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WISCONSIN
DEPT. OF NATURAL RESOURCES

April 17, 2017

Mr. Robert Kaplan
Acting Regional Administrator
U.S. Environmental Protection Agency - Region 5 (R-19J)
77 West Jackson Boulevard
Chicago, Illinois 60604-3507

Subject: State Implementation Plan Submittal of the Attainment Plan for the Wisconsin portion (Kenosha County-Partial) of the Chicago–Naperville (IL-IN-WI) 2008 Ozone NAAQS Nonattainment Area

Dear Mr. Kaplan:

In accordance with Section 182(b) of the Clean Air Act (CAA), the Wisconsin Department of Natural Resources (WDNR) submits this State Implementation Plan (SIP) revision for the 2008 ozone National Ambient Air Quality Standards (NAAQS). The WDNR requests U.S. Environmental Protection Agency (EPA) approval of the attainment plan for the Wisconsin portion (Kenosha County-Partial) of the Chicago–Naperville (IL-IN-WI) 2008 ozone NAAQS nonattainment area. The EPA reclassified the Chicago-Naperville nonattainment area to "moderate" nonattainment status for the 2008 ozone NAAQS on May 4, 2016 [*81 FR 26697*]. Due to this action, Wisconsin is required to submit a plan to EPA demonstrating how the partial Kenosha County nonattainment area will attain the 2008 ozone NAAQS by the moderate area attainment date of July 20, 2018. The enclosed plan is submitted to fulfill that requirement.

This SIP submittal meets the completeness requirements of 40 CFR § 51, Appendix V. The WDNR has legal authority under ss. 285.11(6) Wis. Stats., to develop a SIP for prevention, abatement, and control of air pollution. The WDNR provided opportunity for public comment on this SIP submittal and conducted a public hearing in Kenosha, Wisconsin on March 15, 2017. A copy of the public comment and hearing notice is enclosed. WDNR received one comment during the public comment period, which has been addressed in the attainment plan.

In accordance with EPA's final rule on CAA Section 110 submission requirements effective March 16, 2015 [*80 FR 7336*], this SIP is being submitted using EPA's electronic SIP (eSIP) submission system. If you have any questions regarding this submittal, please contact Kara Koonce of my staff at (608) 267-0553 or kara.koonce@wisconsin.gov.

Sincerely,

Gail E. Good

Gail E. Good
Director
Air Management

cc: David Bizot – AM/7
Kara Koonce – AM/7
Angie Dickens – AM/7
Mike Szabo – LC/8
Doug Aburano – U.S. EPA Region 5 (AR-18J)

Enclosures:

1. Attainment plan for Wisconsin portion (Kenosha County-Partial) of the Chicago–Naperville (IL-IN-WI) 2008 Ozone NAAQS Nonattainment Area
2. Public Hearing Notice for Kenosha County-Partial Attainment Plan SIP Submittal
3. Proof of Publication of Public Hearing Notice
4. SIP Certification

# ATTAINMENT PLAN

# FOR THE

# WISCONSIN PORTION OF THE CHICAGO-NAPERVILLE (IL-IN-WI) 2008 8-HOUR OZONE NONATTAINMENT AREA

Kenosha County (Partial), Wisconsin

Developed by:
The Wisconsin Department of Natural Resources

APRIL 2017

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## List of Acronyms

| | |
|---|---|
| AEI | WDNR's Air Emissions Inventory |
| Btu | British Thermal Unit |
| CAA | Clean Air Act |
| CAIR | Clean Air Interstate Rule |
| CAMx | Comprehensive Air Quality Model with Extensions |
| CART | Classification and Regression Tree Analysis |
| CD | Consent Decree |
| CFR | Code of Federal Regulations |
| CSAPR | Cross-State Air Pollution Rule |
| CTG | Control Technology Guideline |
| EGU | Electric Generating Unit |
| EPA | U.S. Environmental Protection Agency |
| ERTAC | Eastern Regional Technical Advisory Committee |
| FID | Facility Identification Number |
| GEOS-CHEM | Goddard Earth Observing Systems Chemistry Model |
| GR | Gas Recirculation |
| GVWR | Gross Vehicle Weight Rating |
| HC | Hydrocarbon |
| I/M | Inspection and Maintenance |
| ICI | Industrial-Commercial-Institutional |
| IDEM | Indiana Department of Environmental Management |
| IEPA | Illinois Environmental Protection Agency |
| LADCO | Lake Michigan Air Directors Consortium |
| LNB | Low NOx Burner |
| MACT | Maximum Achievable Control Technology |
| MAR | Commercial Marine, Aircraft and Rail Locomotive |
| MATS | Mercury and Air Toxics Standards |
| MATS | Modeled Attainment Test Software |
| MDA8 | Maximum Daily 8-hour Average ozone concentration |
| mmBtu | Million British Thermal Units |
| MOVES | Motor Vehicle Emission Simulator |
| MVEB | Motor Vehicle Emissions Budget |
| NAAQS | National Ambient Air Quality Standards |
| NEI | National Emissions Inventory |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NMHC | Non-Methane Hydrocarbon |
| NO | Nitric Oxide |
| $NO_2$ | Nitrogen Dioxide |
| NOx | Nitrogen Oxides (NO and $NO_2$) |
| OAQPS | EPA's Office of Air Quality Planning and Standards |
| OBDII | Vehicle On-Board Diagnostic System. |
| OFA | Overfire Air |
| ppb | Parts Per Billion |
| PTE | Potential To Emit |
| RACM | Reasonably Available Control Measures |

| | |
|---|---|
| RACT | Reasonably Available Control Technology |
| RFG | Reformulated gasoline |
| RFP | Reasonable Further Progress |
| RICE | Reciprocating Internal Combustion Engines |
| ROP | Rate of Progress |
| SCR | Selective Catalytic Reduction |
| SEWRPC | Southeastern Wisconsin Regional Planning Commission |
| SIP | State Implementation Plan |
| SMOKE | Sparse Matrix Operator Kernel Emissions Modeling System |
| tpsd | Tons Per Summer Day |
| VMT | Vehicle Miles of Travel |
| VOC | Volatile Organic Compound |
| WDNR | Wisconsin Department of Natural Resources |
| WRF | Weather Research and Forecasting |

# 1. INTRODUCTION

The Wisconsin Department of Natural Resources (WDNR) has prepared this attainment plan to fulfill the state's Clean Air Act (CAA) state implementation plan (SIP) requirements for the eastern Kenosha County moderate nonattainment area for the 2008 ozone National Ambient Air Quality Standard (NAAQS). This plan projects that eastern Kenosha County will attain the 2008 ozone NAAQS by the July 20, 2018 moderate area attainment date, as will the rest of the Chicago-Naperville, IL-IN-WI nonattainment area. This document was developed in accordance with the U.S. Environmental Protection Agency (EPA)'s draft modeling guidance[1] and implementation rule for the 2008 ozone NAAQS (80 FR 12264). It includes all required elements for moderate-area attainment plans, including a modeling analysis showing that the area will attain the NAAQS.

## 1.1. Purpose and Regulatory Requirements

The CAA requires an area not meeting a NAAQS for a specified criteria pollutant to develop or revise its State Implementation Plan (SIP) to expeditiously attain and maintain the NAAQS in that nonattainment area. For moderate nonattainment areas, these SIP requirements include:

1) An attainment plan (required under CAA section 182(b)).
2) Reasonably Available Control Technology (RACT) for volatile organic compounds (VOCs) and nitrogen oxides (NOx; CAA section 182(b)(2)).
3) Reasonably Available Control Measures (RACM; CAA section 172(c)(1).
4) Reasonable Further Progress (RFP) reductions in VOC and/or NOx emissions in the area (CAA sections 172(c)(2) and 182(b)(1)).
5) Contingency measures to be implemented in the event of failure to attain the standard (CAA section 172(c)(9)).
6) A vehicle inspection and maintenance (I/M) program, as applicable (CAA section 181(b)(4)).
7) NOx and VOC emission offsets at a ratio of 1.15 to 1 for major source permits (CAA section 182(b)(5)).

This document addresses the first six of these requirements for Wisconsin's eastern Kenosha County ozone nonattainment area under the 2008 ozone NAAQS. [2]

This attainment plan includes assessments of measured and modeled air quality data. These analyses demonstrate that eastern Kenosha County, as well as the larger Chicago nonattainment area of which it is part, are forecast to attain the 2008 ozone NAAQS by the required July 20, 2018 attainment date. These areas are projected to attain the NAAQS due to the full implementation of Wisconsin's ozone SIP, as well as other regional[3] and national emission control measures. In addition, this document describes how permanent and federally-enforceable

[1] EPA (2014) Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze, December 3, 2014. https://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

[2] Wisconsin has a Nonattainment New Source Review (NNSR) permitting program that has addressed the seventh requirement.

[3] These regional measures include implementation of ozone SIPs by the states of Illinois and Indiana.

control measures in Wisconsin have resulted in substantial reductions of ozone precursors in eastern Kenosha County. These controls are projected to yield emission reductions that meet RFP requirements. Supplemental analyses of monitoring data are presented as weight of evidence support. These analyses show that ambient levels of ozone and ozone precursors have been substantially reduced in eastern Wisconsin over the past 15 years. Finally, this document describes how the area has met the all other requirements for moderate nonattainment areas for the 2008 ozone NAAQS.

### 1.2. The Chicago 2008 Ozone Nonattainment Area

Historically, exceedances of the federal ozone standards have been recorded along the lakeshore of Lake Michigan, including eastern Kenosha County. Kenosha County was designated nonattainment for two previous ozone NAAQS, but has been either redesignated to attainment for, or found to be attaining, each of these standards[4], as shown in Table 1.1.

**Table 1.1. Kenosha County nonattainment history for ozone NAAQS.**

| Year Promulgated | 1979 | 1997 | 2008 |
|---|---|---|---|
| **Level** | 0.12 ppm | 0.08 ppm | 0.075 ppm |
| **Averaging Time** | 1 hour | 8 hours | 8 hours |
| **WI Nonattainment Area** | Milwaukee-Racine Area* | Milwaukee-Racine Area* | Kenosha (partial), part of the Chicago Area |
| **Classification** | Severe-17 | Moderate | Marginal (reclassified to Moderate) |
| **Finding of / Redesignation to Attainment[4]** | 4/24/2009<br>74 FR 18641 | 7/31/2012<br>77 FR 45252 | TBD |

*The Milwaukee-Racine Area encompassed Kenosha, Racine, Milwaukee, Ozaukee, Washington and Waukesha Counties for the 1979 and 1997 NAAQS.

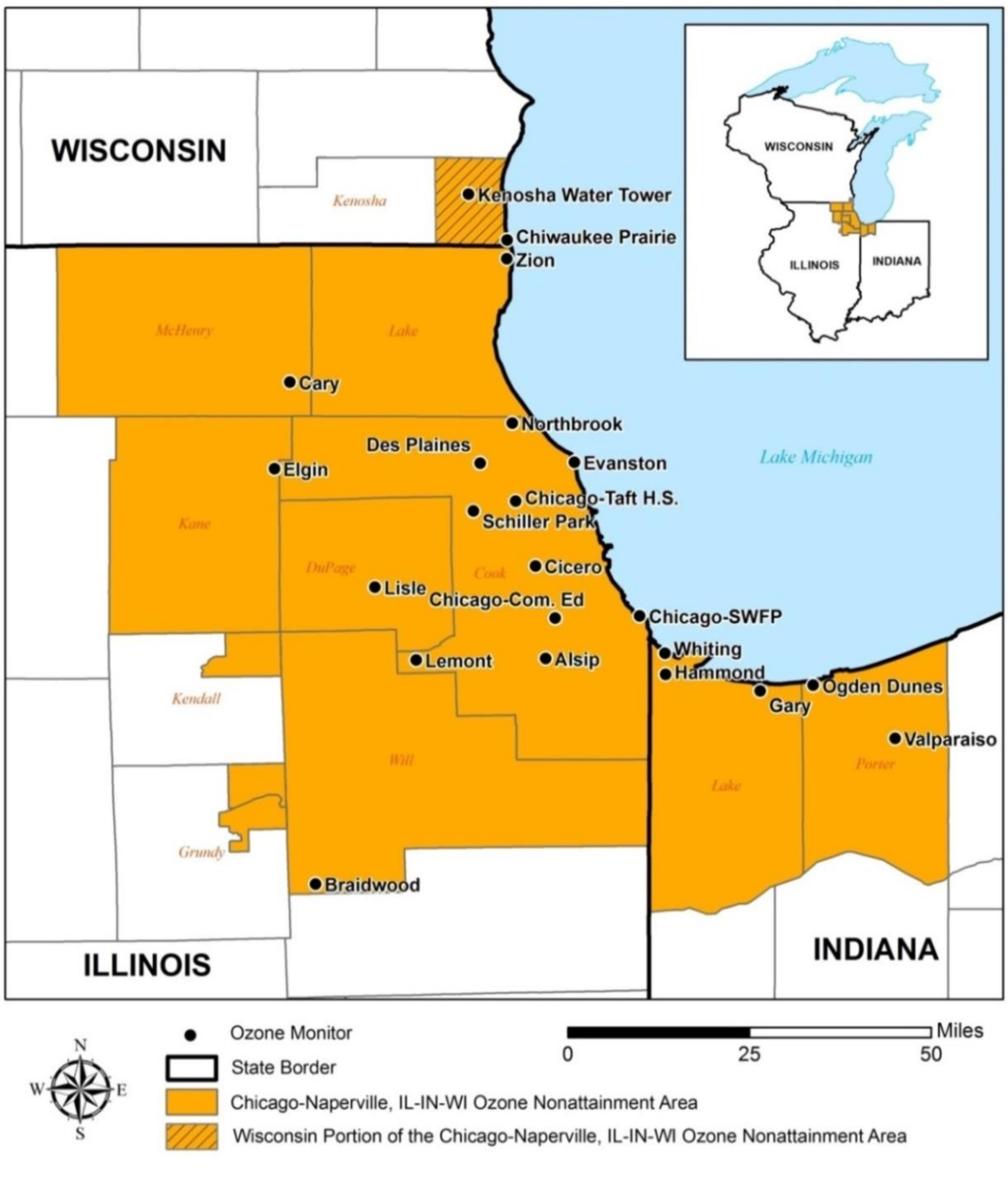
In March 2008, EPA finalized a revision to the 8-hour ozone NAAQS (73 FR 16436). The 2008 ozone NAAQS (0.075 parts per million, ppm) is more stringent than the previous 1997 ozone NAAQS (0.08 ppm). In June 2012, EPA published a final rule that designated all or part of eleven counties in the Chicago-Naperville, IL-IN-WI Combined Statistical Area (CSA) as marginal nonattainment for the 2008 ozone NAAQS (77 FR 34221). This nonattainment area (the "Chicago nonattainment area") is shown in Figure 1.1. This nonattainment area designation was based upon EPA's review of ozone monitoring data collected during the years 2009-2011 for Illinois and 2008-2010 for Indiana and Wisconsin.[5] On May 4, 2016, EPA reclassified the Chicago nonattainment area from marginal to moderate nonattainment status, effective June 3, 2016. This reclassification was based on 2012-2014 monitoring data.

[4] EPA issued an attainment determination for the Milwaukee-Racine nonattainment area after the 1979 1-hour NAAQS was revoked, so this area was never formally redesignated to attainment of this standard. The area was redesignated to attainment of the 1997 ozone NAAQS in July 2012.

[5] EPA designated most areas based on 2008-2010 air monitoring data. However, Illinois certified its 2011 ozone monitoring data for the Chicago area early and submitted this data to EPA for consideration. This delayed the designation process for this area, which was designated nonattainment via a separate rulemaking two months after all other areas.

Wisconsin's part of the Chicago nonattainment area is the eastern portion of Kenosha County. Kenosha County is located in southeastern Wisconsin along the western shoreline of Lake Michigan, just north of the Illinois state line. The nonattainment designation for Kenosha County applies only to the eastern portion of the county, including the townships of Pleasant Prairie and Somers. Kenosha County has a largely service-based and industrial economy, with a 2010 population of 166,426. 77% of the county's population (128,534) lives in the 2008 ozone NAAQS nonattainment area. Kenosha County is roughly halfway between the cities of Chicago and Milwaukee and is part of the Chicago-Naperville CSA. Most of the CSA is upwind of Kenosha County on high ozone days and contributes to high ozone concentrations in Kenosha County.

**Figure 1.1. Map of the Chicago-Naperville, IL-IN-WI, 2008 ozone nonattainment area ("Chicago nonattainment area"), with locations of ozone monitors shown.**



### 1.3. Overview of this Attainment Plan

This document is structured as follows:

Chapter 2 outlines a conceptual model for ozone formation in the Lake Michigan region, including eastern Kenosha County. This chapter describes how synoptic-scale and mesoscale meteorology combine to create high ozone along the Wisconsin lakeshore under particular conditions.

