | Low NOx Burner Technology w/ Closed-coupled OFA | 1,845 | 3.7% |
| NY | Coal | Low NOx Burner Technology w/ Closed-coupled OFA (Began May 29, 2007) Selective Catalytic Redu | 1,345 | 2.7% |
| NY | Coal | Low NOx Burner Technology w/ Closed-coupled OFA Selective Non-catalytic Reduction | 1,480 | 3.0% |
| NY | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA | 2,072 | 4.2% |
| NY | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA Selective Catalytic Reduction | 1,980 | 4.0% |
| NY | Coal | Low NOx Burner Technology w/ Overfire Air | 6,990 | 14.1% |
| NY | Coal | Low NOx Burner Technology w/ Separated OFA | 11,102 | 22.4% |
| NY | Coal | Low NOx Burner Technology w/ Separated OFA Selective Non-catalytic Reduction | 680 | 1.4% |
| NY | Coal | Other | 1,740 | 3.5% |
| NY | Coal | Overfire Air | 1,071 | 2.2% |
| NY | Coal | Selective Catalytic Reduction Low NOx Burner Technology (Dry Bottom only) | 6,280 | 12.7% |
| NY | Coal | Selective Non-catalytic Reduction | 580 | 1.2% |
| NY | Coal, Wood | Selective Non-catalytic Reduction | 692 | 100% |
| NY | Diesel Oil | | 20,876 | 60.1% |
| NY | Diesel Oil | Low NOx Burner Technology w/ Overfire Air | 8,266 | 23.8% |
| NY | Diesel Oil | Other Water Injection | 3,492 | 10.1% |
| NY | Diesel Oil | Water Injection Selective Catalytic Reduction | 2,097 | 6.0% |
| NY | Natural Gas | | 440 | 35.9% |
| NY | Natural Gas | Selective Catalytic Reduction Steam Injection | 787 | 64.1% |
| NY | Other Oil | | 11,984 | 45.1% |
| NY | Other Oil | Low NOx Burner Technology w/ Closed-coupled OFA | 7,000 | 26.3% |
| NY | Other Oil | Overfire Air | 7,600 | 28.6% |
| NY | Pipeline Natural Gas | | 31,428 | 24.2% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| NY | Pipeline Natural Gas | Ammonia Injection Selective Catalytic Reduction | 6,330 | 4.9% |
| NY | Pipeline Natural Gas | Combustion Modification/Fuel Reburning | 2,300 | 1.8% |
| NY | Pipeline Natural Gas | Dry Low NOx Burners Ammonia Injection | 2,156 | 1.7% |
| NY | Pipeline Natural Gas | Dry Low NOx Burners Selective Catalytic Reduction | 9,811 | 7.5% |
| NY | Pipeline Natural Gas | Dry Low NOx Burners Water Injection Selective Catalytic Reduction | 24,546 | 18.9% |
| NY | Pipeline Natural Gas | Overfire Air | 10,349 | 8.0% |
| NY | Pipeline Natural Gas | Selective Catalytic Reduction | 10,634 | 8.2% |
| NY | Pipeline Natural Gas | Selective Catalytic Reduction Steam Injection | 5,754 | 4.4% |
| NY | Pipeline Natural Gas | Selective Catalytic Reduction Water Injection | 625 | 0.5% |
| NY | Pipeline Natural Gas | Steam Injection | 13,914 | 10.7% |
| NY | Pipeline Natural Gas | Water Injection | 1,834 | 1.4% |
| NY | Pipeline Natural Gas | Water Injection Ammonia Injection | 848 | 0.7% |
| NY | Pipeline Natural Gas | Water Injection Ammonia Injection Selective Catalytic Reduction | 858 | 0.7% |
| NY | Pipeline Natural Gas | Water Injection Selective Catalytic Reduction | 8,596 | 6.6% |
| NY | Residual Oil | | 22,380 | 27.7% |
| NY | Residual Oil | Combustion Modification/Fuel Reburning | 2,150 | 2.7% |
| NY | Residual Oil | Combustion Modification/Fuel Reburning Low NOx Burner Technology w/ Overfire Air | 855 | 1.1% |
| NY | Residual Oil | Other | 14,018 | 17.4% |
| NY | Residual Oil | Overfire Air | 41,351 | 51.2% |
| PA | Coal | | 4,918 | 2.6% |
| PA | Coal | Ammonia Injection | 2,249 | 1.2% |
| PA | Coal | Combustion Modification/Fuel Reburning | 1,200 | 0.6% |
| PA | Coal | Combustion Modification/Fuel Reburning Low NOx Burner Technology (Dry Bottom only) Overfire A | 1,300 | 0.7% |
| PA | Coal | Low NOx Burner Technology (Dry Bottom only) | 500 | 0.3% |
| PA | Coal | Low NOx Burner Technology (Dry Bottom only) Overfire Air | 4,684 | 2.4% |
| PA | Coal | Low NOx Burner Technology (Dry Bottom only) Overfire Air Selective Non-catalytic Reduction Co | 2,400 | 1.2% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| PA | Coal | Low NOx Burner Technology (Dry Bottom only) Selective Catalytic Reduction | 7,914 | 4.1% |
| PA | Coal | Low NOx Burner Technology (Dry Bottom only) Selective Non-catalytic Reduction | 5,024 | 2.6% |
| PA | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA | 42,619 | 22.1% |
| PA | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA Selective Catalytic Reduction | 31,998 | 16.6% |
| PA | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA Selective Non-catalytic Reduction | 10,182 | 5.3% |
| PA | Coal | Low NOx Burner Technology w/ Overfire Air | 10,051 | 5.2% |
| PA | Coal | Low NOx Burner Technology w/ Overfire Air Selective Catalytic Reduction | 36,672 | 19.0% |
| PA | Coal | Low NOx Burner Technology w/ Overfire Air Selective Non-catalytic Reduction | 5,189 | 2.7% |
| PA | Coal | Low NOx Burner Technology w/ Separated OFA Selective Catalytic Reduction | 5,280 | 2.7% |
| PA | Coal | Low NOx Cell Burner Overfire Air | 10,148 | 5.3% |
| PA | Coal | Low NOx Cell Burner Overfire Air Selective Non-catalytic Reduction | 5,074 | 2.6% |
| PA | Coal | Other | 1,297 | 0.7% |
| PA | Coal | Selective Non-catalytic Reduction | 3,597 | 1.9% |
| PA | Coal | Selective Non-catalytic Reduction Overfire Air | 450 | 0.2% |
| PA | Coal Refuse | Ammonia Injection | 1,146 | 13.3% |
| PA | Coal Refuse | Overfire Air | 1,040 | 12.1% |
| PA | Coal Refuse | Selective Non-catalytic Reduction | 6,424 | 74.6% |
| PA | Diesel Oil | | 12,371 | 100% |
| PA | Other Gas | | 1,241 | 57.0% |
| PA | Other Gas | Low NOx Burner Technology (Dry Bottom only) | 936 | 43.0% |
| PA | Other Oil | | 853 | 100% |
| PA | Pipeline Natural Gas | | 4,252 | 4.6% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| PA | Pipeline Natural Gas | Dry Low NOx Burners | 1,067 | 1.1% |
| PA | Pipeline Natural Gas | Dry Low NOx Burners Selective Catalytic Reduction | 45,566 | 48.8% |
| PA | Pipeline Natural Gas | Dry Low NOx Burners Water Injection | 9,654 | 10.3% |
| PA | Pipeline Natural Gas | Dry Low NOx Burners Water Injection Ammonia Injection | 5,800 | 6.2% |
| PA | Pipeline Natural Gas | Low NOx Burner Technology (Dry Bottom only) | 381 | 0.4% |
| PA | Pipeline Natural Gas | Low NOx Burner Technology (Dry Bottom only) Other | 2,565 | 2.7% |
| PA | Pipeline Natural Gas | Selective Catalytic Reduction Water Injection | 2,754 | 2.9% |
| PA | Pipeline Natural Gas | Steam Injection | 2,370 | 2.5% |
| PA | Pipeline Natural Gas | Water Injection | 8,907 | 9.5% |
| PA | Pipeline Natural Gas | Water Injection Overfire Air Selective Catalytic Reduction | 10,060 | 10.8% |
| PA | Process Gas | | 2,945 | 60.2% |
| PA | Process Gas | Low NOx Burner Technology (Dry Bottom only) | 1,950 | 39.8% |
| PA | Residual Oil | | 26,213 | 74.5% |
| PA | Residual Oil | Low NOx Burner Technology (Dry Bottom only) | 761 | 2.2% |
| PA | Residual Oil | Other | 8,232 | 23.4% |
| RI | Pipeline Natural Gas | Dry Low NOx Burners Selective Catalytic Reduction | 4,589 | 25.9% |
| RI | Pipeline Natural Gas | Dry Low NOx Burners Selective Catalytic Reduction Steam Injection | 3,915 | 22.1% |
| RI | Pipeline Natural Gas | Selective Catalytic Reduction | 1,943 | 11.0% |
| RI | Pipeline Natural Gas | Water Injection Selective Catalytic Reduction | 7,300 | 41.1% |
| VA | Coal | | 2,349 | 3.5% |
| VA | Coal | Combustion Modification/Fuel Reburning Low NOx Burner Technology w/ Separated OFA | 4,823 | 7.2% |
| VA | Coal | Low NOx Burner Technology (Dry Bottom only) | 8,632 | 12.9% |
| VA | Coal | Low NOx Burner Technology (Dry Bottom only) Ammonia Injection | 322 | 0.5% |
| VA | Coal | Low NOx Burner Technology (Dry Bottom only) Other | 1,838 | 2.7% |
| VA | Coal | Low NOx Burner Technology (Dry Bottom only) Selective Catalytic Reduction | 1,717 | 2.6% |
| VA | Coal | Low NOx Burner Technology w/ Closed-coupled/Separated OFA Selective Catalytic | 7,206 | 10.7% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| | | Reduction | | |
| VA | Coal | Low NOx Burner Technology w/ Overfire Air | 1,669 | 2.5% |
| VA | Coal | Low NOx Burner Technology w/ Separated OFA Selective Catalytic Reduction | 3,604 | 5.4% |
| VA | Coal | Low NOx Burner Technology w/ Separated OFA Selective Non-catalytic Reduction | 3,623 | 5.4% |
| VA | Coal | Other | 5,344 | 8.0% |
| VA | Coal | Other Overfire Air | 507 | 0.8% |
| VA | Coal | Other Selective Non-catalytic Reduction | 2,758 | 4.1% |
| VA | Coal | Overfire Air | 3,856 | 5.7% |
| VA | Coal | Overfire Air Other | 440 | 0.7% |
| VA | Coal | Overfire Air Selective Non-catalytic Reduction | 1,548 | 2.3% |
| VA | Coal | Selective Catalytic Reduction | 4,782 | 7.1% |
| VA | Coal | Selective Catalytic Reduction Other | 1,761 | 2.6% |
| VA | Coal | Selective Non-catalytic Reduction Other | 10,300 | 15.4% |
| VA | Diesel Oil | | 460 | 12.6% |
| VA | Diesel Oil | Water Injection | 3,178 | 87.4% |
| VA | Natural Gas | | 325 | 43.3% |
| VA | Natural Gas | Low NOx Burner Technology (Dry Bottom only) | 425 | 56.7% |
| VA | Pipeline Natural Gas | | 285 | 0.3% |
| VA | Pipeline Natural Gas | Dry Low NOx Burners Selective Catalytic Reduction | 893 | 1.0% |
| VA | Pipeline Natural Gas | Dry Low NOx Burners Selective Catalytic Reduction Steam Injection | 6,248 | 7.3% |
| VA | Pipeline Natural Gas | Dry Low NOx Burners Water Injection | 28,692 | 33.7% |
| VA | Pipeline Natural Gas | Dry Low NOx Burners Water Injection Selective Catalytic Reduction | 15,411 | 18.1% |
| VA | Pipeline Natural Gas | Low NOx Burner Technology (Dry Bottom only) | 254 | 0.3% |
| VA | Pipeline Natural Gas | Low NOx Burner Technology w/ Closed-coupled OFA | 3,686 | 4.3% |
| VA | Pipeline Natural Gas | Selective Catalytic Reduction Steam Injection | 2,486 | 2.9% |
| VA | Pipeline Natural Gas | Steam Injection | 8,511 | 1 % |
| VA | Pipeline Natural Gas | Water Injection | 18,621 | 21.9% |