Chapter 3 presents base and future year inventories for eastern Kenosha County and discusses how these inventories show that the state has met its requirements for RFP and contingency measures. This chapter also outlines the permanent and enforceable emissions reduction measures that have reduced ozone precursor emissions.

Chapter 4 describes the modeled attainment assessment that was completed by the Lake Michigan Air Directors Consortium (LADCO) for the Chicago nonattainment area in support of this analysis. This chapter outlines how emission inventories for the modeling were constructed, how the models were run, and how the results of the modeled attainment test demonstrate the area will attain the NAAQS.

Chapter 5 presents weight of evidence support for this attainment plan. This includes analysis of trends in ozone and ozone precursors, as well as meteorologically adjusted trends in ozone concentrations. This chapter also demonstrates the important roles that transport, meteorology and chemistry play in determining ozone concentrations in eastern Kenosha County.

Chapter 6 describes how the state has met all other moderate nonattainment area SIP requirements. These requirements include transportation conformity, RACT programs for NOx and VOCs, RACM, and a vehicle I/M program.

Chapter 7 describes how the WDNR took public comment on this document.

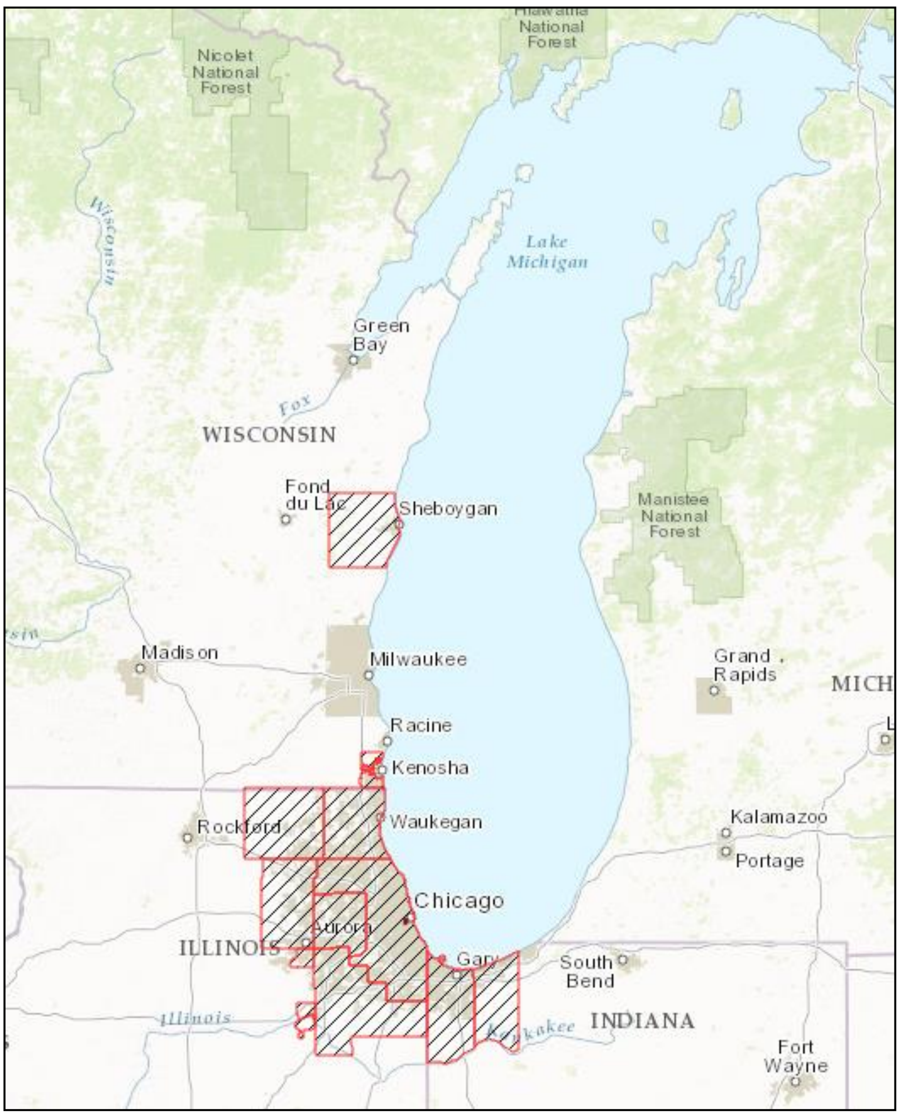
Chapter 8 presents the conclusions of this analysis.

## 2. OZONE DYNAMICS IN THE LAKE MICHIGAN REGION

### 2.1. Introduction

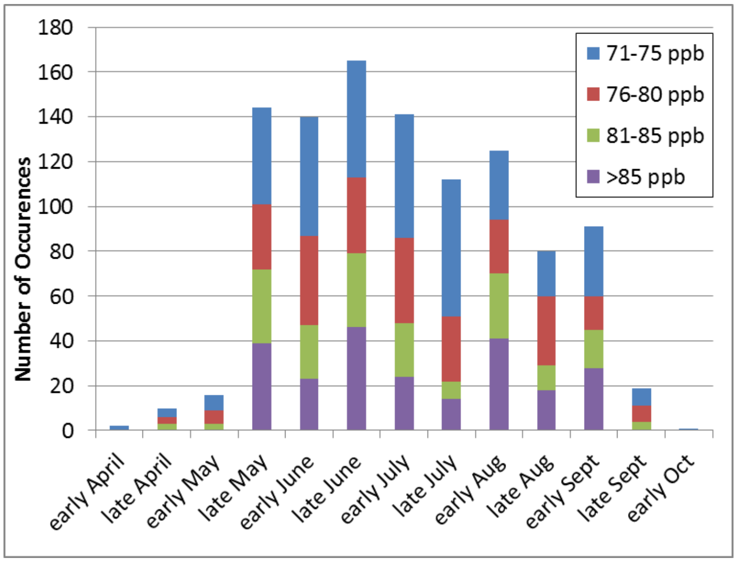
Counties around Lake Michigan have a long history of recording ozone concentrations that exceed the level of the NAAQS. Since the promulgation of the original, 1979 ozone NAAQS, lakeshore counties in Wisconsin, Illinois, Indiana and Michigan have been designated nonattainment with each subsequent standard. While ozone concentrations have decreased dramatically due to implementation of an array of measures controlling emissions of ozone precursors, two Lake Michigan areas are currently designated nonattainment for the 2008 ozone NAAQS: the Chicago nonattainment area and Sheboygan County, WI (Figure 2.1).

**Figure 2.1. A map of the Lake Michigan region, with the Chicago and Sheboygan nonattainment areas for the 2008 ozone NAAQS indicated by hatching (from LADCO, Appendix 9).**



Wisconsin's lakeshore monitors most frequently measure ozone concentrations exceeding the 2008 ozone NAAQS from late May through early August, with peak ozone exceedences in late June (Figure 2.2). A smaller number of exceedences occur in late August and early September, but ozone concentrations very rarely exceed the 2008 NAAQS before May 15 or after September 15. Ozone concentrations peak in the late spring and early summer because of the abundance of sunlight and heat, both of which drive ozone formation. In addition, strong land-lake temperature gradients in late spring and early summer drive lake breeze circulations, which contribute to high ozone concentrations, as discussed below.

**Figure 2.2. Distribution of the number of occurrences of maximum daily 8-hour average ozone concentrations (MDA8) exceeding different thresholds at monitors along Wisconsin's Lake Michigan lakeshore. Data are shown for the years 2005-2014.**




The region's persistent ozone problems have been shown to be due to the unique meteorology of the Lake Michigan area. This meteorology causes transport of significant amounts of ozone from upwind sources to lakeshore counties in Wisconsin and neighboring states. Two types of meteorological patterns have been shown to affect ozone concentrations in the region:

1) Synoptic scale meteorology[6] transports high concentrations of ozone and ozone precursors northward from source regions to the south and southeast, and
2) Mesoscale meteorology[6] (via land-lake breeze circulation patterns) carries precursors over the lake, where they react to form ozone. Winds then shift to pull the high ozone air onshore.

This chapter explores the meteorology of this region in greater depth and presents a conceptual model for ozone formation in this area. Subsequent chapters then address the regulatory requirements for this attainment plan, required because of the resultant high ozone concentrations in this region.

[6] Synoptic-scale meteorology refers to weather features of 24-48 hours' duration, whereas mesoscale meteorology refers to weather features of shorter duration.

## 2.2. The Role of Synoptic-Scale Meteorology on High-Ozone Days

Research has shown that high pressure systems can generate meteorological conditions favorable to elevated ozone as they move through the region from west to east during late May - early September. These systems are typified by hazy, sunny skies with generally weak, clockwise-rotating winds and relatively shallow mixing such that pollution concentrations are not diluted by mixing. These weather conditions contribute to the buildup of considerable amounts of ozone precursors and facilitate formation of ozone via photochemical reactions.

The location of surface high pressure systems is an important driver of ozone transport into the region. Research has shown that ozone episodes are generally associated with high pressure systems over the eastern United States that transport pollutants and precursors from the south and east into the region.[7,8] One study[9] estimated that 50% of Wisconsin's ozone exceedance days during 1980-1988 under the 1-hour ozone NAAQS occurred when the center of a high pressure system was situated southeast of the area (i.e., Ohio and east thereof). Under these circumstances, high ozone concentrations in the Lake Michigan region may result when polluted air from high emissions regions such as the Ohio River Valley is transported northward along the western side of a high pressure system.[10] In addition, while emissions from the heavily industrialized Chicago and Milwaukee areas have decreased dramatically in recent decades (see, e.g., Sections 3 and 5.3), sources in these large metropolitan areas still generate significant ozone precursor emissions. Pollution from sources in these areas can add to the pool of pollution transported into the region.[7]

Figure 2.3 shows the synoptic scale weather pattern for one such episode, along with the resulting patterns in ozone concentrations. On this day, a high pressure system was located to the southeast, centered over Virginia. Southeasterly to southerly winds on the western side of this system carried pollutants from the Ohio River Valley to Lake Michigan. This episode shows a common pattern for ozone distributions on episode days: ozone concentrations were lowest in the regions with the highest emissions (in central Chicago and extending into northwestern Indiana) and the highest in rural coastal areas far downwind. During such classic transport episodes, peak ozone concentrations move northward over the course of the day. For example, on the day shown in Figure 2.3, ozone peaked at Wisconsin’s southern Chiwaukee Prairie monitor between 11 a.m. and 1 p.m., at the Kohler Andrae monitor midway up the coast between 2 p.m. and 4 p.m., and at the northern Newport monitor between 4 p.m. and 6 p.m.

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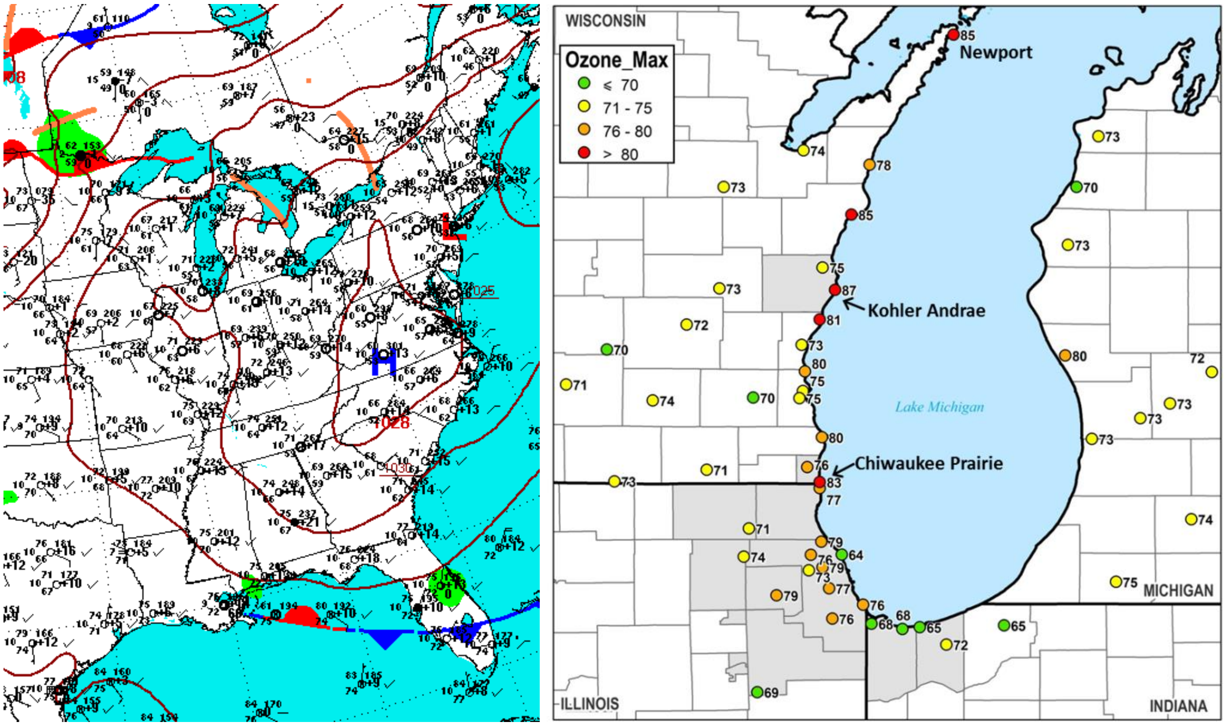
[7] Dye, T.S., P.T. Roberts, and M.E. Korc, 1995: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study. J. App. Meteor, 34: 1877-1889.

[8] Hanna, S.R., and J.C. Chang, 1995: Relations between meteorology and ozone in the Lake Michigan region. J. Applied Meteorology, 34: 670-678.

[9] Haney, J.L., S.G. Douglas, L.R. Chinkin, D.R. Souten, C.S.Burton, and P.T. Roberts, 1989: Ozone Air Quality Scoping Study for the Lower Lake Michigan Air Quality Region, SAI report #SYSAPP-89/101, prepared for US EPA, August, 197 pp.

[10] For example, Ragland, K. and P. Samson, 1977: Ozone and visibility reduction in the Midwest: evidence for large-scale transport. J. Applied Meteorology, 16: 1101–1106.

**Figure 2.3. (left) Surface synoptic weather map for 6 a.m. CST for the eastern U.S., and (right) the maximum daily 8-hour average (MDA8) ozone concentrations for the Lake Michigan region for June 19, 2016. The Chicago and Sheboygan, WI, nonattainment areas are shaded in gray.**




### 2.3. The Role of Mesoscale Meteorology (Lake Breeze Circulation) on High-Ozone Days

The synoptic meteorological conditions often work in combination with unique lake-induced mesoscale meteorological features to produce the highest ozone concentrations in this region. Wisconsin's ozone nonattainment areas are positioned along the state's coastline with Lake Michigan (Figure 2.1). With a surface area of approximately 22,400 square miles, Lake Michigan acts as a huge heat sink during the warm months. Figure 2.4 highlights the considerable difference between the over-land air temperatures (measured at Racine, WI) and over-water air temperatures (measured at a buoy in southern Lake Michigan) during a 5-day ozone episode in June 2002. The strong daytime temperature contrast between the warm land and cold lake can lead to the formation of a thermally-driven circulation cell called the lake breeze, which runs approximately perpendicular to the Lake Michigan shoreline (Figure 2.5). As this figure shows, the lake breeze is generally preceded by an early morning land breeze, driven by relatively warm temperatures over the lake. The land breeze can carry ozone precursors emitted from urban areas, primarily Chicago, out over the lake, where they can react to form ozone. The onshore flow of the lake breeze circulation then transports elevated ozone from over the lake onshore into eastern Wisconsin.