| State | Primary Fuel | NOx Control | Capacity (MMBtu/hr | Percent of State Fuel |
|---|---|---|---|---|
| VA | Residual Oil | | 280 | 1.6% |
| VA | Residual Oil | Other | 8,909 | 50.4% |
| VA | Residual Oil | Overfire Air Other | 8,486 | 48.0% |
| VT | Wood | Other | 842 | 100% |

**Table 13-2.** Capacity percentages by State, fuel and $SO_2$ control technology.

| State | Primary Fuel | $SO_2$ Control | Capacity (mmBtu/hr) | Percent of State Fuel |
|---|---|---|---|---|
| CT | Coal | | 4,100 | 66.2% |
| CT | Coal | Fluidized Bed Limestone Injection | 2,090 | 33.8% |
| CT | Diesel Oil | | 3,361 | 100% |
| CT | Other Oil | | 2,499 | 100% |
| CT | Pipeline Natural Gas | | 22,315 | 100% |
| CT | Residual Oil | | 27,536 | 100% |
| DC | Pipeline Natural Gas | | 1,326 | 100% |
| DC | Residual Oil | | 6,460 | 100% |
| DE | Coal | | 12,655 | 100% |
| DE | Diesel Oil | | 7,746 | 100% |
| DE | Other Gas | | 2,186 | 100% |
| DE | Pipeline Natural Gas | | 6,753 | 100% |
| DE | Process Gas | | 6,506 | 90.5% |
| DE | Process Gas | Other (Retired Mar 31, 2007) | 680 | 9.5% |
| DE | Residual Oil | | 6,325 | 100% |
| MA | Coal | | 16,437 | 100% |
| MA | Diesel Oil | | 10,209 | 100% |
| MA | Other Oil | | 1,122 | 100% |
| MA | Pipeline Natural Gas | | 57,646 | 100% |
| MA | Residual Oil | | 33,321 | 100% |
| MD | Coal | | 46,397 | 95.8% |
| MD | Coal | Fluidized Bed Limestone Injection | 2,047 | 4.2% |
| MD | Diesel Oil | | 6,056 | 100% |
| MD | Other Oil | | 5,537 | 100% |
| MD | Pipeline Natural Gas | | 26,944 | 100% |
| MD | Residual Oil | | 16,008 | 100% |
| ME | Pipeline Natural Gas | | 18,568 | 100% |
| ME | Residual Oil | | 8,740 | 100% |
| NH | Coal | | 5,545 | 100% |
| NH | Diesel Oil | | 260 | 100% |

| State | Primary Fuel | $SO_2$ Control | Capacity (mmBtu/hr) | Percent of State Fuel |
|---|---|---|---|---|
| NH | Other Oil | | 1,002 | 100% |
| NH | Pipeline Natural Gas | | 9,813 | 100% |
| NH | Residual Oil | | 4,429 | 100% |
| NH | Wood | Fluidized Bed Limestone Injection | 720 | 100% |
| NJ | Coal | | 15,787 | 69.1% |
| NJ | Coal | Dry Lime FGD | 5,476 | 24.0% |
| NJ | Coal | Wet Limestone | 1,600 | 7.0% |
| NJ | Diesel Oil | | 22,740 | 100% |
| NJ | Pipeline Natural Gas | | 115,411 | 100% |
| NJ | Process Gas | | 5,637 | 100% |
| NJ | Residual Oil | | 8,567 | 100% |
| NY | Coal | | 37,072 | 74.9% |
| NY | Coal | Dry Lime FGD | 747 | 1.5% |
| NY | Coal | Dry Lime FGD (Began May 29, 2007) | 1,345 | 2.7% |
| NY | Coal | Wet Limestone | 10,332 | 20.9% |
| NY | Coal, Wood | Fluidized Bed Limestone Injection | 692 | 100% |
| NY | Diesel Oil | | 34,731 | 100% |
| NY | Natural Gas | | 1,227 | 100% |
| NY | Other Oil | | 26,584 | 100% |
| NY | Pipeline Natural Gas | | 129,983 | 100% |
| NY | Residual Oil | | 80,754 | 100% |
| PA | Coal | | 115,060 | 59.7% |
| PA | Coal | Dry Lime FGD | 1,227 | 0.6% |
| PA | Coal | Fluidized Bed Limestone Injection | 7,464 | 3.9% |
| PA | Coal | Magnesium Oxide | 10,335 | 5.4% |
| PA | Coal | Wet Lime FGD | 32,667 | 16.9% |
| PA | Coal | Wet Limestone | 25,993 | 13.5% |
| PA | Coal Refuse | Fluidized Bed Limestone Injection | 8,610 | 100% |
| PA | Diesel Oil | | 12,371 | 100% |
| PA | Other Gas | | 2,177 | 100% |
| PA | Other Oil | | 853 | 100% |
| PA | Pipeline Natural Gas | | 93,377 | 100% |

| State | Primary Fuel | $SO_2$ Control | Capacity (mmBtu/hr) | Percent of State Fuel |
|---|---|---|---|---|
| PA | Process Gas | | 4,895 | 100% |
| PA | Residual Oil | | 35,206 | 100% |
| RI | Pipeline Natural Gas | | 17,748 | 100% |
| VA | Coal | | 40,886 | 61.0% |
| VA | Coal | Dry Lime FGD | 9,317 | 13.9% |
| VA | Coal | Dry Lime FGD (Began Nov 07, 2007) | 200 | 0.3% |
| VA | Coal | Dry Lime FGD (Began Nov 08, 2007) | 400 | 0.6% |
| VA | Coal | Dry Lime FGD (Began Oct 10, 2007) | 600 | 0.9% |
| VA | Coal | Sodium Based | 4,823 | 7.2% |
| VA | Coal | Sodium Based (Began Oct 05, 2007) | 553 | 0.8% |
| VA | Coal | Wet Limestone | 10,300 | 15.4% |
| VA | Diesel Oil | | 3,638 | 100% |
| VA | Natural Gas | | 750 | 100% |
| VA | Pipeline Natural Gas | | 85,087 | 100% |
| VA | Residual Oil | | 17,675 | 100% |
| VT | Wood | | 842 | 100% |

# APPENDIX A

## LIST OF
## COMBINED STATISTICAL AREAS (CSAs) AND
## CORE BASED STATISTICAL AREAS (CBSAs)
## IN THE MANE-VU+VA REGION

**(Counties Not Listed Are Not in a CSA or CBSA)**

**Source: U.S. Census Bureau, Population Division**

**Internet Release Date: August 2009**

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 36001 | New York | Albany County | 104 | Albany-Schenectady-Amsterdam, NY | 10580 | Albany-Schenectady-Troy, NY |
| 36083 | New York | Rensselaer County | 104 | Albany-Schenectady-Amsterdam, NY | 10580 | Albany-Schenectady-Troy, NY |
| 36091 | New York | Saratoga County | 104 | Albany-Schenectady-Amsterdam, NY | 10580 | Albany-Schenectady-Troy, NY |
| 36093 | New York | Schenectady County | 104 | Albany-Schenectady-Amsterdam, NY | 10580 | Albany-Schenectady-Troy, NY |
| 36095 | New York | Schoharie County | 104 | Albany-Schenectady-Amsterdam, NY | 10580 | Albany-Schenectady-Troy, NY |
| 36057 | New York | Montgomery County | 104 | Albany-Schenectady-Amsterdam, NY | 11220 | Amsterdam, NY |
| 36113 | New York | Warren County | 104 | Albany-Schenectady-Amsterdam, NY | 24020 | Glens Falls, NY |
| 36115 | New York | Washington County | 104 | Albany-Schenectady-Amsterdam, NY | 24020 | Glens Falls, NY |
| 36035 | New York | Fulton County | 104 | Albany-Schenectady-Amsterdam, NY | 24100 | Gloversville, NY |
| 36021 | New York | Columbia County | 104 | Albany-Schenectady-Amsterdam, NY | 26460 | Hudson, NY |
| 25009 | Massachusetts | Essex County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 14460 | Boston-Cambridge-Quincy, MA-NH |
| 25017 | Massachusetts | Middlesex County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 14460 | Boston-Cambridge-Quincy, MA-NH |
| 25021 | Massachusetts | Norfolk County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 14460 | Boston-Cambridge-Quincy, MA-NH |
| 25023 | Massachusetts | Plymouth County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 14460 | Boston-Cambridge-Quincy, MA-NH |
| 25025 | Massachusetts | Suffolk County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 14460 | Boston-Cambridge-Quincy, MA-NH |
| 33015 | New Hampshire | Rockingham County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 14460 | Boston-Cambridge-Quincy, MA-NH |
| 33017 | New Hampshire | Strafford County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 14460 | Boston-Cambridge-Quincy, MA-NH |
| 33013 | New Hampshire | Merrimack County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 18180 | Concord, NH |
| 33001 | New Hampshire | Belknap County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 29060 | Laconia, NH |
| 33011 | New Hampshire | Hillsborough County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 31700 | Manchester-Nashua, NH |
| 25005 | Massachusetts | Bristol County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 39300 | Providence-New Bedford-Fall River |
| 44001 | Rhode Island | Bristol County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 39300 | Providence-New Bedford-Fall River |
| 44003 | Rhode Island | Kent County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 39300 | Providence-New Bedford-Fall River |
| 44005 | Rhode Island | Newport County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 39300 | Providence-New Bedford-Fall River |
| 44007 | Rhode Island | Providence County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 39300 | Providence-New Bedford-Fall River |
| 44009 | Rhode Island | Washington County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 39300 | Providence-New Bedford-Fall River |
| 25027 | Massachusetts | Worcester County | 148 | Boston-Worcester-Manchester, MA-RI-NH | 49340 | Worcester, MA |
| 36029 | New York | Erie County | 160 | Buffalo-Niagara-Cattaraugus, NY | 15380 | Buffalo-Niagara Falls, NY |
| 36063 | New York | Niagara County | 160 | Buffalo-Niagara-Cattaraugus, NY | 15380 | Buffalo-Niagara Falls, NY |
| 36009 | New York | Cattaraugus County | 160 | Buffalo-Niagara-Cattaraugus, NY | 36460 | Olean, NY |
| 33019 | New Hampshire | Sullivan County | 180 | Claremont-Lebanon, NH-VT | 17200 | Claremont, NH |
| 33009 | New Hampshire | Grafton County | 180 | Claremont-Lebanon, NH-VT | 30100 | Lebanon, NH-VT |
| 50017 | Vermont | Orange County | 180 | Claremont-Lebanon, NH-VT | 30100 | Lebanon, NH-VT |
| 50027 | Vermont | Windsor County | 180 | Claremont-Lebanon, NH-VT | 30100 | Lebanon, NH-VT |

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 42041 | Pennsylvania | Cumberland County | 276 | Harrisburg-Carlisle-Lebanon, PA | 25420 | Harrisburg-Carlisle, PA |
| 42043 | Pennsylvania | Dauphin County | 276 | Harrisburg-Carlisle-Lebanon, PA | 25420 | Harrisburg-Carlisle, PA |
| 42099 | Pennsylvania | Perry County | 276 | Harrisburg-Carlisle-Lebanon, PA | 25420 | Harrisburg-Carlisle, PA |
| 42075 | Pennsylvania | Lebanon County | 276 | Harrisburg-Carlisle-Lebanon, PA | 30140 | Lebanon, PA |
| 09003 | Connecticut | Hartford County | 278 | Hartford-West Hartford-Willimantic, CT | 25540 | Hartford-West Hartford-East Hartford, CT |
| 09007 | Connecticut | Middlesex County | 278 | Hartford-West Hartford-Willimantic, CT | 25540 | Hartford-West Hartford-East Hartford, CT |
| 09013 | Connecticut | Tolland County | 278 | Hartford-West Hartford-Willimantic, CT | 25540 | Hartford-West Hartford-East Hartford, CT |
| 09015 | Connecticut | Windham County | 278 | Hartford-West Hartford-Willimantic, CT | 48740 | Willimantic, CT |
| 36023 | New York | Cortland County | 296 | Ithaca-Cortland, NY | 18660 | Cortland, NY |
| 36109 | New York | Tompkins County | 296 | Ithaca-Cortland, NY | 27060 | Ithaca, NY |
| 51169 | Virginia | Scott County | 304 | Johnson City-Kingsport-Bristol, TN-VA | 28700 | Kingsport-Bristol-Bristol, TN-VA |
| 51191 | Virginia | Washington County | 304 | Johnson City-Kingsport-Bristol, TN-VA | 28700 | Kingsport-Bristol-Bristol, TN-VA |
| 51520 | Virginia | Bristol city | 304 | Johnson City-Kingsport-Bristol, TN-VA | 28700 | Kingsport-Bristol-Bristol, TN-VA |
| 09001 | Connecticut | Fairfield County | 408 | New York-Newark-Bridgeport | 14860 | Bridgeport-Stamford-Norwalk, CT |
| 36111 | New York | Ulster County | 408 | New York-Newark-Bridgeport | 28740 | Kingston, NY |
| 09009 | Connecticut | New Haven County | 408 | New York-Newark-Bridgeport | 35300 | New Haven-Milford, CT |
| 34003 | New Jersey | Bergen County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34013 | New Jersey | Essex County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34017 | New Jersey | Hudson County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34019 | New Jersey | Hunterdon County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34023 | New Jersey | Middlesex County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34025 | New Jersey | Monmouth County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34027 | New Jersey | Morris County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34029 | New Jersey | Ocean County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34031 | New Jersey | Passaic County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34035 | New Jersey | Somerset County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34037 | New Jersey | Sussex County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 34039 | New Jersey | Union County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36005 | New York | Bronx County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36047 | New York | Kings County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36059 | New York | Nassau County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36061 | New York | New York County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36079 | New York | Putnam County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36081 | New York | Queens County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36085 | New York | Richmond County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 36087 | New York | Rockland County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36103 | New York | Suffolk County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36119 | New York | Westchester County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 42103 | Pennsylvania | Pike County | 408 | New York-Newark-Bridgeport | 35620 | New York-Northern NJ-Long Island |
| 36027 | New York | Dutchess County | 408 | New York-Newark-Bridgeport | 39100 | Poughkeepsie-Newburgh-Middletown, NY |
| 36071 | New York | Orange County | 408 | New York-Newark-Bridgeport | 39100 | Poughkeepsie-Newburgh-Middletown, NY |
| 09005 | Connecticut | Litchfield County | 408 | New York-Newark-Bridgeport | 45860 | Torrington, CT |
| 34021 | New Jersey | Mercer County | 408 | New York-Newark-Bridgeport | 45940 | Trenton-Ewing, NJ |
| 10003 | Delaware | New Castle County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 24015 | Maryland | Cecil County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 34005 | New Jersey | Burlington County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 34007 | New Jersey | Camden County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 34015 | New Jersey | Gloucester County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 34033 | New Jersey | Salem County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 42017 | Pennsylvania | Bucks County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 42029 | Pennsylvania | Chester County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 42045 | Pennsylvania | Delaware County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 42091 | Pennsylvania | Montgomery County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 42101 | Pennsylvania | Philadelphia County | 428 | Philadelphia-Camden-Vineland | 37980 | Philadelphia-Camden-Wilmington |
| 42011 | Pennsylvania | Berks County | 428 | Philadelphia-Camden-Vineland | 39740 | Reading, PA |
| 34011 | New Jersey | Cumberland County | 428 | Philadelphia-Camden-Vineland | 47220 | Vineland-Millville-Bridgeton, NJ |
| 42073 | Pennsylvania | Lawrence County | 430 | Pittsburgh-New Castle, PA | 35260 | New Castle, PA |
| 42003 | Pennsylvania | Allegheny County | 430 | Pittsburgh-New Castle, PA | 38300 | Pittsburgh, PA |
| 42005 | Pennsylvania | Armstrong County | 430 | Pittsburgh-New Castle, PA | 38300 | Pittsburgh, PA |
| 42007 | Pennsylvania | Beaver County | 430 | Pittsburgh-New Castle, PA | 38300 | Pittsburgh, PA |
| 42019 | Pennsylvania | Butler County | 430 | Pittsburgh-New Castle, PA | 38300 | Pittsburgh, PA |
| 42051 | Pennsylvania | Fayette County | 430 | Pittsburgh-New Castle, PA | 38300 | Pittsburgh, PA |
| 42125 | Pennsylvania | Washington County | 430 | Pittsburgh-New Castle, PA | 38300 | Pittsburgh, PA |
| 42129 | Pennsylvania | Westmoreland County | 430 | Pittsburgh-New Castle, PA | 38300 | Pittsburgh, PA |
| 23001 | Maine | Androscoggin County | 438 | Portland-Lewiston-South Portland, ME | 30340 | Lewiston-Auburn, ME |
| 23005 | Maine | Cumberland County | 438 | Portland-Lewiston-South Portland, ME | 38860 | Portland-South Portland-Biddeford, ME |
| 23023 | Maine | Sagadahoc County | 438 | Portland-Lewiston-South Portland, ME | 38860 | Portland-South Portland-Biddeford, ME |
| 23031 | Maine | York County | 438 | Portland-Lewiston-South Portland, ME | 38860 | Portland-South Portland-Biddeford, ME |
| 36037 | New York | Genesee County | 464 | Rochester-Batavia-Seneca Falls, NY | 12860 | Batavia, NY |
| 36051 | New York | Livingston County | 464 | Rochester-Batavia-Seneca Falls, NY | 40380 | Rochester, NY |