**Figure 2.4. Hourly surface air temperatures at Racine, WI and at the South Lake Michigan Buoy during an ozone episode on June 20-25, 2002.**

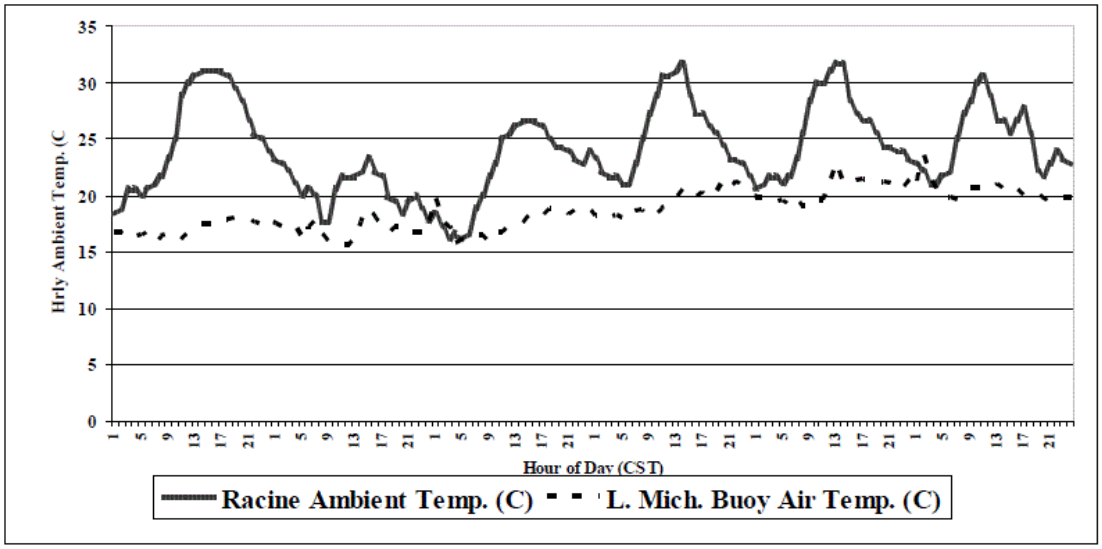
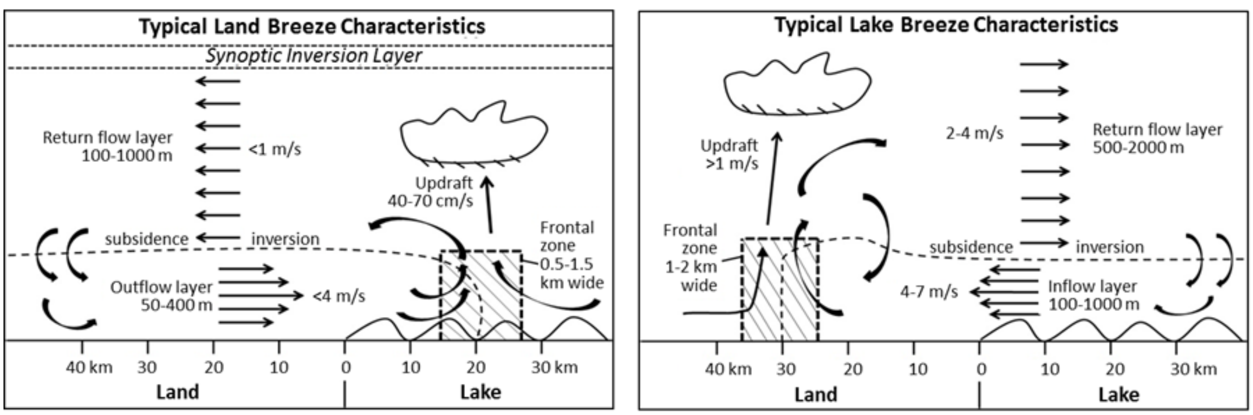



**Figure 2.5. Schematic diagrams of the (left) early morning land breeze and (right) late morning/afternoon lake breeze circulations responsible for enhanced ozone production along the Lake Michigan shoreline (modified from Foley et al., 2011[11]).**




## 2.4. Conceptual model for ozone formation in the Lake Michigan region

Synoptic and mesoscale meteorological patterns together drive ozone formation in the region, as described in a conceptual model in Dye et al. (1995).[7] Dye et al. (1995) described this model with the following series of inter-related steps. This discussion focuses on the conditions impacting Wisconsin's shoreline:

[11] Foley, T. , E. A. Betterton, P.E. R. Jacko, and J. Hillery, 2011: Lake Michigan air quality: The 1994-2003 LADCO Aircraft Project (LAP), Atmos. Env., 45: 3192-3202.

1) A shallow but intensely stable conduction inversion exists just above the relatively cold lake surface (Figure 2.5). During the early morning hours the land breeze and general offshore flow (i.e., southerly to west-southwesterly winds) transport ozone and fresh precursor emissions into the stable air in the conduction layer over Lake Michigan. A primary source region is the Chicago area, located at the southern edge of the lake.

2) By midmorning a sharp horizontal temperature gradient forms along the shoreline between the cold lake air and the increasingly warmer air over the land. This gradient effectively "cuts off" air in the conduction layer from additional injections of shore-emitted precursors. Strong stability in the conduction layer limits dispersion, creating high concentrations of ozone precursors, which can react in this layer.

3) By midmorning, the developing convective boundary layer (CBL) grows and the resulting convection mixes ozone vertically, where it combines with ozone transported from sources outside the region. Ozone concentrations in this air are lower due to the dilutive effects of convective mixing. As this air is transported lakeward, it is forced to flow up and over the conduction layer (Figure 2.5).

4) The ozone-rich air in both layers is transported northward over Lake Michigan by the prevailing winds. When a lake breeze is present, it produces southerly to south-southeasterly winds along the western shore of Lake Michigan. This wind pattern transports the ozone originating from sources in the south to downwind receptor regions in eastern Wisconsin. On occasion, areas north of Ozaukee County experience elevated ozone levels as a southerly wind intercepts the shoreline where it juts into Lake Michigan.

5) When the ozone-laden air flows onshore in the downwind receptor regions, air with the highest ozone concentrations, located in the lowest 300 m, mixes down to the surface first. This causes the highest ozone concentrations to be found along the shoreline. Eventually, air from higher altitudes mixes down to the surface further inland, but ozone concentrations in this air are lower. This air mass is the remnant of the ozone-diluted CBL air that flowed up and over the conduction layer during the mid-morning hours.

This complex meteorology leads to the high ozone concentrations and persistent nonattainment issues faced by the counties along the Lake Michigan shoreline. The impact of this meteorology on the transport of ozone, NOx, and VOCs to eastern Kenosha County is explored in more detail in Chapter 5.

## 3. REASONABLE FURTHER PROGRESS (RFP), CONTINGENCY MEASURES, AND IMPLEMENTED CONTROL MEASURES

### 3.1. Introduction

Sections 172(c)(2) and 182(b)(1) of the federal CAA require states with ozone nonattainment areas classified as moderate or higher to submit plans that show RFP towards attaining the NAAQS. The implementation rule for the 2008 ozone NAAQS[12] defines RFP for moderate nonattainment areas (e.g., eastern Kenosha County) as a demonstration that there has been at least a 15% emission reduction between the base year (2011) and the attainment year (2017). Because this area has a previously approved 15% VOC rate of progress (ROP) plan (61 FR 11735), the 15% reduction requirement for the 2008 NAAQS can be satisfied with any combination of NOx and VOC reductions. These reductions may come from any SIP-approved or federally promulgated measures implemented after the base year.

States must also submit requirements for contingency measures that will be implemented if the state fails to attain the standard as required by CAA Section 172(c)(9). These contingency measures must represent one year of emissions reduction progress, equivalent to an additional 3% reduction. States may meet contingency measures by demonstrating an additional 3% reduction in combined NOx and VOC emissions within one year beyond that required for RFP. Inventories for 2018 are included to make this demonstration.

Table 3.1 provides a summary of the eastern Kenosha County emission inventories (in tons per summer day, or tpsd) for NOx and VOCs. Sections 3.2 and 3.3 present the emission inventories by sector (i.e., point, area, onroad and nonroad) for eastern Kenosha County for the base (section 3.2) and projected (section 3.3) years. These sections also include the supporting methodology used to develop the inventories. Section 3.4 demonstrates that the state has met its RFP requirement for the eastern Kenosha County nonattainment area, and Section 3.5 outlines contingency measures. Finally, Section 3.6 describes the enforceable control measures that led to the significant reductions in both NOx and VOC emissions.

**Table 3.1. Eastern Kenosha County NOx and VOC emissions (tons per summer day, tpsd).**

| Pollutant | 2011 | 2017 | 2018 | 2011-2017 change (%) | 2017-2018 change (%)* |
|---|---|---|---|---|---|
| NOx | 19.45 | 16.59 | 16.23 | -15.4% | -1.9% |
| VOC | 9.43 | 8.09 | 7.92 | -13.0% | -2.0% |

*The % change from 2017 to 2018 was calculated relative to 2011 emissions.

### 3.2. 2011 Base Year Inventory for RFP

The base year (2011) portion of the RFP requirement is a compilation of all anthropogenic sources of NOx and VOCs for an average summer day in 2011, incorporating all control programs in place at that time. The WDNR followed EPA's requirements and guidance to prepare a comprehensive statewide emission inventory of NOx and VOC emissions for 2011.

[12] Implementation of the 2008 National Ambient Air Quality Standard for Ozone: State Implementation Plan Requirements, 80 FR 12264, March 6, 2015.

EPA has approved Wisconsin's 2011 emission inventories for eastern Kenosha County and other nonattainment areas under the 2008 8-hour ozone standard (81 FR 11673). The following is a description of the methodologies used to develop the sector-specific emission inventory estimates. Appendix 1 includes a more thorough discussion of the methodology used to estimate emissions for 2011. Table 3.2 shows the NOx and VOC emissions (in tpsd) in 2011 for the different sectors.

**Table 3.2. Eastern Kenosha County NOx and VOC emissions (tpsd) for nonattainment year 2011.**

| Pollutant | Point - EGU | Point – Non-EGU | Area | Onroad | Nonroad | Total |
|---|---|---|---|---|---|---|
| NOx | 11.05 | 0.11 | 1.09 | 5.15 | 2.07 | 19.47 |
| VOC | 0.54 | 0.18 | 4.78 | 2.42 | 1.51 | 9.43 |

### 3.2.1. Point Source Inventory

The Pleasant Prairie coal-fired power plant is the only electric generating unit (EGU) point source facility in eastern Kenosha County. For this source, WDNR used the maximum daily heat input reported in EPA's Clean Air Market Division database as a conservative estimate of summer day heat input during the 2011 ozone season. The summer day emissions were then calculated by multiplying the maximum daily heat input by an average NOx and VOC emission rate. Appendix 2 provides the detailed methodology used to calculate EGU summer day emissions.

The 2011 emission inventory for non-EGU point sources were tabulated using the emissions data reported annually by each facility operator to the WDNR air emissions inventory (AEI).[13] The AEI calculates emissions for each individual emissions unit or process line by multiplying fuel or process throughput by the appropriate emission factor that is derived from mass balance analysis, stack testing, continuous emissions monitoring, engineering analysis, or EPA's Factor Information Retrieval database. The emission calculations in the AEI also account for any operating control equipment.

Non-EGU facilities located in eastern Kenosha County were identified using the Geographic Information System coordinates reported for each facility in the AEI. Appendix 3 provides a list of non-EGU point source emissions by facility identification number (FID) and facility name for 2011. These non-EGU point source facilities are assumed to operate steadily over 365 days each year. Therefore, summer day emissions are derived by dividing each facility's annual reported emissions by 365 days.

### 3.2.2. Area Source Inventory

For 2011, area source emission estimates were based on calculations used for submission to the National Emissions Inventory (NEI), unless otherwise indicated. EPA has approved Wisconsin's 2011 NEI data. These emissions were typically calculated using population, gasoline

[13] Under Wisconsin rule NR 438.03, Wis. Adm. Code, a facility operator is required to report NOx or VOC emissions data to the WDNR for any facility emitting 5 or more tons of NOx or 3 or more tons of VOC per year. These sources are considered "point" sources. Smaller stationary sources are considered "area" sources.

consumption, employment, crop acreage and other activity surrogates associated with the source categories. These categories mainly include industrial, commercial and institutional fuel combustion, solvent utilization, residential wood combustion and agricultural emissions. For each source category, any point source activity or emissions were subtracted from total category-specific activity or emissions to calculate area category-specific emissions and avoid double counting. Emission factors were derived from local data, local or national surveys and EPA procedural guidance for the development of emission inventories. Appendix 4 includes tables of area source emissions by source category.

In order to obtain the area source emissions for the eastern portion of Kenosha County, the whole county emission estimates were allocated to the partial county nonattainment area based on population data from the Wisconsin Department of Administration. The partial-county population was identified based on the relative population of the Minor Civil Divisions in the nonattainment area compared with the entire county. For 2011, 77% of the county's population was estimated to live in the nonattainment area.

#### 3.2.3. Onroad Inventory

The 2011 onroad emission estimates were developed using the EPA's current mobile source emissions model, the Motor Vehicle Emission Simulator (MOVES2014a). All estimates were made in accordance with current EPA technical guidance. The key inputs used for the MOVES2014a modeling include:

- Vehicle age distributions based on registration data from the Wisconsin Department of Transportation;

- Detailed transportation data for the sub-county area provided by the Southeastern Wisconsin Regional Planning Commission (SEWRPC), including vehicle miles of travel (VMT) by vehicle class, road class and hour of day, and average speed distributions; and

- Control measures, including the Wisconsin vehicle I/M and reformulated gasoline (RFG) programs.

Hot summer day temperatures were input to the model (minimum 70 degrees F, maximum 94 degrees F). This temperature range has been used for all onroad ozone SIP modeling in southeastern Wisconsin since the 1990 CAA Amendments and is based on a WDNR analysis of temperatures on high ozone days.

Appendix 5 provides detailed listings of the estimated onroad emissions and activity data.

#### 3.2.4. Nonroad Inventory

For the purpose of inventory calculation, nonroad mobile sources are divided into two major groups:

- Commercial Marine, Aircraft and Rail Locomotive (MAR)
- All other nonroad categories

Nonroad categories other than MAR include:

- Recreational vehicles
- Construction equipment
- Industrial equipment
- Lawn and garden equipment
- Agricultural equipment
- Commercial equipment
- Logging equipment
- Underground mining equipment
- Oil field equipment
- Pleasure craft
- Railway maintenance equipment

The 2011 nonroad emissions for the non-MAR categories were developed using EPA's MOVES2014a model using hot summer day temperatures (as defined for onroad modeling). The model was run for Kenosha County for the months of June, July and August. Hot summer day emissions were calculated by dividing the total emissions over these three months by 92 (the number of days in the three months). Emissions were then allocated to the eastern Kenosha County area based on surrogates such as population, land area and water area, depending on the category.

Annual emissions for the MAR categories were obtained from EPA's 2011 Emissions Modeling Platform, Version 6.3. Countywide emissions were allocated to the sub-county nonattainment area based on airport location for aircraft and rail link location for rail locomotives. All commercial marine emissions were allocated to the sub-county nonattainment area, since those emissions originate from Lake Michigan. Summer day emissions were estimated by applying annual-to-summer day ratios from LADCO for the year 2007 to each of the three MAR categories provided in the modeling inventory.

Appendix 6 provides detailed listings of the estimated nonroad emissions data for over 200 subcategories.

### 3.3. 2017 & 2018 Projected Year Inventories for RFP

Emissions for the attainment year (2017) were projected using the methodological approaches described below. The same approaches were used to project emissions for 2018, which will be used to meet the required contingency. Appendix 7 includes more information on emissions projection methodology. Tables 3.3 and 3.4 show the projected NOx and VOC emissions (in tpsd) in 2017 and 2018 for the different sectors. The application of these inventory projection methodologies also forecasts that the current trend of decreasing NOx and VOC emissions will continue into the near future.

**Table 3.3. Eastern Kenosha County NOx and VOC emissions (tpsd) for projected attainment year 2017.**

| Pollutant | Point - EGU | Point – Non-EGU* | Area | Onroad | Nonroad | Total |
|---|---|---|---|---|---|---|
| NOx | 10.75 | 0.12 | 1.08 | 3.05 | 1.47 | 16.46 |
| VOC | 0.56 | 0.31 | 4.77 | 1.56 | 1.00 | 8.20 |

* Includes projections of emissions for both existing sources and new/modified sources.

**Table 3.4. Eastern Kenosha County NOx and VOC projected 2018 emissions (tpsd) for additional year of attainment.**

| Pollutant | Point - EGU | Point – Non-EGU* | Area | Onroad | Nonroad | Total |
|---|---|---|---|---|---|---|
| NOx | 10.75 | 0.12 | 1.08 | 2.75 | 1.40 | 16.10 |
| VOC | 0.56 | 0.31 | 4.74 | 1.44 | 0.96 | 8.02 |

* Includes projections of emissions for both existing sources and new/modified sources.

### 3.3.1. Point Source Inventory Projections

As previously stated, the Pleasant Prairie power plant is the only EGU point source in eastern Kenosha County. WDNR conservatively based projections of summer day emissions through 2018 on the 99$^{th}$ percentile highest heat input day from the 2015 ozone season. The 2015 heat input value is the highest value from 2010 through 2015 and is greater than the reported maximum nominal heat input reported for the facility. Therefore, future heat input levels are not reasonably expected to exceed the 2015 heat input level. This projected heat input value was then multiplied by projected emission rates to yield projected summer day emissions. The projected NOx emission rate is based on demonstrated emission rates since 2006 and incorporates the committed continued operation of controls. The projected VOC emission rate assumes the 2014 demonstrated emission rate will continue in the future. The details of the EGU projection methodology and calculations are provided in Appendix 2.

Based on this information, NOx emissions are projected to be 10.75 tpsd and VOC emissions to be 0.56 tpsd in both the 2017 and 2018 inventory years for the Pleasant Prairie power plant (Tables 3.3 and 3.4). These projected emission levels do not represent an enforceable emission requirement for daily emissions. Instead, these values represent the reasonably expected summer day maximum emissions for the EGU sector in eastern Kenosha County.

Non-EGU point source emissions are projected for 2017 and 2018 by applying growth factors to the 2011 base year inventory. These growth factors were developed from Annual Energy Outlook 2014 and 2016 industry-specific energy consumption data.[14,15] Additional emissions for the non-EGU sector were then factored in by projecting emissions for new and modified sources that have been or may be permitted to start operation by 2017. A more detailed description of the methodology for projecting non-EGU point source emissions is provided in Appendix 7, and a list of sources with the applied growth rates and calculated emissions is provided in Appendix 3.

[14] Annual Energy Outlook 2014, 2014. U.S. Energy Information Administration Analysis and Projections Web site. http://www.eia.gov/forecasts/archive/aeo14/ (accessed Feb 15, 2016).
[15] Annual Energy Outlook 2016, 2016. U.S. Energy Information Administration Analysis and Projections Web site. http://www.eia.gov/forecasts/aeo/ (accessed Dec 7, 2016).

It should be noted that Wisconsin's approach to projecting emissions for non-EGU point sources is more conservative than EPA-projected inventories, which typically assume "no-growth" for non-EGU point sources.

### 3.3.2. Area Source Inventory Projections

EPA's 2011 Emissions Modeling Platform, Version 6.2 includes projections for the years 2017 and 2025.[16] Wisconsin's 2017 area source emissions estimates were based on EPA's 2017 modeling inventory, unless otherwise indicated. Wisconsin's 2018 area source emissions were estimated by interpolating between EPA's 2017 and 2025 modeling inventories, unless otherwise indicated. Projected area source emissions can be found in Appendix 4. Appendix 7 includes more information on emissions projection methodology for area source emissions.

In order to obtain area source emissions for the eastern portion of Kenosha County, emission estimates for the whole county were allocated to the partial county nonattainment area based on population data. The Kenosha County population for 2017 and 2018 was estimated by interpolating the population between 2015 and 2020 population projections from the Wisconsin Department of Administration. The partial-county population was identified based on the relative population of the Minor Civil Divisions in the nonattainment area compared with the entire county. For 2017 and 2018, 77% of the county's population was estimated to live in the nonattainment area.

### 3.3.3. Onroad Inventory Projections

The 2017 and 2018 projected onroad emissions were developed using the MOVES2014a model, as was the case for the 2011 emissions. Vehicle age distributions were projected using a spreadsheet program developed by EPA. SEWRPC provided projected transportation data assuming their "high economic growth" scenario. The speed distributions provided by SEWRPC reflected the 5 mph speed limit increase (65 mph to 70 mph) which took effect in 2015 on certain restricted access roadways. WDNR increased the onroad mobile source portions of the 2017 and 2018 projected VOC and NOx emissions inventories by 7.5% to account for uncertainties in future mobile source emission factors as well as activity levels, as agreed upon through the transportation conformity consultative process. The motor vehicle I/M program and RFG program were both assumed to remain in effect.

Detailed listings of the projected onroad emissions and activity data are provided in Appendix 5.

### 3.3.4. Nonroad Inventory Projections

The methodology for the 2017 and 2018 projected nonroad emissions is parallel to the methodology used for the 2011 estimates. For the non-MAR categories, the MOVES2014a model was run at hot summer day temperatures (as defined for 2011 modeling), assuming the model's default growth projections.

For the MAR categories, the 2017 emissions were directly obtained from EPA's Version 6.3 Modeling Platform. The 2018 emissions were linearly extrapolated from the 2011 and 2017

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[16] ftp://ftp.epa.gov/EmisInventory/2011v6/v2platform/2017emissions/

emissions on that platform. Detailed listings of the projected nonroad emissions for over 200 subcategories are provided in Appendix 6.

### 3.4. Demonstration of RFP

Because Kenosha County has already met the 15% VOC ROP requirement in addressing a prior ozone NAAQS, the required 15% RFP reduction can come from any combination of NOx and VOC reductions occurring between 2011 and 2017. WDNR compared actual emissions from 2011 to emission estimates from the projected attainment year (2017) and the additional year of attainment (2018) for eastern Kenosha County, as shown in Tables 3.5 and 3.6 and Figure 3.1. NOx emissions are projected to decrease by 15.4% (3.01 tpsd) between 2011 and 2017. The largest reductions in NOx for the 2011–2017 period are projected from the onroad mobile sector (2.10 tpsd), followed by the nonroad mobile sector (0.60 tpsd). These reductions are due to the federal and state mobile source control programs detailed in Section 3.6. VOC emissions are projected to decrease by 13.0% (1.23 tpsd) over this same time period. As with NOx emissions, the largest VOC reductions are from the onroad mobile sector (0.86 tpsd) followed by the nonroad mobile sector (0.51 tpsd).

Overall, the combined reduction in NOx and VOC emissions on a percent basis between the base year (2011) and the projected attainment year (2017) is 28.4%. This reduction is well in excess of the required 15% reduction, demonstrating that the RFP requirement is satisfied for the eastern Kenosha portion of the nonattainment area.

**Table 3.5. Eastern Kenosha County comparison of NOx emissions (tpsd) by source type.**

| Sector | 2011 | 2017 | 2018 | 2011-2017 change (%)* | 2017-2018 change (%)* |
|---|---|---|---|---|---|
| Point - EGU | 11.05 | 10.75 | 10.75 | -2.7% | 0.0% |
| Point - Non-EGU[†] | 0.11 | 0.12 | 0.12 | +6.3% | -0.2% |
| Area | 1.09 | 1.08 | 1.08 | -1.1% | 0.0% |
| Onroad | 5.15 | 3.05 | 2.75 | -40.8% | -5.7% |
| Nonroad | 2.07 | 1.47 | 1.40 | -28.9% | -3.4% |
| **TOTAL** | **19.47** | **16.46** | **16.10** | **-15.4%** | **-1.9%** |

*The percent changes from 2011-2017 and 2017-2018 were calculated relative to 2011 emissions.

**Table 3.6. Eastern Kenosha County comparison of VOC emissions (tpsd) by source type.**

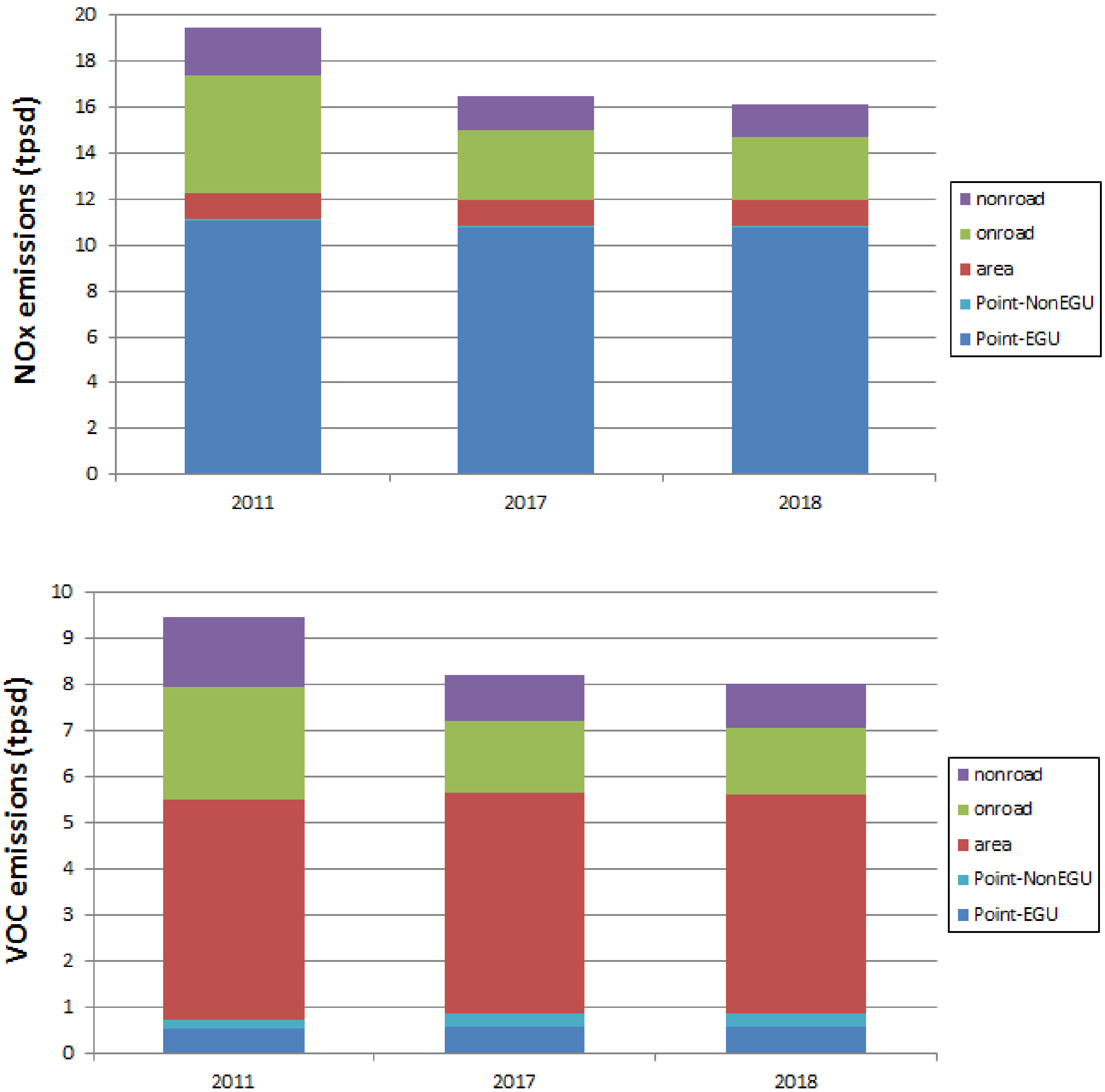
| Sector | 2011 | 2017 | 2018 | 2011-2017 change (%)* | 2017-2018 change (%)* |
|---|---|---|---|---|---|
| Point - EGU | 0.54 | 0.56 | 0.56 | +3.7% | 0.0% |
| Point - Non-EGU[†] | 0.18 | 0.31 | 0.31 | +73.6% | 0.1% |
| Area | 4.78 | 4.77 | 4.74 | -0.1% | -0.6% |
| Onroad | 2.42 | 1.56 | 1.44 | -35.5% | -5.1% |
| Nonroad | 1.51 | 1.00 | 0.96 | -33.8% | -2.4% |
| **TOTAL** | **9.43** | **8.20** | **8.02** | **-13.0%** | **-2.0%** |

*The percent changes from 2011-2017 and 2017-2018 were calculated relative to 2011 emissions.
[†]The large increase in non-EGU VOC emissions after 2011 is due to inclusion of projected emissions (0.14 tpsd) for new/modified sources.

### 3.5. Contingency Measures

The state must also include contingency measures representing one year of emissions reduction progress, equivalent to an additional 3% reduction. These measures must be implemented within one year of an area failing to attain the NAAQS. Table 3.5 shows that NOx emissions are projected to decrease an additional 1.9% from 2017 to 2018. Similarly, Table 3.6 shows that VOC emissions are projected to decrease an additional 2.0% from 2017 to 2018. Overall, NOx and VOC emissions are projected to decrease by a combined 3.9% from 2017 to 2018. This means that even if eastern Kenosha County does not attain the 2008 NAAQS in the 2017 attainment year, NOx and VOC emissions are projected to decrease by more than 3% in the following year without the state needing to do anything to trigger such reductions. Accordingly, these emissions reductions serve as the progress-related contingency measures for the eastern Kenosha County portion of the nonattainment area under the 2008 ozone NAAQS.

**Figure 3.1. Eastern Kenosha County (top) NOx and (bottom) VOC emissions by source type.**




## 3.6. Control Strategies for Ozone Precursor Emissions

This section documents the permanent and enforceable control measures that reduced emissions in eastern Kenosha County. Many of the control measures listed have been implemented under long-standing programs that began prior to 2011.[17] These measures will continue to contribute to emissions reductions through the 2017 ozone season and beyond, allowing attainment by the July 20, 2018 attainment date. However, this discussion highlights those control measures and

[17] Section 5.3 shows emission trends extending back to 2002.

emission reductions that have occurred since 2011. Other federal control programs reducing emissions in both the larger nonattainment area and transport regions are also discussed.

It is important to note that the total NOx and VOC emissions from eastern Kenosha County are very small in relation to the aggregate Chicago nonattainment area; in addition, major Wisconsin point sources of these emissions are already very well-controlled. Because of this, even though control programs continue to decrease emissions, the overall reduction is relatively small within eastern Kenosha County[18].

### 3.6.1. Point Source Control Measures

NOx Control Measures

*Wisconsin NOx RACT* – Wisconsin has implemented RACT for major NOx sources (sources with a potential to emit (PTE) of 100 tons or greater per year) in a number of areas, including all of Kenosha County, as part of compliance requirements for the 1997 ozone NAAQS.[19] The NOx RACT requirements are codified under ss. NR 428.20 to 428.25, Wis. Adm. Code. Affected facilities were required to first comply with NOx RACT emission limitations beginning May 1, 2009.

Table 3.7 shows that approximately 98% of annual point source NOx emissions in eastern Kenosha County during 2015 originated from two coal-fired boilers operated by WE Energies at the Pleasant Prairie electric utility plant. These boilers have been subject to a consent decree (CD) since 2007, which limited NOx emissions to 0.10 pounds per million British thermal units (Btu) of heat input on a 30-day rolling basis. The Wisconsin NOx RACT program implemented the same emission limitation in 2009. Under the CD, the Pleasant Prairie coal boilers became subject to a second, more stringent, NOx limit on January 1, 2015 of 0.08 pound per million Btu (mmBtu) of heat input, on a 12-month rolling average. The CD control requirements are permanent and federally enforceable under the Title I permit 15-RSG-006.

In 2015, approximately 47 individual emission units were responsible for the remaining 1.9% of NOx emitted by point sources in the eastern Kenosha County nonattainment area. These emission units are at smaller facilities that do not have PTEs above major source thresholds or are individual emissions units that are relatively small in PTE or operate infrequently (e.g., batch heat treat furnaces, emergency generators, auxiliary boilers) and therefore are not subject to NOx RACT requirements. If the owners of these facilities modify or add sources such that total facility potential emissions increase above 100 tons per year, the facilities and emission units become subject to state NOx RACT requirements. In addition, any new emission units at these facilities would be subject to performance standards under s. NR 428.05, Wis. Adm. Code, as discussed in section 6.2.

[18] The two coal-fired boilers operating at the Pleasant Prairie electric utility generating plant are responsible for the majority of NOx and VOC point source emissions in eastern Kenosha County. However, it is important to note that the Pleasant Prairie boilers have been well controlled since 2006 for both NOx and VOC. Pleasant Prairie emissions and controls are documented in section 6.1.

[19] Wisconsin's NOx RACT program is described in greater detail in Section 6.2.

On the whole, emission reductions due to control measures applied to point source NOx emissions in eastern Kenosha County occurred prior to 2011. Any change in emissions between 2011 and 2015 is due to a change in activity levels or due to normal fluctuations in operation or to the actual fuels utilized.

**Table 3.7: 2008-2015 NOx emissions and requirements for point sources in the eastern Kenosha County nonattainment area.**

| FID | Facility | 2008 NOx (Annual Tons) | 2011 NOx (Annual Tons) | 2015 NOx (Annual Tons) | 2008 – 2015 Emissions Change | Permanent and Enforceable Control Measures |
|---|---|---|---|---|---|---|
| 230006260 | We Energies - Pleasant Prairie Power Plant: Boilers B21 & B22 | 2,852.8 | 2,489.5 | 2,513.6 | -11.9% | 2007 – 0.1 lbs/mmBtu<br>2015 – 0.08 lbs/mmBtu |
| | Percent of Total Emissions | 97.7% | 98.3% | 98.1% | | |
| Multiple | Balance of Emission Units (NOx tons) | 68.1 | 44.0 | 49.6 | -27.1% | Emission units become subject to NOx RACT if facilities exceed 100 TPY PTE in the future. |
| | Percent of Total Emissions | 2.3% | 1.7% | 1.9% | | |
| | Number of Emission Units | 66 | 41 | 47 | | |
| **Total** | | **2,920.9** | **2,533.5** | **2,563.2** | **-12.2%** | |

*Wisconsin NOx Control* - Wisconsin codified NOx rules under ss. NR 428.04 to 428.12. Affected sources were required to first comply with the NOx emission limitations beginning February 1, 2001. The ch. NR 428 codified NOx limitations contributed to the NOx emission reductions as shown in Table 3.7. The Wisconsin NOx control program in ch. NR 428 also implemented emission limitations ensuring that any new source is installed with NOx emissions control equipment.