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 36055 | New York | Monroe County | 464 | Rochester-Batavia-Seneca Falls, NY | 40380 | Rochester, NY |
| 36069 | New York | Ontario County | 464 | Rochester-Batavia-Seneca Falls, NY | 40380 | Rochester, NY |
| 36073 | New York | Orleans County | 464 | Rochester-Batavia-Seneca Falls, NY | 40380 | Rochester, NY |
| 36117 | New York | Wayne County | 464 | Rochester-Batavia-Seneca Falls, NY | 40380 | Rochester, NY |
| 36099 | New York | Seneca County | 464 | Rochester-Batavia-Seneca Falls, NY | 42900 | Seneca Falls, NY |
| 24047 | Maryland | Worcester County | 480 | Salisbury-Ocean Pines, MD | 36180 | Ocean Pines, MD |
| 24039 | Maryland | Somerset County | 480 | Salisbury-Ocean Pines, MD | 41540 | Salisbury, MD |
| 24045 | Maryland | Wicomico County | 480 | Salisbury-Ocean Pines, MD | 41540 | Salisbury, MD |
| 42119 | Pennsylvania | Union County | 526 | Sunbury-Lewisburg-Selinsgrove, PA | 30260 | Lewisburg, PA |
| 42109 | Pennsylvania | Snyder County | 526 | Sunbury-Lewisburg-Selinsgrove, PA | 42780 | Selinsgrove, PA |
| 42097 | Pennsylvania | Northumberland County | 526 | Sunbury-Lewisburg-Selinsgrove, PA | 44980 | Sunbury, PA |
| 36011 | New York | Cayuga County | 532 | Syracuse-Auburn, NY | 12180 | Auburn, NY |
| 36053 | New York | Madison County | 532 | Syracuse-Auburn, NY | 45060 | Syracuse, NY |
| 36067 | New York | Onondaga County | 532 | Syracuse-Auburn, NY | 45060 | Syracuse, NY |
| 36075 | New York | Oswego County | 532 | Syracuse-Auburn, NY | 45060 | Syracuse, NY |
| 24003 | Maryland | Anne Arundel County | 548 | Washington-Baltimore-Northern Virginia | 12580 | Baltimore-Towson, MD |
| 24005 | Maryland | Baltimore County | 548 | Washington-Baltimore-Northern Virginia | 12580 | Baltimore-Towson, MD |
| 24013 | Maryland | Carroll County | 548 | Washington-Baltimore-Northern Virginia | 12580 | Baltimore-Towson, MD |
| 24025 | Maryland | Harford County | 548 | Washington-Baltimore-Northern Virginia | 12580 | Baltimore-Towson, MD |
| 24027 | Maryland | Howard County | 548 | Washington-Baltimore-Northern Virginia | 12580 | Baltimore-Towson, MD |
| 24035 | Maryland | Queen Anne's County | 548 | Washington-Baltimore-Northern Virginia | 12580 | Baltimore-Towson, MD |
| 24510 | Maryland | Baltimore city | 548 | Washington-Baltimore-Northern Virginia | 12580 | Baltimore-Towson, MD |
| 51047 | Virginia | Culpeper County | 548 | Washington-Baltimore-Northern Virginia | 19020 | Culpeper, VA |
| 24037 | Maryland | St. Mary's County | 548 | Washington-Baltimore-Northern Virginia | 30500 | Lexington Park, MD |
| 11001 | DC | District of Columbia | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 24009 | Maryland | Calvert County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 24017 | Maryland | Charles County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 24021 | Maryland | Frederick County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 24031 | Maryland | Montgomery County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 24033 | Maryland | Prince George's County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51013 | Virginia | Arlington County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51043 | Virginia | Clarke County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51059 | Virginia | Fairfax County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51061 | Virginia | Fauquier County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51107 | Virginia | Loudoun County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 51153 | Virginia | Prince William County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51177 | Virginia | Spotsylvania County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51179 | Virginia | Stafford County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51187 | Virginia | Warren County | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51510 | Virginia | Alexandria city | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51600 | Virginia | Fairfax city | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51610 | Virginia | Falls Church city | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51630 | Virginia | Fredericksburg city | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51683 | Virginia | Manassas city | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51685 | Virginia | Manassas Park city | 548 | Washington-Baltimore-Northern Virginia | 47900 | Washington-Arlington-Alexandria |
| 51069 | Virginia | Frederick County | 548 | Washington-Baltimore-Northern Virginia | 49020 | Winchester, VA-WV |
| 51840 | Virginia | Winchester city | 548 | Washington-Baltimore-Northern Virginia | 49020 | Winchester, VA-WV |
| 42035 | Pennsylvania | Clinton County | 558 | Williamsport-Lock Haven, PA | 30820 | Lock Haven, PA |
| 42081 | Pennsylvania | Lycoming County | 558 | Williamsport-Lock Haven, PA | 48700 | Williamsport, PA |
| 42001 | Pennsylvania | Adams County | 564 | York-Hanover-Gettysburg, PA | 23900 | Gettysburg, PA |
| 42133 | Pennsylvania | York County | 564 | York-Hanover-Gettysburg, PA | 49620 | York-Hanover, PA |
| 42085 | Pennsylvania | Mercer County | 566 | Youngstown-Warren-East Liverpool | 49660 | Youngstown-Warren-Boardman |
| 34041 | New Jersey | Warren County | | Not in a CSA | 10900 | Allentown-Bethlehem-Easton, PA-NJ |
| 42025 | Pennsylvania | Carbon County | | Not in a CSA | 10900 | Allentown-Bethlehem-Easton, PA-NJ |
| 42077 | Pennsylvania | Lehigh County | | Not in a CSA | 10900 | Allentown-Bethlehem-Easton, PA-NJ |
| 42095 | Pennsylvania | Northampton County | | Not in a CSA | 10900 | Allentown-Bethlehem-Easton, PA-NJ |
| 42013 | Pennsylvania | Blair County | | Not in a CSA | 11020 | Altoona, PA |
| 34001 | New Jersey | Atlantic County | | Not in a CSA | 12100 | Atlantic City-Hammonton, NJ |
| 23011 | Maine | Kennebec County | | Not in a CSA | 12300 | Augusta-Waterville, ME |
| 23019 | Maine | Penobscot County | | Not in a CSA | 12620 | Bangor, ME |
| 25001 | Massachusetts | Barnstable County | | Not in a CSA | 12700 | Barnstable Town, MA |
| 50023 | Vermont | Washington County | | Not in a CSA | 12740 | Barre, VT |
| 50003 | Vermont | Bennington County | | Not in a CSA | 13540 | Bennington, VT |
| 33007 | New Hampshire | Coos County | | Not in a CSA | 13620 | Berlin, NH-VT |
| 50009 | Vermont | Essex County | | Not in a CSA | 13620 | Berlin, NH-VT |
| 36007 | New York | Broome County | | Not in a CSA | 13780 | Binghamton, NY |
| 36107 | New York | Tioga County | | Not in a CSA | 13780 | Binghamton, NY |
| 51071 | Virginia | Giles County | | Not in a CSA | 13980 | Blacksburg-Christiansburg-Radford, VA |
| 51121 | Virginia | Montgomery County | | Not in a CSA | 13980 | Blacksburg-Christiansburg-Radford, VA |
| 51155 | Virginia | Pulaski County | | Not in a CSA | 13980 | Blacksburg-Christiansburg-Radford, VA |