*Federal NOx Transport Rules* – Beginning January 1, 2009, EGUs in 22 states east of the Mississippi (including Wisconsin) became subject to ozone season NOx emission budgets under the Clean Air Interstate Rule (CAIR). CAIR addresses the broad regional interstate transport of NOx affecting attainment and maintenance of the 1997 ozone NAAQS, as required under CAA s. 110(a)(2)(D)[20]. CAIR resulted in a significant reduction of NOx emissions during the ozone season in areas contributing to eastern Kenosha County over the 2009-2014 period.

Table 3.8 shows emission levels for EGUs affected by the CAIR rule through 2014 for states upwind of the eastern Kenosha County area. The states listed (in decreasing order of

[20] The first transport rule promulgated by EPA was the NOx SIP Call in 2003. The EGU requirements are subsumed by the CAIR rule. However, NOx emissions for some larger industrial sources in states contributing to Wisconsin continue to be regulated under the NOx SIP Call.

contribution) are those states contributing more than 1% of the 2008 standard (0.75 parts per billion, ppb) to the Chiwaukee Prairie monitor[21]. Between 2008 and 2014, total EGU emissions across these states decreased by approximately 24%. Emission reductions were proportionately larger, ranging from 24% to 54.4%, for the three-state region contributing the most to eastern Kenosha County ozone concentrations: Illinois, Indiana, and Wisconsin.

Starting with the 2015 ozone season, the Cross-State Air Pollution Rule (CSAPR) replaced CAIR to reduce interstate NOx transport relative to the 1997 ozone NAAQS. CSAPR implemented NOx budgets for the impacted states in two phases. Phase I limits NOx emissions in 2015 and 2016. EPA published the CSAPR Update (81 FR 74504) in 2016 to address NOx transport affecting the attainment and maintenance of the 2008 ozone NAAQS (79 FR 16436). The CSAPR Update establishes Phase II NOx budgets starting with the 2017 ozone season.

**Table 3.8. EGU NOx emitted under the CAIR program in states contributing > 0.75 ppb (1% of the 2008 NAAQS) in Kenosha County.**

| State | CSAPR Modeled Contribution to Kenosha County[a] (ppb) | Ozone Season NOx Emissions (Tons) | | | Percent Reduction | | |
|---|---|---|---|---|---|---|---|
| | | 2008 | 2011 | 2014 | 2008 - 2011 | 2011 – 2014 | 2008 – 2014 |
| Illinois | 31.090 | 29,891 | 25,755 | 17,132 | 13.8% | 33.5% | 42.7% |
| Indiana | 12.888 | 53,016 | 48,926 | 40,247 | 7.7% | 17.7% | 24.1% |
| Wisconsin | 3.990 | 19,947 | 13,818 | 9,087 | 30.7% | 34.2% | 54.4% |
| Michigan | 3.336 | 38,437 | 32,780 | 24,981 | 14.7% | 23.8% | 35.0% |
| Ohio | 2.354 | 52,479 | 43,346 | 32,181 | 17.4% | 25.8% | 38.7% |
| Kentucky | 1.875 | 39,324 | 40,055 | 33,896 | -1.9% | 15.4% | 13.8% |
| Missouri | 1.349 | 34,820 | 26,912 | 31,235 | 22.7% | -16.1% | 10.3% |
| W. Virginia | 1.069 | 25,398 | 23,431 | 28,681 | 7.7% | -22.4% | -12.9% |
| Virginia | 0.958 | 17,392 | 15,620 | 9,695 | 10.2% | 37.9% | 44.3% |
| Pennsylvania | 0.878 | 53,545 | 64,885 | 44,005 | -21.2% | 32.2% | 17.8% |
| **Total** | | **364,250** | **335,527** | **271,141** | **7.9%** | **19.2%** | **25.6%** |

[a] Ozone contributions as determined by EPA in the final CSAPR rule, 76 FR 48208, August 8, 2011.
Source: EPA Clean Air Markets Division, Database of reported emissions.

Wisconsin VOC Control Measures

*VOC RACT/CTG* – Wisconsin has implemented VOC RACT to fulfill control technology guideline (CTG) requirements for the Wisconsin nonattainment areas under the 1997 ozone NAAQS, which includes all of Kenosha County.[22] These VOC RACT/CTG requirements are codified under chapters NR 419 through 424, Wis. Adm. Code. The list of the CTGs in place in Wisconsin is provided in Appendix 8. All of these CTG requirements were implemented and effective prior to the 2011 base year.

[21] Contributions as determined by EPA in the final CSAPR rule, 76 FR 48208, August 8, 2011.
[22] Wisconsin's VOC RACT program is described in greater detail in Section 6.3.

Table 3.9. lists the point sources emitting VOCs in the eastern Kenosha County nonattainment area in 2015. This assessment shows that approximately 92% of 2015 VOC emissions come from combustion sources. These combustion sources include two utility boilers, which accounted for 88% of total VOC emissions. The remaining combustion emissions originated from a number of industrial boilers, reciprocating engines, and various large space and process heating units. As indicated in Table 3.9, the majority of these combustion-related emissions are subject to various National Emission Standards for Hazardous Air Pollutant (NESHAP) rules that have become effective since 2011. These NESHAP rules implement good combustion practices that minimize VOC emissions or apply direct emission limitations on total hydrocarbons (including VOCs). The specifics of each NESHAP rule is further described below in the section "Federal VOC Control Measures for Point Sources". It should be noted, however, that although the good combustion NESHAP requirements are expected to minimize VOC emissions, the incremental emission reductions due to these rules are expected to be relatively small and hard to quantify.

Table 3.9 shows that approximately 8% of VOC point source emissions in 2015 came from non-combustion activities or processes, typically involving some form of fugitive evaporative-based emissions The non-combustion VOC sources are subject to RACT/CTG rules as applicable. These rules aid in controlling VOC emissions, but these rules were implemented prior to 2011 with no additional incremental reduction expected between 2011 and 2017.

<u>Federal VOC Control Measures for Point Sources</u>

A number of federal NESHAP rules have been implemented to control hazardous pollutants. These rules include requirements to control hazardous organic pollutants through ensuring complete combustion of fuels or implementing requirements for emissions of total hydrocarbons. Under either approach, the rules act to reduce total VOC emitted by the affected sources. These NESHAP rules apply to both major and area source facilities. Major sources are those facilities emitting more than 10 tons per year of a single hazardous air pollutant or more than 25 tons per year of all hazardous air pollutants in total. Area sources are those facilities that emit less than the major source thresholds for hazardous air pollutants.

**Table 3.9. 2015 VOC emissions and requirements for point sources in the eastern Kenosha County nonattainment area.**

| FID | Facility | Unit | Annual VOC (Tons) | Percent of Total | Permanent and Enforceable Control Measures |
|---|---|---|---|---|---|
| Combustion Sources | | | | | |
| 230006260 | We-Energies Pleasant Prairie Power Plant | B20 & B21 | 133.1 | 88.4% | MATS Combustion Requirements |
| Multiple | Natural gas-fired boilers | 17 units | 1.8 | 1.2% | ICI Boiler and process heater NESHAP combustion requirements[a] |
| Multiple | Fuel oil-fired boilers | 8 units | 0.03 | 0.02% | ICI Boiler and process heater NESHAP combustion requirements[a] |
| Multiple | Reciprocating Engines | 5 units | 0.01 | 0.01% | RICE NESHAP requirements[a] |
| Multiple | Process Heaters | 19 units | 3.6 | 2.4% | ICI Boiler and process heater NESHAP combustion requirements[a] |
| **Subtotal =** | | | **138.5** | **92.0%** | |
| Non-Combustion Sources | | | | | |
| Multiple | Non-Combustion Sources | 24 units | 12.0 | 8.0% | Individual emission units subject to VOC RACT/CTGs as applicable |
| | | | | | |
| **Total =** | | | **150.5** | **100%** | |

[a] The emissions units are subject to either major source or area source NESHAP emission requirements based on size thresholds. The applicability of requirements and exemptions for each unit has not been determined for purposes of this assessment. Natural gas-fired boilers and processes at area sources are not subject to requirements.

These NESHAP measures apply not only to sources within the eastern Kenosha County nonattainment area, but also nationally, thereby reducing the transport of VOC emissions into the nonattainment areas. The NESHAP rules that will likely contribute to VOC emission reductions in the 2017 ozone season include the following:

- *Mercury and Air Toxics (MATS) NESHAP* – On February 16, 2012, EPA promulgated the MATS rule under part 63 subpart UUUUU. Emission requirements were fully applicable by April 16, 2015. Affected sources were required to conduct energy assessments and combustion tuning to ensure complete combustion.

- *Major Source Industrial, Commercial, and Institutional (ICI) Boiler and Process Heater NESHAP* – On March 21, 2011, EPA promulgated the "National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters" under part 63 subpart DDDDD. This NESHAP requires all boilers and process heaters, including natural gas fired units, at major source facilities to perform an initial energy assessment and perform periodic tune-ups by January 31, 2016. This action is intended to ensure complete combustion.

- *Area Source (non-major point sources) ICI Boiler and Process Heater NESHAP* – On March 21, 2011 EPA promulgated the "National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers" under part 63 subpart JJJJJJ. This NESHAP requires solid fuel and oil fuel fired boilers operated by sources that are below the major source threshold to begin periodic combustion tuning by March 21, 2014.

- *Internal Combustion Engine Rules* – EPA has promulgated three rules that limit the total amount of hydrocarbon emissions from internal combustion engines - the "National Emission Standards for Hazardous Pollutants for Reciprocating Internal Combustion Engines" (RICE Maximum Achievable Control Technology, MACT) was promulgated on June 15, 2004 under Part 63, subpart ZZZZ and revised in January 2008 and March 2010, with the two revisions impacting additional RICE units; the "Standards of Performance for Stationary Spark Ignition Internal Combustion Engines" promulgated on January 18, 2008 under Part 60, subpart JJJJ; and "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines promulgated on July 11, 2006 under Part 60, subpart IIII. These rules implement hydrocarbon emission limitations prior to and after 2011 based on compliance dates. These rules also act to continuously reduce emissions as existing stationary engines are replaced by new, cleaner-burning engines.

### 3.6.2. Area Source Control Measures

*Area source VOC controls* - As noted for point sources, Wisconsin has implemented all of the necessary VOC RACT/CTG rules under chs. NR 419 through 424, Wis. Adm. Code. A number of these rules limit VOC emissions from area sources as well, as noted in Appendix 8. In addition to Stage 1 fuel delivery vapor controls (the loading of underground storage tanks at gas stations), Wisconsin previously had a Stage 2 vehicle refueling vapor recovery program in place. However, the Stage 2 program was removed from Wisconsin's ozone SIP on November 4, 2013 (78 FR 65875) with EPA approval because the equipment was found to interface negatively with the onboard vapor recovery systems required on gasoline fueled new vehicles after 1998. As stage 2 equipment was removed, refueling facility VOC emissions decreased slightly due to reduced fugitive underground storage tank VOC venting. This SIP revision was based on a technical showing of net benefit as required under CAA Sections 110(l) and 193 in order to prevent SIP backsliding.

There are also a number of federal programs in place which reduce area source VOC emissions. VOC emission standards for consumer and commercial products were promulgated under 40 CFR Part 59. This program was implemented prior to 2011 and will continue to maintain reduced VOCs emitted from this source category. Future emission levels will vary depending on population and activity use factors. Another federal rule, the area source hazardous air pollutant control rule, also controls area VOC emissions associated with fuel storage and transfer activities (40 CFR 63, Subpart R, BBBBBB, and CCCCCC). Kenosha County remains a part of the federal RFG program, which meets a more refined set of gasoline fuel formulation characteristics, including very low summer volatility, resulting in much lower VOC fugitive losses per unit fuel compared to non-RFG areas.

### 3.6.3. Onroad Source Control Measures

Both NOx and VOC emissions from onroad mobile sources are substantially controlled through federal new vehicle emission standards programs and fuel standards that impact both tailpipe emissions and evaporative losses. Although initial compliance dates in many cases were prior to 2011, these regulations have continued to reduce areawide emissions as fleets turn over to newer vehicles. All of these programs apply nationally and have reduced emissions both within the nonattainment areas and in contributing ozone precursor transport areas. The federal programs contributing to reductions in ozone precursor emissions include those listed in Table 3.10.

**Table 3.10. Federal onroad mobile source regulations contributing to attainment.**

| On-road Control Program | Pollutants | Model Year[a] | Regulation |
|---|---|---|---|
| Passenger vehicles, SUVs, and light duty trucks – emissions and fuel standards | VOC & NOx | 2004 – 2009+ (Tier 2)<br>2017+ (Tier 3) | 40 CFR Part 85 & 86 |
| Light-duty trucks and medium duty passenger vehicle – evaporative standards | VOC | 2004 - 2010 | 40 CFR Part 86 |
| Heavy-duty highway compression engines | VOC & NOx | 2007+ | 40 CFR Part 86 |
| Heavy-duty spark ignition engines | VOC & NOx | 2005 – 2008+ | 40 CFR Part 86 |
| Motorcycles | VOC & NOx | 2006 – 2010 ( Tier 1 & 2) | 40 CFR Part 86 |
| Mobile Source Air Toxics – fuel formulation, passenger vehicle emissions, and portable container emissions | Organic Toxics & VOC | 2009 – 2015[b] | 40 CFR Part 59, 80, 85, & 86 |
| Light duty vehicle corporate average fuel economy standards | Fuel efficiency (VOC and NOx) | 2012-2016 & 2017-2025 | 40 CFR Part 600 |

[a] The range in model years affected can reflect phasing of requirements based on engine size or initial years for replacing earlier tier requirements.
[b] The range in model years reflects phased implementation of fuel, passenger vehicle, and portable container emission requirements as well as the phasing by vehicle size and type.

Two additional ongoing CAA-required programs limit onroad VOC and NOx emissions. The first program, administered by EPA, has required the use of RFG in southeast Wisconsin (including Kenosha County) and the Chicago nonattainment area since 1995. The second program is the Wisconsin-administered I/M program and is required for Kenosha County. The Wisconsin I/M program was first implemented in 1984 and has gone through several modifications and enhancements since that time.[23] The I/M program requirements are codified in ch. NR 485, Wis. Adm. Code. Both the RFG and the I/M programs reduce average vehicle VOC and NOx emissions and garner some level of continued incremental reduction as fleets turn over to new vehicles.

### 3.6.4. Nonroad Source Control Measures

Similar to on-road sources, VOC and NOx emitted by nonroad mobile sources are significantly controlled via federal standards for new engines. These programs therefore reduce ozone precursor emissions generated within Kenosha County and in the broader regional areas contributing to ozone transport. Table 3.11 lists the nonroad source categories and applicable federal regulations. The nonroad regulations continue to slowly lower average unit and total sector total emissions as equipment fleets are replaced each year (it takes approximately 20 years for complete fleet turnover), pulling the highest emitting equipment out of circulation or substantially reducing its use. The new engine requirements are implemented in conjunction with fuel programs regulating fuel sulfur content. The fuel programs enable achievement of various new engine tier VOC and NOx emission limits.

The RFG program noted in the onroad control measures also contributes to lower NOx and VOC emissions from the nonroad mobile sector.

[23] Wisconsin's I/M program is described in greater detail in Section 6.5.

**Table 3.11. Federal nonroad mobile source regulations contributing to attainment.**

| Nonroad Control Program | Pollutants | Model Year[a] | Regulation |
|---|---|---|---|
| Aircraft | HC & NOx | 2000 – 2005+ | 40 CFR Part 87 |
| Compression Ignition[b] | NMHC & NOx | 2000 – 2015+ (Tier 4) | 40 CFR Part 89 & 1039 |
| Large Spark Ignition | HC & NOx | 2007+ | 40 CFR Part 1048 |
| Locomotive Engines | HC & NOx | 2012 – 2014 (Tier 3) 2015+ (Tier 4) | 40 CFR Part 1033 |
| Marine Compression Ignition | HC & NOx | 2012 – 2018 | 40 CFR Part 1042 |
| Marine Spark Ignition | HC & NOx | 2010+ | 40 CFR Part 1045 |
| Recreational Vehicle[c] | HC & NOx | 2006 – 2012 (Tier 1 – 3) (phasing dependent on vehicle type) | 40 CFR Part 1051 |
| Small Spark Ignition Engine < 19[d] Kw – emission standards | HC & NOx | 2005 – 2012 (Tier 2 & 3) (phasing based on both Tier and engine size) | 40 CFR Part 90 & 1054 |
| Small Spark Ignition Engine < 19 Kw – evaporative standards | HC & NOx | 2008 – 2016 (phasing based on both engine size and category) | 40 CFR Part 1045, 54, & 60 |

HC – Hydrocarbon (VOCs)
NMHC – Non-Methane Hydrocarbon (VOCs)
[a] The range in model years affected can reflect phasing of requirements based on engine size or initial years for replacing earlier tier requirements.
[b]Compression ignition applies to diesel non-road compression engines including engines operated in construction, agricultural, and mining equipment.
[c] Recreational vehicles include snowmobiles, off-road motorcycles, and all-terrain vehicles.
[d] Small spark ignition engines include engines operated in lawn and hand-held equipment.

# 4. MODELED ATTAINMENT ASSESSMENT

One of the central requirements for moderate nonattainment areas is a modeled demonstration that a nonattainment area will attain the NAAQS. Wisconsin, Illinois, and Indiana are relying on photochemical modeling conducted by LADCO to make this modeled attainment assessment for the Chicago nonattainment area under the 2008 ozone NAAQS. LADCO developed an air quality modeling platform to evaluate the adequacy of current and potential emissions reduction strategies for allowing attainment of the 2008 ozone NAAQS by the 2017 attainment deadline. The technical support document for this modeling analysis is included as Appendix 9. In addition to discussing how the model was set up, evaluated and run (including the emissions inventories used), this appendix presents additional regional data analyses and weight of evidence support for the modeled attainment finding. This chapter provides a high-level overview of this modeled attainment demonstration for the Chicago nonattainment area. This analysis demonstrates that all monitoring sites within the Chicago nonattainment area are projected to attain the 2008 ozone NAAQS by the 2017 ozone season.

## 4.1. Emission Inventories for Photochemical Modeling

The emission inventories used for the photochemical modeling rely heavily on emissions and other model inputs prepared by EPA. Both EPA and LADCO extensively quality assure their emission inventories.[24] LADCO's emissions modeling quality assurance procedures include reviewing emissions model output files for errors, comparing emissions between processing steps, checking that speciation, temporal, and spatial allocation factors are applied correctly, and reviewing the air quality model emissions inputs and stack parameters.

### 4.1.1. Base Case Modeling for 2011 and 2017

LADCO utilized emissions inventories compiled by EPA for the years 2011 and 2017 as the starting point for the modeling inventories used in this analysis. EPA's 2011 emission inventory (Version 2011EH) is based on the 2011 NEI, version 2 (2011NEIv2), which was speciated, temporalized and gridded to provide hourly emissions inputs to support photochemical modeling. Emissions include all criteria pollutants and precursors, and some hazardous air pollutants. See EPA's Technical Support Document[24] for a thorough description of the methodology used to develop the 2011EH emissions inventory. EPA's projected future emission inventory for the year 2017 is based on the 2011 baseline inventory and incorporates current "on-the-books" emission control measures and sector-specific forecasts for activity changes from 2011-2017.

LADCO updated the 2011 and 2017 EPA inventories for regional onroad mobile sources and EGUs. EGU emissions were updated to use outputs from the Eastern Regional Technical Advisory Committee (ERTAC) EGU Forecast Tool. LADCO used improved outputs to the MOVES emissions model for 2011 and 2017 to update the onroad mobile source emissions estimates. These updates are described in greater detail in Appendix 9.

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[24] EPA, 2015. Notice of Availability of the Environmental Protection Agency's Updated Ozone Transport Modeling Data for the 2008 Ozone National Ambient Air Quality Standard (NAAQS). Available at https://www.epa.gov/airmarkets/noda-epas-updated-ozone-transport-modeling

### 4.1.2. Modeling with Additional Control Measures for 2017

LADCO also modeled a scenario for 2017 that considered additional emission reductions due to implementation of the CSAPR Update (see section 3.6.1). This rule is expected to further reduce $NO_X$ emissions from EGUs in 22 states in the eastern U.S., including five of the states in the LADCO region. These emissions reductions are required to be in place by the beginning of the 2017 ozone season. LADCO used the ERTAC EGU Forecast Tool to project likely NOx emissions reductions from the CSAPR Update. LADCO's approach assumed that electric utilities would likely optimize their use of existing controls (selective catalytic reduction, SCR, and selective non-catalytic reduction systems) and shift electric generation from higher emitting units to cleaner ones to in order to comply with reduced 2017 CSAPR state ozone season NOx budgets. See Appendix 9 for more information.

In addition to CSAPR, EPA has adopted a number of national rules over the past few years that require or will require VOC and NOx emission reductions. Emissions standards established for mobile sources have been phased in over recent years, but fleet turnover will ensure continued emissions reductions for many years in the future. For the LADCO states, these rules have provided emissions reductions between 2011 and 2017 and have been factored into the modeling assessment.

Figure 4.1 compares projected VOC and NOx emissions for 2017 (considering all control measures) with 2011 base year emissions for all emissions categories. Emissions of VOCs and $NO_X$ are expected to decrease substantially from each state in the Chicago nonattainment area and regionally between 2011 and 2017 due to "on-the-books," enforceable control measures.

## 4.2. Photochemical Modeling for Ozone

LADCO, in cooperation with the Illinois Environmental Protection Agency (IEPA), the Indiana Department of Environmental Management (IDEM), and WDNR, conducted the modeling assessment described here to support the development of the states' ozone attainment SIPs. The modeling analyses were conducted in accordance with EPA's attainment demonstration and related modeling guidelines.[25]

### 4.2.1. Selection of Base Year

The calendar year 2011 was selected as the base year for regional ozone modeling, based on the following considerations:

- The 2011 base year is representative of the observed baseline design values for the time period (2009-2011) when EPA established the final air quality designations for the Chicago area for the 2008 ozone NAAQS.

- There are extensive air quality, meteorological, and emissions databases that have been developed for 2011 by EPA, and others, for regulatory purposes.[24]

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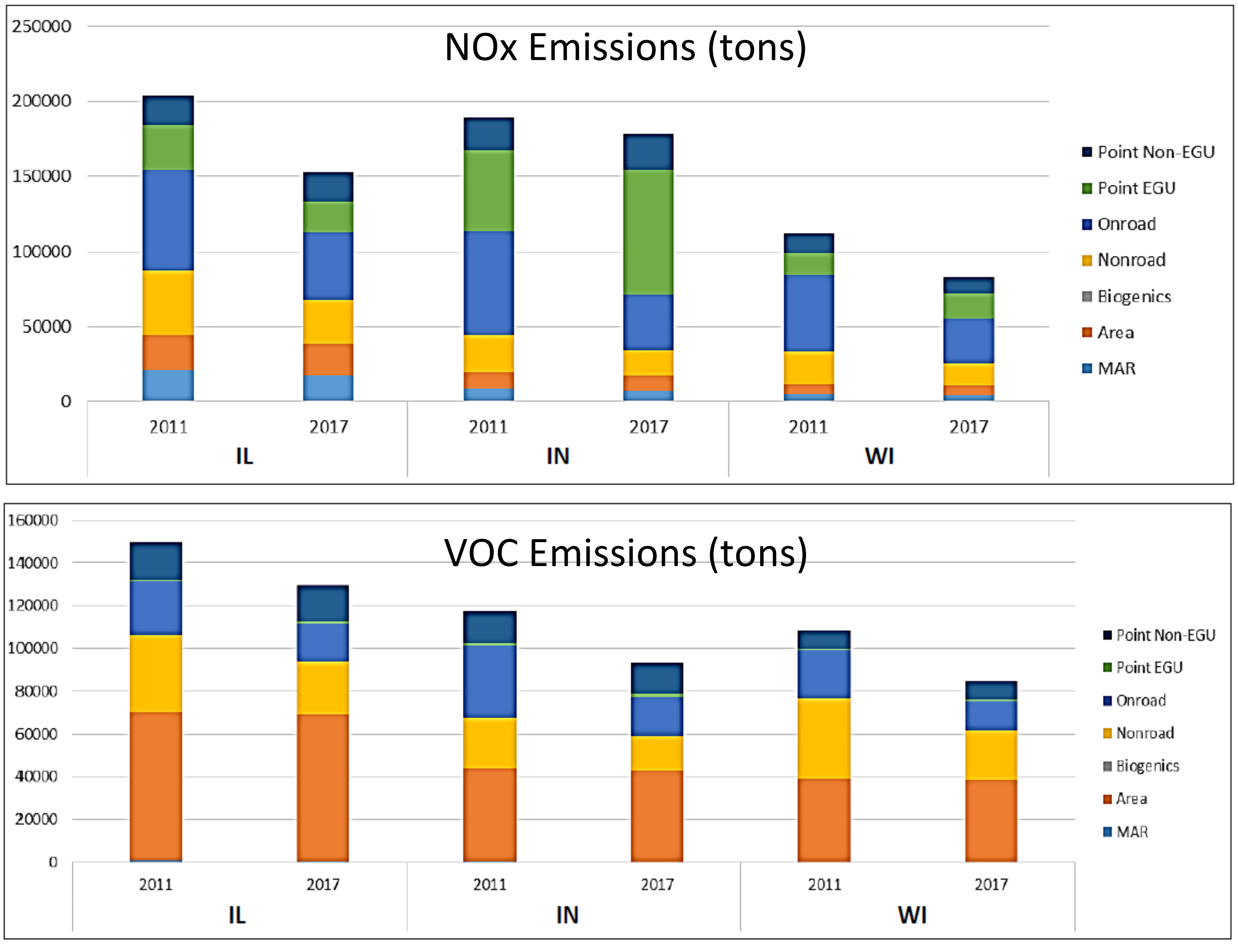
[25] EPA, 2014. Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ , and Regional Haze. Available at http://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

- The 2011 ozone season was typical in terms of meteorology and ozone conduciveness in the Lake Michigan region.

**Figure 4.1. Base year (2011) and future year (2017) emissions of (top) NOx and (bottom) VOCs from the three states in the Chicago nonattainment area. Emissions are shown in tons per year for the entire state (not just the nonattainment area).[26] Data for 2017 include reductions due to the CSAPR Update rule (From LADCO, Appendix 9)**




### 4.2.2. Modeling Platform

The modeling platform consists of emissions and transport models that reflect the spatial and temporal characteristics of the study region. A summary of the models used in the 2011 modeling platform are shown in Table 4.1. Meteorological modeling for the 2011 modeling platform was performed with the Weather Research and Forecast (WRF-ARW V3.4) model operated by EPA's Office of Air Quality Planning and Standards (OAQPS). LADCO's modeling

[26] It should be noted that a large majority of Wisconsin emissions do not contribute to ozone in the Chicago nonattainment area due to the regional transport patterns described in Chapter 2. However, emissions from sources in Illinois and Indiana upwind of the nonattainment area significantly contribute to ozone in the area.

assessment utilized the WRF meteorological outputs developed by EPA.[27] The 2011 WRF meteorological data has been extensively evaluated on a national scale by EPA.[25] Appendix 9 describes the meteorological inputs in greater detail.

**Table 4.1. Modeling platform components.**

| Model | Type | Managing Organization |
|---|---|---|
| WRF | Meteorology | EPA OAQPS[a] |
| GEOS-CHEM | Global Chemical Transport | EPA OAQPS |
| SMOKE | Emissions | EPA OAQPS / LADCO |
| CAMx | Regional Photochemical | LADCO |

[a] OAQPS is EPA's Office of Air Quality Planning and Standards.

Photochemical modeling of criteria air pollutants is performed with the Comprehensive Air quality Model with Extensions (CAMx V6.30[28]). CAMx is commonly used for attainment plans[25], has been extensively peer reviewed[29,30] and has performed well in previous applications[31]. Emissions inventory data is converted into the formatted emission files required by the CAMx model using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. Initial and boundary conditions are derived from a 2011 global simulation run using the Goddard Earth Observing Systems Chemistry (GEOS-CHEM) model. The CAMx photochemical model outputs hourly concentrations of tropospheric pollutants including ozone, NOx, and various groupings of VOCs. Hourly results are post-processed to daily averages, maximum daily 8-hour average (MDA8) ozone concentrations, or annual averages for the purpose of assessing and projecting monitor design values in the context of regional attainment demonstrations. Appendix 9 describes the model configuration in greater detail.

#### 4.2.3. Summary of Model Performance Evaluation

LADCO evaluated the 2011 base case modeling to assess the model's ability to reproduce observed ozone and precursor concentrations regionally and in the Lake Michigan area. The model performance evaluation examines the platform's ability to replicate the magnitude, spatial, and temporal pattern of measured concentrations. This exercise is intended to assess whether confidence in the model is warranted and, if so, to what degree. Model performance is assessed by comparing paired modeled and monitored concentrations.

EPA's modeling guidance does not specify rigid acceptance/rejection criteria for model performance. However, ozone model performance is generally considered good if bias is within

[27] EPA, 2014. Meteorological Model Performance for Annual 2011 WRF v3.4 Simulation. Available at http://www.epa.gov/ttn/scram/reports/MET_TSD_2011_final_11-26-14.pdf
[28] Available at http://www.camx.com/home.aspx
[29] Baker, K., Scheff, P., 2007. Photochemical Model Performance for $PM_{2.5}$ Sulfate, Nitrate, Ammonium, and Precursor Species $SO_2$ , $HNO_3$, and $NH_3$ at Background Monitor Locations in the Central and Eastern United States. Atmospheric Environment, 41, 6185- 6195.
[30] Vizuete, W., Jeffries, H.E., Tesche, T.W., Olaguer, E.P., Couzo, E., 2011. Issues with Ozone Attainment Methodology for Houston, TX. J. Air Waste Manage. Assoc., 61, 238-253.
[31] Simon, H., Baker, K.R., Phillips, S., 2012. Compilation and Interpretation of Photochemical Model Performance Statistics Published Between 2006 and 2012. Atmospheric Environment, 61, 124-139.

15% (positive or negative) and error is within 30% for MDA8 values. Simon et al.[31] present a thorough discussion and summary of regional modeling performance statistics. The model's bias is within 15% at virtually all ozone monitor locations in the Lake Michigan region and in the Midwest, which shows that the model is performing well at predicting MDA8. The mean fractional error is within 20% at all locations near Lake Michigan. The relatively low error and bias suggest that the model is performing adequately for the immediate attainment assessment purpose. See Appendix 9 for more information about model performance.

#### 4.2.4. Modeled Attainment Test

CAA Section 182(b) requires states to use an attainment demonstration based on air quality modeling to determine whether identified emissions reduction measures are sufficient to reduce projected pollutant concentrations to a level that meets the NAAQS by the statutory deadline established by EPA. This modeling analysis uses 2017 as the projection year to demonstrate attainment of the 2008 ozone NAAQS. The emissions scenarios previously discussed were evaluated using the CAMx model to determine the likelihood that the 2008 ozone NAAQS will be achieved in the Chicago nonattainment area in 2017. LADCO performed this modeling assessment consistent with the draft guidance issued by EPA in 2014.[25] LADCO has estimated the amount of emission reductions expected by 2017 and has applied the CAMx photochemical model to simulate both base year and future year ozone concentrations.

The model attainment test uses the photochemical model to estimate future year design values via the Modeled Attainment Test Software (MATS).[32] The MATS software computes the fractional changes, or relative response factors, of ozone concentrations at each monitor location based on a comparison of the modeled air quality in the base and future years. Meteorological conditions are assumed to be unchanged for the base and projection years. Modeled relative reduction factors are then applied to a weighted baseline 2011 design value, which is determined by averaging three successive three-year design values centered on 2011 (i.e., 2009-2011, 2010-2012, 2011-2013). The resulting estimates of future ozone design values are then compared to the NAAQS. If the future ozone design values are less than or equal to the NAAQS, then the analysis suggests that attainment will be reached. LADCO has used the MATS software according to EPA's recommended approach.[25,33]

Table 4.2 summarizes the results of the model attainment test for the 2017 future year with LADCO's projection of the impact of EPA's CSAPR Update. As shown in Table 4.2, all monitoring locations in the Chicago nonattainment area are projected to meet the level of the 2008 ozone NAAQS (75 ppb) by 2017. Projected design values range from 53.9 ppb to 66.4 ppb. Accordingly, all monitors in the Chicago nonattainment area are projected to have ozone concentrations at least 9 ppb below the level of the 2008 ozone NAAQS. This demonstrates that the modeling predicts that the Chicago area should easily attain the 2008 ozone NAAQS by the July 2018 attainment date.