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 51750 | Virginia | Radford city | | Not in a CSA | 13980 | Blacksburg-Christiansburg-Radford, VA |
| 42037 | Pennsylvania | Columbia County | | Not in a CSA | 14100 | Bloomsburg-Berwick, PA |
| 42093 | Pennsylvania | Montour County | | Not in a CSA | 14100 | Bloomsburg-Berwick, PA |
| 51185 | Virginia | Tazewell County | | Not in a CSA | 14140 | Bluefield, WV-VA |
| 42083 | Pennsylvania | McKean County | | Not in a CSA | 14620 | Bradford, PA |
| 50007 | Vermont | Chittenden County | | Not in a CSA | 15540 | Burlington-South Burlington, VT |
| 50011 | Vermont | Franklin County | | Not in a CSA | 15540 | Burlington-South Burlington, VT |
| 50013 | Vermont | Grand Isle County | | Not in a CSA | 15540 | Burlington-South Burlington, VT |
| 24019 | Maryland | Dorchester County | | Not in a CSA | 15700 | Cambridge, MD |
| 42055 | Pennsylvania | Franklin County | | Not in a CSA | 16540 | Chambersburg, PA |
| 51003 | Virginia | Albemarle County | | Not in a CSA | 16820 | Charlottesville, VA |
| 51065 | Virginia | Fluvanna County | | Not in a CSA | 16820 | Charlottesville, VA |
| 51079 | Virginia | Greene County | | Not in a CSA | 16820 | Charlottesville, VA |
| 51125 | Virginia | Nelson County | | Not in a CSA | 16820 | Charlottesville, VA |
| 51540 | Virginia | Charlottesville city | | Not in a CSA | 16820 | Charlottesville, VA |
| 36101 | New York | Steuben County | | Not in a CSA | 18500 | Corning, NY |
| 24001 | Maryland | Allegany County | | Not in a CSA | 19060 | Cumberland, MD-WV |
| 51143 | Virginia | Pittsylvania County | | Not in a CSA | 19260 | Danville, VA |
| 51590 | Virginia | Danville city | | Not in a CSA | 19260 | Danville, VA |
| 10001 | Delaware | Kent County | | Not in a CSA | 20100 | Dover, DE |
| 42033 | Pennsylvania | Clearfield County | | Not in a CSA | 20180 | DuBois, PA |
| 42089 | Pennsylvania | Monroe County | | Not in a CSA | 20700 | East Stroudsburg, PA |
| 24041 | Maryland | Talbot County | | Not in a CSA | 20660 | Easton, MD |
| 36015 | New York | Chemung County | | Not in a CSA | 21300 | Elmira, NY |
| 42049 | Pennsylvania | Erie County | | Not in a CSA | 21500 | Erie, PA |
| 24043 | Maryland | Washington County | | Not in a CSA | 25180 | Hagerstown-Martinsburg, MD-WV |
| 51165 | Virginia | Rockingham County | | Not in a CSA | 25500 | Harrisonburg, VA |
| 51660 | Virginia | Harrisonburg city | | Not in a CSA | 25500 | Harrisonburg, VA |
| 42061 | Pennsylvania | Huntingdon County | | Not in a CSA | 26500 | Huntingdon, PA |
| 42063 | Pennsylvania | Indiana County | | Not in a CSA | 26860 | Indiana, PA |
| 36013 | New York | Chautauqua County | | Not in a CSA | 27460 | Jamestown-Dunkirk-Fredonia, NY |
| 42021 | Pennsylvania | Cambria County | | Not in a CSA | 27780 | Johnstown, PA |
| 33005 | New Hampshire | Cheshire County | | Not in a CSA | 28300 | Keene, NH |
| 42071 | Pennsylvania | Lancaster County | | Not in a CSA | 29540 | Lancaster, PA |
| 42087 | Pennsylvania | Mifflin County | | Not in a CSA | 30380 | Lewistown, PA |