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[32] Available at http://www.epa.gov/scram001/modelingapps_mats.htm

[33] Abt Associates, 2014. Modeled Attainment Test Software: User's Manual. Available at: https://www3.epa.gov/ttn/scram/guidance/guide/MATS_2-6-1_manual.pdf

**Table 4.2. Projected ozone design values (ppb) for 2017 in the Chicago nonattainment area.**

| AQS ID | State | County | LADCO 2017 | EPA 2017 |
|---|---|---|---|---|
| 170310001 | Illinois | Cook | 66.3 | 67.5 |
| 170310032 | Illinois | Cook | 64.5 | 63.7 |
| 170310064 | Illinois | Cook | 59.2 | 58.4 |
| 170310076 | Illinois | Cook | 65.9 | 67.0 |
| 170311003 | Illinois | Cook | 55.1 | 55.9 |
| 170311601 | Illinois | Cook | 65.5 | 66.4 |
| 170314002 | Illinois | Cook | 58.8 | 57.9 |
| 170314007 | Illinois | Cook | 53.9 | 54.1 |
| 170314201 | Illinois | Cook | 62.1 | 62.3 |
| 170317002 | Illinois | Cook | 60.3 | 61.2 |
| 170436001 | Illinois | DuPage | 61.0 | 61.8 |
| 170890005 | Illinois | Kane | 65.8 | 66.5 |
| 170971007 | Illinois | Lake | 64.8 | 65.0 |
| 171110001 | Illinois | McHenry | 64.4 | 65.2 |
| 171971011 | Illinois | Will | 58.0 | 58.9 |
| 180890022 | Indiana | Lake | 59.0 | 60.2 |
| 180890030 | Indiana | Lake | 61.0 | 61.3 |
| 180892008 | Indiana | Lake | 59.6 | 59.8 |
| 181270024 | Indiana | Porter | 62.0 | 62.5 |
| 181270026 | Indiana | Porter | 57.9 | 58.4 |
| 550590019 | Wisconsin | Kenosha | 66.4 | 66.7 |

### 4.3. Modeling-Related Weight of Evidence Support for Attainment

A number of other types of analyses support the modeled projection of attainment for the Chicago area in 2017. These analyses suggest that ozone precursor emissions may be overestimated in the modeling, that the attainment finding is not sensitive to the choice of base year, and support the finding of attainment through a separate modeling effort, as described below.

Appendix 9 describes a number of reasons why the modeled projections for 2017 ozone concentrations may overestimate emissions of ozone precursors, and thus ozone concentrations, in 2017. Several of the emissions projections used are considered conservative, meaning that they overestimate future emissions from these sources. The sectors that are believed to have conservative emissions forecasts include EGUs and future coal utilization at EGUs.

LADCO also projected ozone design values assuming a range of 2011 baseline design values, as shown in Table 4.4 of Appendix 9. In all of these scenarios, projected 2017 design values for all monitors in the Chicago nonattainment area were well below the 2008 NAAQS. This suggests that the modeled projection of attainment for the Chicago area is not sensitive to the selection of the base year.

EPA conducted modeling in 2015 in support of regulatory initiatives regarding the revised ozone NAAQS and interstate transport.[34] The projections from EPA's modeling are shown in Table 4.2, along with LADCO's modeling results. EPA's model projections are very similar to LADCO's projections, with a range of ozone design values of 54.1 ppb to 66.7 ppb, with the high and low values at the same monitors. These projections support the modeled demonstration of attainment of the 2008 ozone NAAQS for the Chicago nonattainment area in 2017.

[34] EPA, 2015. Notice of Availability of the Environmental Protection Agency's Updated Ozone Transport Modeling Data for the 2008 Ozone National Ambient Air Quality Standard (NAAQS). Available at https://www.epa.gov/airmarkets/noda-epas-updated-ozone-transport-modeling

# 5. WEIGHT OF EVIDENCE ANALYSIS: OZONE AND OZONE PRECURSOR TRENDS

## 5.1. Introduction

EPA recommends that states submit supplemental analyses in support of any attainment plan. These analyses are intended to provide additional support for a finding of attainment based on the required modeled attainment assessment. Such supplemental analyses are part of a "weight of evidence" demonstration that an area will attain a standard. This section presents and discusses trends in ambient ozone and ozone precursor concentrations and forms the core of such a weight of evidence demonstration.

These weight of evidence analyses support the projection of attainment from the modeled attainment demonstration for the Chiwaukee Prairie monitor, along with all of the other ozone monitors in the Chicago nonattainment area. The MATS modeling analysis projects attainment in the Chicago area by a wide margin (Section 4 and Table 5.1). Monitoring data shows that the Chiwaukee Prairie monitor (the highest-ozone monitor in the Chicago area) is very close to attainment. A fourth high value of 71 ppb or lower in 2017 would allow the area to attain the 2008 ozone NAAQS (Table 5.1). This value was last measured as a fourth high value at this monitor in 2009, at a point in time when aggregate ozone precursor emissions from the major source categories were higher than they are today.

**Table 5.1. Comparison of modeled 2017 design values, recent monitored values and 2017 critical values for the Chiwaukee Prairie monitor in Kenosha County.**

| Modeled 2017 DV (ppb) | | Monitored 4th highs (ppb) | | 2017 critical values |
|---|---|---|---|---|
| LADCO | EPA | 2015 | 2016 | |
| 66.4 | 66.7 | 75 | 81 | to attain: 71 ppb or lower |
| | | | | to violate: 72 ppb or higher |

This chapter shows that emissions of ozone precursors have decreased regionally since at least 2002 and are currently roughly half of their 2002 levels. As a result of these emissions reductions, monitored concentrations of NOx and VOCs in Wisconsin have decreased by similar proportions and are continuing to decrease. Ozone concentrations adjusted for meteorology are also continuing to decrease. Section 5.4 of this chapter also demonstrates the crucial role of transport of ozone and ozone precursors to the Chiwaukee Prairie monitor, which severely limits Wisconsin's ability to reduce ozone concentrations in Kenosha County. Overall, this weight of evidence analysis supports a finding of forecast attainment of the 2008 ozone NAAQS in Kenosha County.

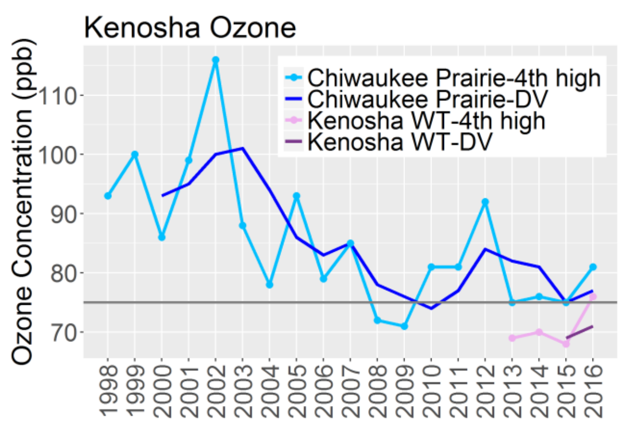
## 5.2. Trends in Ambient Ozone Concentrations

WDNR currently monitors ozone at two locations within the eastern Kenosha nonattainment area (Figure 1.1). In addition, IEPA operates an additional 15 ozone monitors within the larger Chicago nonattainment area, and IDEM operates five monitors within this area.

### 5.2.1. Trends in Monitored Ozone Concentrations

Figure 5.1 shows trends in the annual fourth high MDA8 ozone concentration and design values for Wisconsin's monitors in the Chicago nonattainment area. Since 1998, ozone concentrations have decreased considerably. Annual fourth high values at the Chiwaukee Prairie monitor have decreased from 86-116 ppb before 2004 to 75-81 ppb since 2013. Design values[35] have decreased from 93-101 ppb before 2004 to 75-77 ppb in 2015 and 2016. The largest reductions occurred during the early years of this period, with design values decreasing by 15 ppb from 2000 to 2008 but only 1 ppb from 2008 to 2016 (Table 5.2). Meteorological variability significantly affects ozone concentrations and can obscure trends over shorter time periods. For example, 2012 had an extremely hot summer with a high frequency of elevated ozone concentrations, 2008 and 2009 had relatively cool summers with a lower frequency of elevated ozone concentrations. The next two sections discuss the impact of meteorology on ozone concentrations at these locations and show that when adjusted for meteorology, ozone concentrations are continuing to decrease.[36]

**Figure 5.1. Trends in annual fourth high maximum daily 8-hour ozone concentrations and design values for the monitors in Kenosha County, Wisconsin.**




Ozone concentrations followed similar trends at the other monitors in the Chicago nonattainment area (Figure 5.2; Table 5.2). The Chiwaukee Prairie monitor almost always had the highest annual fourth high concentration and always had the highest design value (Figure 5.2) across the Chicago area. Table 5.2 shows design values for 2000, 2008[37] and 2016 for all monitors currently operating in the area. Ozone design values decreased by an average of 11.5 ppb across the entire nonattainment area from 2000 to 2016. The largest reductions occurred south of

[35] Ozone design values are the three-year average of the annual fourth high MDA8 value.
[36] WDNR began operating a new monitor, Kenosha Water Tower, a few miles inland from the lakeshore in 2013. Fourth high MDA8 concentrations at this monitor have been consistently 5-7 ppb lower than those on the lakeshore, although the interannual trends are similar.
[37] Values for 2008 are shown because this year is the midpoint of the record shown here. Recent trends would show steeper decreases if starting with an earlier year and variable trends if starting with a more recent year. Because the impacts of meteorological variability tend to dwarf long-term trends when assessed over short time periods, it is difficult to meaningfully assess trends in ozone concentrations over short (less than a decade) time periods without controlling for meteorological factors.

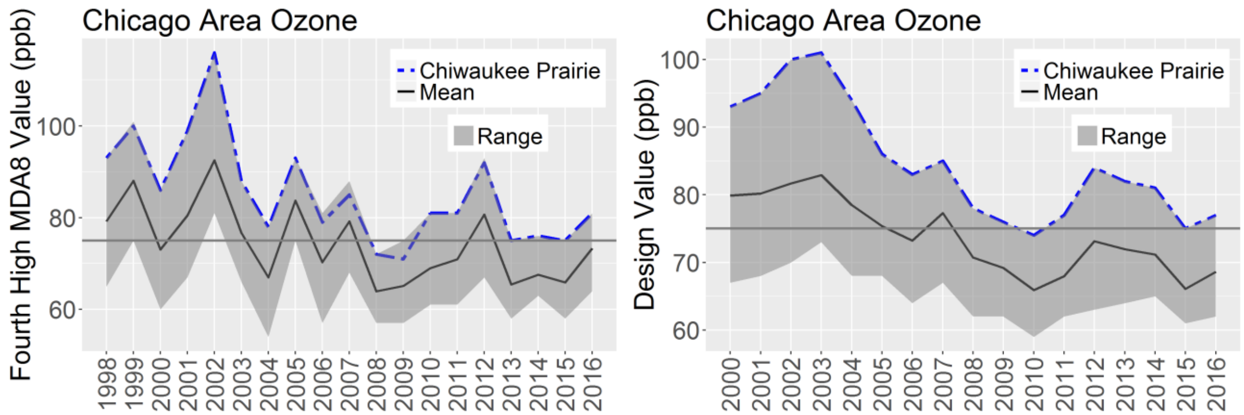
Chicago (including monitors in Indiana and Illinois's Braidwood and Chicago-SWFP monitors), with these monitors having 16-23% reductions in ozone concentrations. The smallest reductions occurred in and around Chicago itself, which saw changes varying from a 1% increase in ozone to a 6% reduction. Most of the reductions in ozone occurred prior to the 2006-2008 design value year, except at a few monitors within the city of Chicago.

**Table 5.2. Ozone design values for Chicago nonattainment area monitors for 1998-2000, 2006-2008, and 2014-2016 (preliminary), along with the change between these values. Data for 2008 are shown because this is the midpoint in the record.[37]**

| | | | | Design Value (ppb) | | | Change (ppb) | | |
|---|---|---|---|---|---|---|---|---|---|
| **Site ID** | **County** | **State** | **Site** | **1998-2000** | **2006-2008** | **2014-2016*** | **2000-2008** | **2008-2016** | **2000-2016** |
| 17-031-0001 | Cook | IL | Alsip | 75 | 76 | 69 | 1 | -7 | -6 |
| 17-031-0032 | Cook | IL | Chicago-SWFP | 86 | 74 | 70 | -12 | -4 | -16 |
| 17-031-0076 | Cook | IL | Chicago-Com. Ed | - | 73 | 68 | | -5 | |
| 17-031-1003 | Cook | IL | Chicago-Taft H.S. | 70 | 73 | 68 | 3 | -5 | -2 |
| 17-031-1601 | Cook | IL | Lemont | 74 | 75 | 69 | 1 | -6 | -5 |
| 17-031-3103 | Cook | IL | Schiller Park | - | - | 62 | | | |
| 17-031-4002 | Cook | IL | Cicero | 70 | 62 | 66 | -8 | 4 | -4 |
| 17-031-4007 | Cook | IL | Des Plaines | - | 66 | 71 | | 5 | |
| 17-031-4201 | Cook | IL | Northbrook | 81 | 69 | 70 | -12 | 1 | -11 |
| 17-031-7002 | Cook | IL | Evanston | 83 | 70 | 72 | -13 | 2 | -11 |
| 17-043-6001 | DuPage | IL | Lisle | 67 | 63 | 68 | -4 | 5 | 1 |
| 17-089-0005 | Kane | IL | Elgin | 75 | 66 | 68 | -9 | 2 | -7 |
| 17-097-1007 | Lake | IL | Zion | 81 | 72 | 73 | -9 | 1 | -8 |
| 17-111-0001 | McHenry | IL | Cary | 81 | 65 | 68 | -16 | 3 | -13 |
| 17-197-1011 | Will | IL | Braidwood | 80 | 66 | 64 | -14 | -2 | -16 |
| 18-089-0022 | Lake | IN | Gary | 84 | 73 | 67 | -11 | -6 | -17 |
| 18-089-2008 | Lake | IN | Hammond | 88 | 73 | 65 | -15 | -8 | -23 |
| 18-127-0024 | Porter | IN | Ogden Dunes | 91 | 74 | 69 | -17 | -5 | -22 |
| 18-127-0026 | Porter | IN | Valparaiso | 86 | 70 | 66 | -16 | -4 | -20 |
| 55-059-0019 | Kenosha | WI | Chiwaukee Prairie | 93 | 78 | 77 | -15 | -1 | -16 |
| 55-059-0025 | Kenosha | WI | Kenosha WT | - | - | 71 | | | |

*2016 data is preliminary and is subject to change.

**Figure 5.2. Trends in the average (left) fourth high maximum daily 8-hour average (MDA8) ozone concentration and (right) design value for ozone monitors in the Chicago nonattainment area. The shaded area shows the range of values. The values for the Chiwaukee Prairie, WI, monitor are shown for reference.**

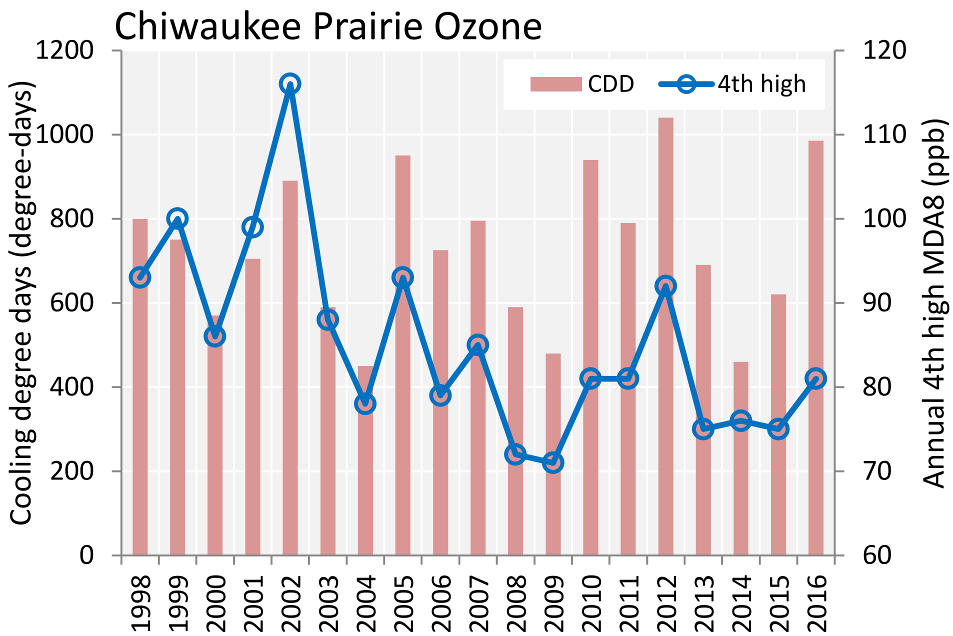


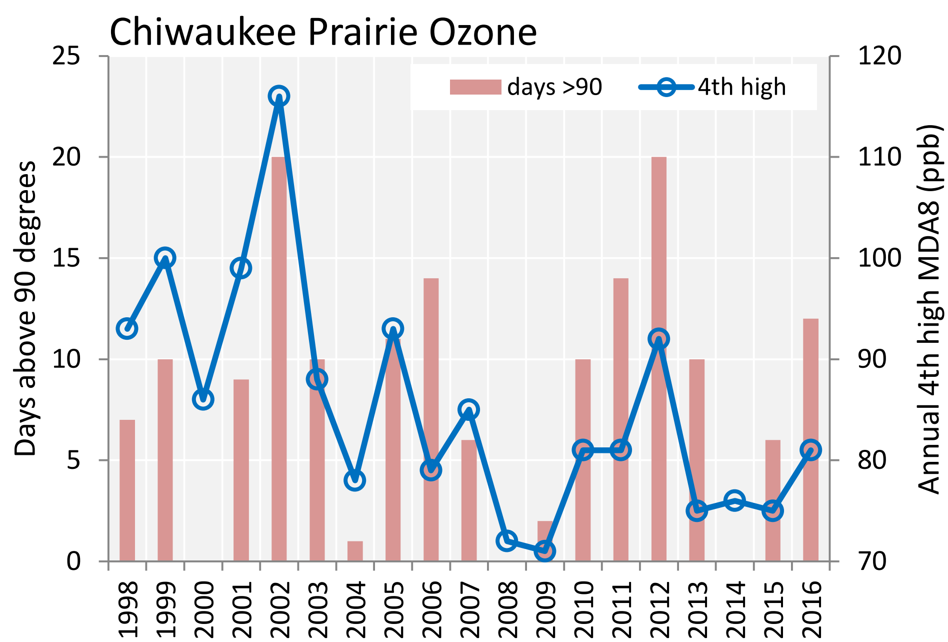

### 5.2.2. Influence of Temperature on Ozone Concentrations

Temperature is an important and well-known driver of ozone formation, with much more ozone produced at high temperatures than at low temperatures. Figure 5.3 compares annual fourth high MDA8 concentrations at Chiwaukee Prairie with two different measures of temperature at the Milwaukee Airport. Cooling degree days give a measure of how warm the whole year was, with higher overall temperatures leading to higher cooling degree days.[38] In comparison, the count of days with temperatures over 90° indicates how often extreme temperatures occurred in a year. The correlations between ozone concentrations and temperature are very clear from Figure 5.3. The highest ozone concentrations occurred in years with the highest temperatures, measured using both parameters, and vice versa. This figure also suggests that the amount of ozone produced for a given temperature level has decreased over time. For example, comparison of the years 2002 with 2012 shows that the fourth high MDA8 value was much lower in 2012 relative to 2002 (92 ppb versus 116 ppb) even though temperatures were similar between the years. These reductions are presumably due to reduced emissions of ozone precursors, as described in Chapter 3 and Section 5.3. The next part of this document explores these relationships in more detail and attempts to adjust ozone concentrations for different meteorological factors.