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 51009 | Virginia | Amherst County | | Not in a CSA | 31340 | Lynchburg, VA |
| 51011 | Virginia | Appomattox County | | Not in a CSA | 31340 | Lynchburg, VA |
| 51019 | Virginia | Bedford County | | Not in a CSA | 31340 | Lynchburg, VA |
| 51031 | Virginia | Campbell County | | Not in a CSA | 31340 | Lynchburg, VA |
| 51515 | Virginia | Bedford city | | Not in a CSA | 31340 | Lynchburg, VA |
| 51680 | Virginia | Lynchburg city | | Not in a CSA | 31340 | Lynchburg, VA |
| 36033 | New York | Franklin County | | Not in a CSA | 31660 | Malone, NY |
| 51089 | Virginia | Henry County | | Not in a CSA | 32300 | Martinsville, VA |
| 51690 | Virginia | Martinsville city | | Not in a CSA | 32300 | Martinsville, VA |
| 42039 | Pennsylvania | Crawford County | | Not in a CSA | 32740 | Meadville, PA |
| 09011 | Connecticut | New London County | | Not in a CSA | 35980 | Norwich-New London, CT |
| 34009 | New Jersey | Cape May County | | Not in a CSA | 36140 | Ocean City, NJ |
| 36089 | New York | St. Lawrence County | | Not in a CSA | 36300 | Ogdensburg-Massena, NY |
| 42121 | Pennsylvania | Venango County | | Not in a CSA | 36340 | Oil City, PA |
| 36077 | New York | Otsego County | | Not in a CSA | 36580 | Oneonta, NY |
| 25003 | Massachusetts | Berkshire County | | Not in a CSA | 38340 | Pittsfield, MA |
| 36019 | New York | Clinton County | | Not in a CSA | 38460 | Plattsburgh, NY |
| 42107 | Pennsylvania | Schuylkill County | | Not in a CSA | 39060 | Pottsville, PA |
| 51007 | Virginia | Amelia County | | Not in a CSA | 40060 | Richmond, VA |
| 51033 | Virginia | Caroline County | | Not in a CSA | 40060 | Richmond, VA |
| 51036 | Virginia | Charles City County | | Not in a CSA | 40060 | Richmond, VA |
| 51041 | Virginia | Chesterfield County | | Not in a CSA | 40060 | Richmond, VA |
| 51049 | Virginia | Cumberland County | | Not in a CSA | 40060 | Richmond, VA |
| 51053 | Virginia | Dinwiddie County | | Not in a CSA | 40060 | Richmond, VA |
| 51075 | Virginia | Goochland County | | Not in a CSA | 40060 | Richmond, VA |
| 51085 | Virginia | Hanover County | | Not in a CSA | 40060 | Richmond, VA |
| 51087 | Virginia | Henrico County | | Not in a CSA | 40060 | Richmond, VA |
| 51097 | Virginia | King and Queen County | | Not in a CSA | 40060 | Richmond, VA |
| 51101 | Virginia | King William County | | Not in a CSA | 40060 | Richmond, VA |
| 51109 | Virginia | Louisa County | | Not in a CSA | 40060 | Richmond, VA |
| 51127 | Virginia | New Kent County | | Not in a CSA | 40060 | Richmond, VA |
| 51145 | Virginia | Powhatan County | | Not in a CSA | 40060 | Richmond, VA |
| 51149 | Virginia | Prince George County | | Not in a CSA | 40060 | Richmond, VA |
| 51183 | Virginia | Sussex County | | Not in a CSA | 40060 | Richmond, VA |
| 51570 | Virginia | Colonial Heights city | | Not in a CSA | 40060 | Richmond, VA |

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 51670 | Virginia | Hopewell city | | Not in a CSA | 40060 | Richmond, VA |
| 51730 | Virginia | Petersburg city | | Not in a CSA | 40060 | Richmond, VA |
| 51760 | Virginia | Richmond city | | Not in a CSA | 40060 | Richmond, VA |
| 51023 | Virginia | Botetourt County | | Not in a CSA | 40220 | Roanoke, VA |
| 51045 | Virginia | Craig County | | Not in a CSA | 40220 | Roanoke, VA |
| 51067 | Virginia | Franklin County | | Not in a CSA | 40220 | Roanoke, VA |
| 51161 | Virginia | Roanoke County | | Not in a CSA | 40220 | Roanoke, VA |
| 51770 | Virginia | Roanoke city | | Not in a CSA | 40220 | Roanoke, VA |
| 51775 | Virginia | Salem city | | Not in a CSA | 40220 | Roanoke, VA |
| 23013 | Maine | Knox County | | Not in a CSA | 40500 | Rockland, ME |
| 50021 | Vermont | Rutland County | | Not in a CSA | 40860 | Rutland, VT |
| 42015 | Pennsylvania | Bradford County | | Not in a CSA | 42380 | Sayre, PA |
| 42069 | Pennsylvania | Lackawanna County | | Not in a CSA | 42540 | Scranton--Wilkes-Barre, PA |
| 42079 | Pennsylvania | Luzerne County | | Not in a CSA | 42540 | Scranton--Wilkes-Barre, PA |
| 42131 | Pennsylvania | Wyoming County | | Not in a CSA | 42540 | Scranton--Wilkes-Barre, PA |
| 10005 | Delaware | Sussex County | | Not in a CSA | 42580 | Seaford, DE |
| 42111 | Pennsylvania | Somerset County | | Not in a CSA | 43740 | Somerset, PA |
| 25011 | Massachusetts | Franklin County | | Not in a CSA | 44140 | Springfield, MA |
| 25013 | Massachusetts | Hampden County | | Not in a CSA | 44140 | Springfield, MA |
| 25015 | Massachusetts | Hampshire County | | Not in a CSA | 44140 | Springfield, MA |
| 42047 | Pennsylvania | Elk County | | Not in a CSA | 41260 | St. Marys, PA |
| 42027 | Pennsylvania | Centre County | | Not in a CSA | 44300 | State College, PA |
| 51015 | Virginia | Augusta County | | Not in a CSA | 44420 | Staunton-Waynesboro, VA |
| 51790 | Virginia | Staunton city | | Not in a CSA | 44420 | Staunton-Waynesboro, VA |
| 51820 | Virginia | Waynesboro city | | Not in a CSA | 44420 | Staunton-Waynesboro, VA |
| 36043 | New York | Herkimer County | | Not in a CSA | 46540 | Utica-Rome, NY |
| 36065 | New York | Oneida County | | Not in a CSA | 46540 | Utica-Rome, NY |
| 51073 | Virginia | Gloucester County | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51093 | Virginia | Isle of Wight County | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51095 | Virginia | James City County | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51115 | Virginia | Mathews County | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51181 | Virginia | Surry County | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51199 | Virginia | York County | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51550 | Virginia | Chesapeake city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51650 | Virginia | Hampton city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |

| FIPS | State | Component Name | CSA Code | CSA Title | CBSA Code | CBSA Title |
|---|---|---|---|---|---|---|
| 51700 | Virginia | Newport News city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51710 | Virginia | Norfolk city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51735 | Virginia | Poquoson city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51740 | Virginia | Portsmouth city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51800 | Virginia | Suffolk city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51810 | Virginia | Virginia Beach city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 51830 | Virginia | Williamsburg city | | Not in a CSA | 47260 | Virginia Beach-Norfolk-Newport News |
| 42123 | Pennsylvania | Warren County | | Not in a CSA | 47620 | Warren, PA |
| 36045 | New York | Jefferson County | | Not in a CSA | 48060 | Watertown-Fort Drum, NY |

**APPENDIX B**

# MARAMA Response to Comments

(October 21, 2010)

# Analysis of Emissions from Power Plants and Other Large Combustion Sources in the Northeast/Mid-Atlantic Region (September 15, 2010)

## Commenter: John Shimshock, RRI Energy

***General Comment:*** There are many other peaking-type electrical generating units (primarily combustion turbines and diesel generators) that do not report their emissions to CAMD because (i) their nameplate capacity is less than 25 MWe or (ii) the electrical generating units do not supply their electricity to the local electrical grid (i.e., distributed generating units). Neither of the aforementioned units is subject to emissions monitoring and reporting to CAMD per 40 CFR 75 requirements. It is conceivable that NOx emissions from these units can be substantial because many of these units are not equipped with NOx emissions control devices. Although the analyses provided in the draft MARAMA report is valuable, RRI suggests that the scope of analysis be expanded to include the non- CAMD reporting units in order to provide for a more comprehensive examination of $SO_2$ and NOx emissions from this source category. Please note that the recently proposed Clean Air Transport Rule included a file provided by U.S. EPA that presented all known EGUs (excludes distributed generating units). Emissions data for the non-CAMD reporting EGUs and distributed generation units can be obtained from the applicable state regulatory agency.

***Response:*** We recognize that there are other types of peaking units besides those that report their emissions to CAMD. However, we elected to limit the analysis to the units reporting to CAMD because the hourly emissions for these units were readily available and we were interested in understanding how the emissions varied on an hourly basis during peak periods. On an annual basis, the emissions from the nonCAMD EGUs are relatively small. We queried the MANE-VU+VA 2007 annual inventory for nonCAMD EGUs (i.e., source classification code of 1-01-xxx-xx or 2-01-xxx-xx that do not report to CAMD). For NOx, the annual emissions for CAMD reporting units were 431,331 tons, compared to only 14,677 tons for EGUs that do not report hourly data to CAMD. That is not to say that the emissions from nonCAMD EGUs are not important during peak periods. We just don't have sufficient data to include these units in the analysis at this time. The comment, however, is valid and we added a "Data Caveats" section to the Introduction to the report to address this issue.

***Comment 1:*** Figures 1-1, 1-2, 7-1, 7-2, 8-1 and 8-2 – the color scheme used to distinguish between coal-fired units and wood-fired units is not discernable

***Response:*** Color scheme changed to show wood using a green color scheme. There are very few wood-fired units in the CAMD database, with little capacity and emissions.

***Comment 2:*** Figures 1-2, 1-6 and 1-10 - the text presented immediately above the figure denotes that the ordinate (y-axis) is expressed in terms of "megawatt capacity" whereas the ordinate within the figure presents capacity in terms of heat input (MMBtu/hour). The text needs to be changed to reflect the information presented in the figure.

***Response:*** Corrections made.

***Comment 3:*** Figures 1-3 and 1-4 – Presumably NOx and $SO_2$ emissions, respectively, are presented in units of tons. The mass units should be included in these figures.

***Response:*** Corrections made.

***Comment 4:*** Figure 1-8. Please provide the hierarchy of NOx control technologies assumed in this analysis.

***Response:*** NOx controls in the CAMD database are reported directly by the industry. CAMD provides a lookup table of valid NOx control devices (http://www.epa.gov/airmarkets/business/ecmps/docs/ECMPSLookup.pdf ). Sources can indicate that there are multiple control measures (combustion modifications or post-combustion controls) for each unit. Since there were about 75 unique combinations of NOx controls reported in the CAMD database, it was necessary to aggregate these in some simplified manner for graphical presentation. NOx controls were generally grouped according to the emission reduction potentials identified in Table 1.1-2 of AP-42. The intent of this Figure 1.8 was to show that there are a large number of uncontrolled units in the <15% operating time bin. Figure 1.9 was prepared to show the NOx emission rates (lbs/mmBtu) that result from the various combinations of combustion modification and post-combustion controls.

***Comment 5:*** Question 3, first table, data entry for 02/07/07, > 50 % bin – the value should be 80.0, not 8. Additionally, RRI presumes that the time periods selected for the data presented in the first and second tables represent unusually cold and hot periods, respectively. If so, then this should be stated and supporting temperature data should also be presented.

***Response:*** Correction made and a discussion of temperatures associated with the February and August dates was added to the text.

***Comment 6:*** Question 6, table preceding Figure 6-1. How do these findings differ from those presented in Figure 2-2, which presents NOx emissions (percentages) for each of the three

operating bins versus month? The percentages are similar on high ozone days as compared with the month as a whole.

***Response:*** The table was modified to also show the monthly averages in addition to the day-specific values.

***Comment 7a:*** Figures 9-1a through 9-1e, Figures 9-2a through 9-2e, Figures 9-3a through 9-3e, Figures 9-4a through 9-4e – These figures present time series plots of daily maximum ozone season concentration and hourly NOx emission rates for each of the three operating bins for selected high ozone events. RRI notes that high ozone concentrations are not necessarily correlated with high NOx emission rates, thus suggesting that there are other contributing factors that need to be considered. For example, it would be helpful to include ambient temperature and humidity on these plots as these data are likely available with the ozone data.

***Response:*** Daily maximum temperature was added to each chart.

***Comment 7b:*** It should also be noted that MARAMA has recently reported that annual NOx emissions from on-road mobile sources are nearly four times greater than annual NOx emissions from CAMD-reporting EGUs, so perhaps similar figures could also be generated if hourly on-road mobile source NOx emissions data are available.

***Response:*** Hourly on-road mobile source NOx emissions are not currently available pending completion of MOVES modeling and review/approval by the States. The suggestion is noted and will be considered at a later date.

***Comment 8:*** Figures 10-4 through 10-6 – Why were the data from Virginia excluded from this particular analysis? Although Virginia is not included within the MANE-VU states, the scope of the report was focused on the MANE-VU states plus Virginia. Additionally, the heat input data presented in Figure 10-3 shows that the pattern of higher annual heat input in 2007 as compared with 2006 and 2008 was demonstrated in both the MANE-VU and VISTAS states.

***Response:*** Data for Virginia was added to Tables 10-1, 10-2 and 10-3 as well as Figures 10-4, 10-5, and 10-6.

## Commenter: Roger Caiazza, Environmental Energy Alliance of New York

***Comment:*** The MARAMA report should note that there are different reporting methodologies and the reported emission values for the units in the "Units that operated less than 15 percent of the time (<15% bin)" are often conservative estimates rather than direct measurements.

***Response:*** A discussion of the potential overestimation of emissions was added to the "Data Caveats" section of the Introduction to the report.