[38] Cooling degree days are measured in degree-days relative to 65° (in this case) and are a measure of the difference between the average temperature of a day and 65°, summed over an entire year. Cooling degree days are used as a relative measure of how much you would need to cool a space to keep temperatures steady at 65°.

**Figure 5.3. Trends in (top) cooling degree days (relative to 65 °F) and (bottom) days with temperatures above 90 °F at Milwaukee Airport, plotted with annual 4th high maximum daily 8-hour average (MDA8) ozone concentrations. Climatological data is from the Wisconsin State Climatology Office website (http://www.aos.wisc.edu/~sco/clim-history/index.html).**



### 5.2.3. Ozone Trends Adjusted for Meteorology

Because of the large effect of meteorology, particularly temperature, on ozone concentrations, meteorologically driven variability in ozone concentrations often obscures trends in ozone due to factors such as permanently reduced rates of precursor emissions. For this reason, it is important to adjust ozone concentrations for meteorology in order to examine trends in ozone concentrations due to precursor emission reductions and other factors. This section describes two such efforts to remove the effect of meteorology from ozone trends. Both sets of analyses show that when adjusted for meteorology, ozone concentrations in the Chicago nonattainment area are continuing to decrease.

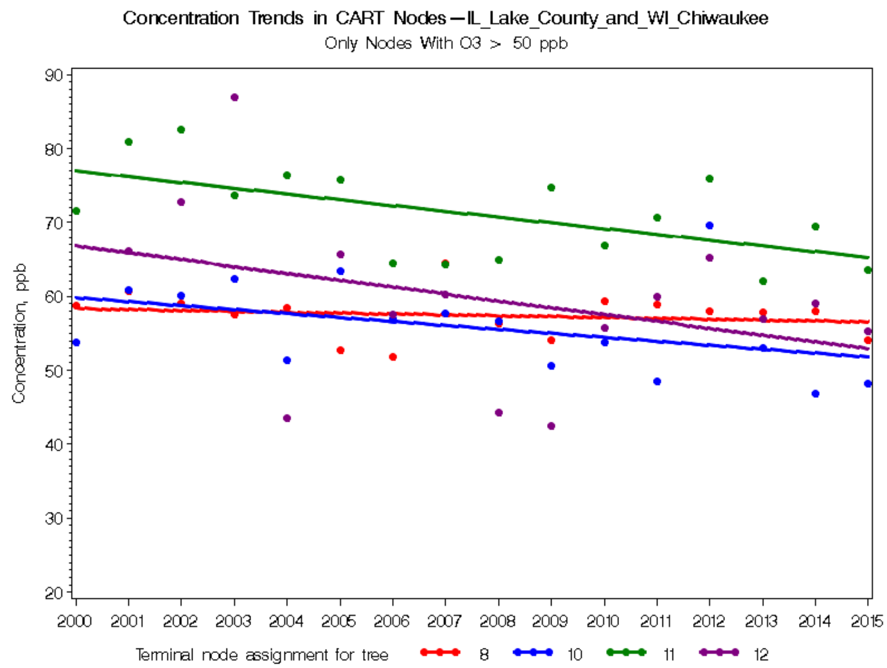
CART Analysis

Classification and Regression Tree (CART) analysis allows comparison of ozone concentrations on days with similar meteorological conditions. This analysis partially controls for the influence of year-to-year meteorological variability on ozone concentrations. CART analysis produces average ozone concentrations for a number of different classes of days (determined by meteorology) for each year under review. This analysis therefore allows examination of ozone concentration trends over long periods resulting from non-meteorological factors, including permanent and enforceable reductions in emissions of ozone precursors impacting the sites.

A CART analysis conducted by LADCO visualized changes in ozone concentrations under different meteorological conditions over 16 years from 2000-2015. Figure 5.4 shows average ozone concentrations for the four sets of meteorological conditions ("nodes") with the highest ozone concentrations for two monitors in the northern part of the Chicago nonattainment area. The data shown for each node are the average ozone concentrations on all days with a particular set of meteorological conditions.[39] (Note that this timeframe analyzed incorporates a period predating the 2008 standard.) Average ozone concentrations decreased under all of these meteorological conditions over this time period (the one exception is node 8, which remained relatively flat at concentrations around 60 ppb). The greatest decrease came from the nodes with the highest concentrations in the early 2000s (nodes 11 and 12). This analysis suggests that the observed long-term decreases in ozone concentrations are due to reductions in ozone precursors (discussed in Chapter 3 and section 5.3) rather than solely due to meteorological factors. This analysis is presented in more detail in Appendix 10, which presents the meteorological conditions represented by each node along with a CART analysis of monitors from Cook County, IL.

[39] For example, Node 11 in Figure 5.4 shows the average ozone concentrations for days characterized by maximum temperatures and average morning temperatures above 76.5 °F and 77.56 °F, respectively, average afternoon winds of greater than 2.41 m/s from the south, and no precipitation.

**Figure 5.4. Concentration trends from the CART analysis for Lake County, IL, and Kenosha County, WI monitors. Data points show the average ozone concentration for days sharing certain meteorological conditions ("nodes"). Only meteorological nodes with an average ozone concentration above 50 ppb are shown. (From LADCO, Appendix 9)**



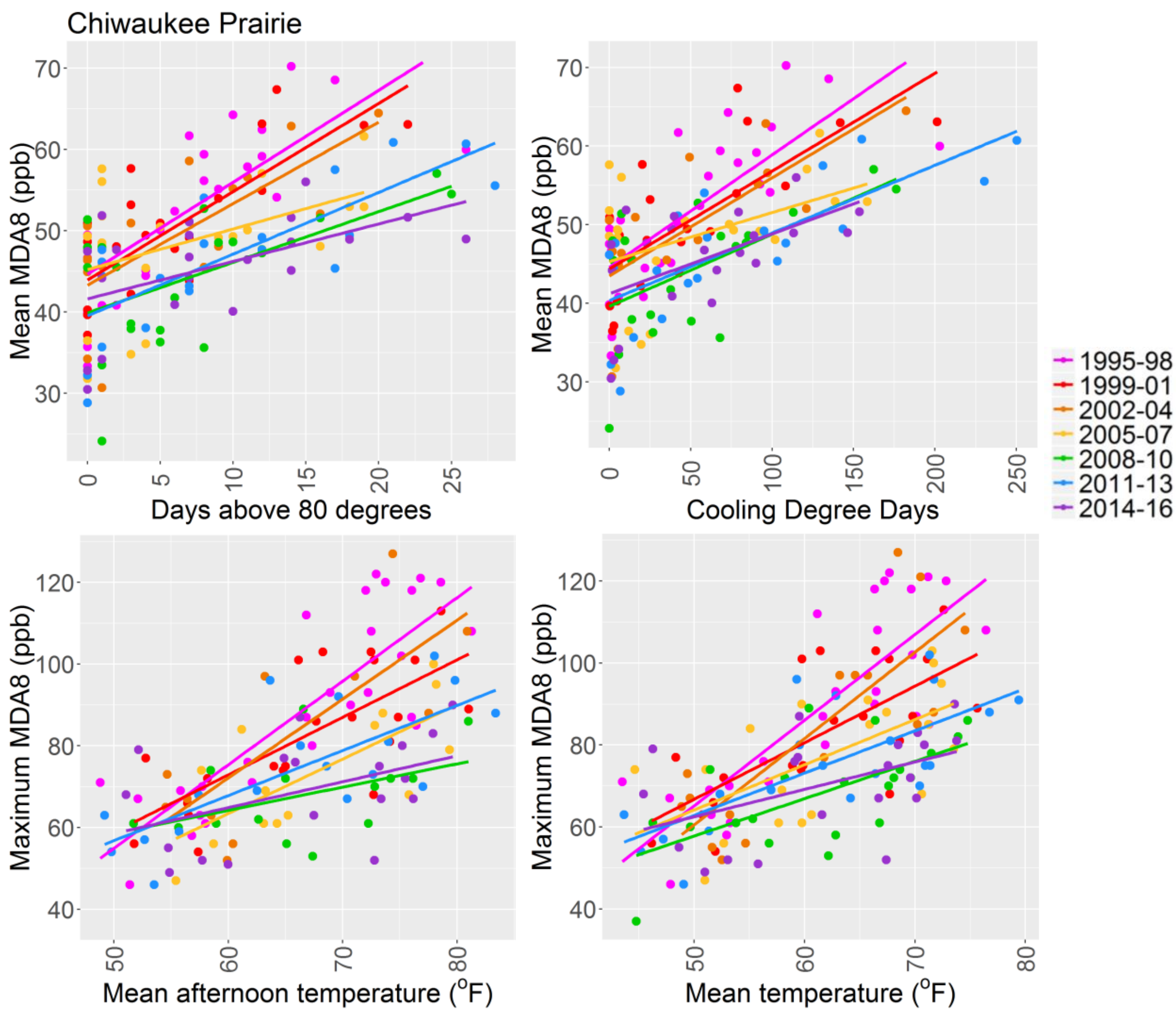

<u>Ozone-Temperature Correlations</u>

Plots of ozone versus temperature, separated by time period, also show reductions over time in the "conduciveness" of the atmosphere to form ozone given a certain amount of heat. Figure 5.5 shows plots of two ozone parameters versus four temperature parameters for individual months, with data grouped into three-year blocks.[40] (Appendix 10 shows many more of these plots, comparing different ozone and temperature parameters and comparing with temperatures at another location. The graphs shown here are those that had the best correlation coefficients.) These graphs confirm the earlier observations that ozone concentrations tend to increase with increasing temperature (Section 5.2.2). They also show that the amount of ozone produced at a given temperature level has decreased between almost every 3-year period. For example, comparison of trends in mean MDA8 values with the number of days above 80 degrees suggests that the mean MDA8 value for a month with 15 days above 80 degrees has decreased in almost every progressive time period. These values decreased from around 62 ppb in 1995-98 to 60 ppb in 1999-2001, 58 ppb in 2002-2004, 53 ppb in 2005-07, and 49 ppb in 2008-10. The exception to this trend is that the ozone values for 2008-10 generally were lower than those for 2011-13 and above or very near those for 2014-16. It is likely that ozone during the years 2008-10 was lower

[40] Temperature data is shown for the inland Lake Geneva monitor rather than for the Chiwaukee Prairie monitor itself because temperature at the lakeshore monitor can be greatly affected by localized lake breeze events, which would not impact temperature and precursor emission rates sensitive to temperature in upwind areas where the ozone is formed. Using Lake Geneva temperatures removes localized impacts and should be reflective of regional temperatures. Correlations between ozone parameters and temperatures at the Milwaukee Airport were conducted and are shown in Appendix 10. However, the correlations with temperatures at Lake Geneva were stronger.

than during the other years because of the economic recession, which lowered emissions because of less economic activity. This impact is apparent in monitored NOx (Figure 5.9) and VOC (Figure 5.10) concentrations and was confirmed by a recent research study[41].

**Figure 5.5. Trends in monthly averages of two ozone concentration parameters (mean maximum daily 8-hour average, MDA8, and maximum MDA8) plotted versus four different temperature parameters. Data are grouped into three- or four-year groups. Ozone was measured at the Chiwaukee Prairie monitor whereas temperature was measured at the inland Lake Geneva monitor.[40]**




In all of these graphs, the trend line for the most recent set of years, 2014-16, is either the lowest or among the lowest (with the low-ozone recession years, 2008-10), indicating that these years yielded the lowest amount of ozone for a given amount of warmth. This analysis confirms the conclusion of the CART analysis that ozone concentrations, when controlled for meteorology, have continued to decrease, even in the last few years. These findings suggest that, independent

[41] Tong et al. (2016) Impact of the 2008 Global Recession on air quality over the United States: Implications for surface ozone levels from changes in NOx emissions. *Geophys. Res. Letters*, 10.1002/2016GL069885.

of meteorology, reductions in ozone precursor emissions (discussed in Chapter 3 and section 5.3) are continuing to drive decreases in ambient ozone concentrations. The analysis furthermore suggests that the apparent "flatness" of the trend in monitored ozone concentrations since 2008 likely reflects variable meteorology, in concert with a return to more typical economic activity levels, rather than a true leveling off in the pattern of declining ozone concentrations. This is evident from the finding that 2014-16 showed reduced relative ozone compared to the 2011-2013 period and similar concentrations relative to 2008-10, a unique period of both lower ozone formation propensity and lowered relative economic activity.

## 5.3. Trends in Ambient Ozone Precursor Concentrations

### 5.3.1. NOx and VOC Roles in Ozone Formation and Emission Trends

Ozone is formed from the reaction of NOx and VOCs in the presence of sunlight. Ozone formation involves a number of different reactions. Partly because of the interactions between these different reactions, rates of ozone formation often respond non-linearly to reductions in ozone precursor concentrations. For example, under some circumstances, ozone formation may be NOx-limited, such that reductions in NOx emission cause reductions in ozone concentrations. Under NOx-limited conditions, VOC reductions may not affect ozone concentrations. Under other conditions, ozone formations may be VOC-limited. Currently, ozone formation in most of the eastern U.S. is believed to be NOx-limited[42]. The primary exception to this assumed NOx-limitation is in the largest urban centers, which often have high NOx concentrations and where ozone formation may be limited by the concentrations of the less-abundant VOCs. Because of this complex chemistry, approaches to decreasing ozone concentrations have relied on reductions in both NOx and VOC emissions.

NOx consists of nitric oxide (NO) and nitrogen dioxide ($NO_2$). Most NOx is emitted as NO, which reacts fairly rapidly in the atmosphere to form $NO_2$, which has a longer lifetime in the atmosphere and can be transported longer distances. VOCs are a complex mixture of hundreds of different types of organic compounds, including compounds that contain only carbon and hydrogen ("hydrocarbons") and compounds that also include oxygen, nitrogen, sulfur and/or other elements. Some VOCs are emitted directly by anthropogenic sources, including benzene and toluene, whereas others are formed in the atmosphere from reaction of other VOCs. These "secondary VOCs" include formaldehyde and acetaldehyde, which are important "carbonyl" compounds.[43]

Emissions of both NOx and VOCs have decreased dramatically in the last few decades from Wisconsin and other U.S. states. Emissions of NOx from sources in Wisconsin decreased by 51% from 2002 to 2014, and emissions of VOCs decreased 50% in this same timeframe (Figure 5.6). These reductions resulted from the control programs described in Section 3.6, as well as earlier programs. Most of the NOx reductions came from the utility, highway vehicle, and off-highway vehicle sectors, whose emissions have decreased by 76%, 56% and 46%, respectively. VOC emissions reductions primarily occurred in the solvent utilization, highway vehicle, off-highway vehicle and other combustion sectors, whose emissions decreased by 41%, 48%, 35%

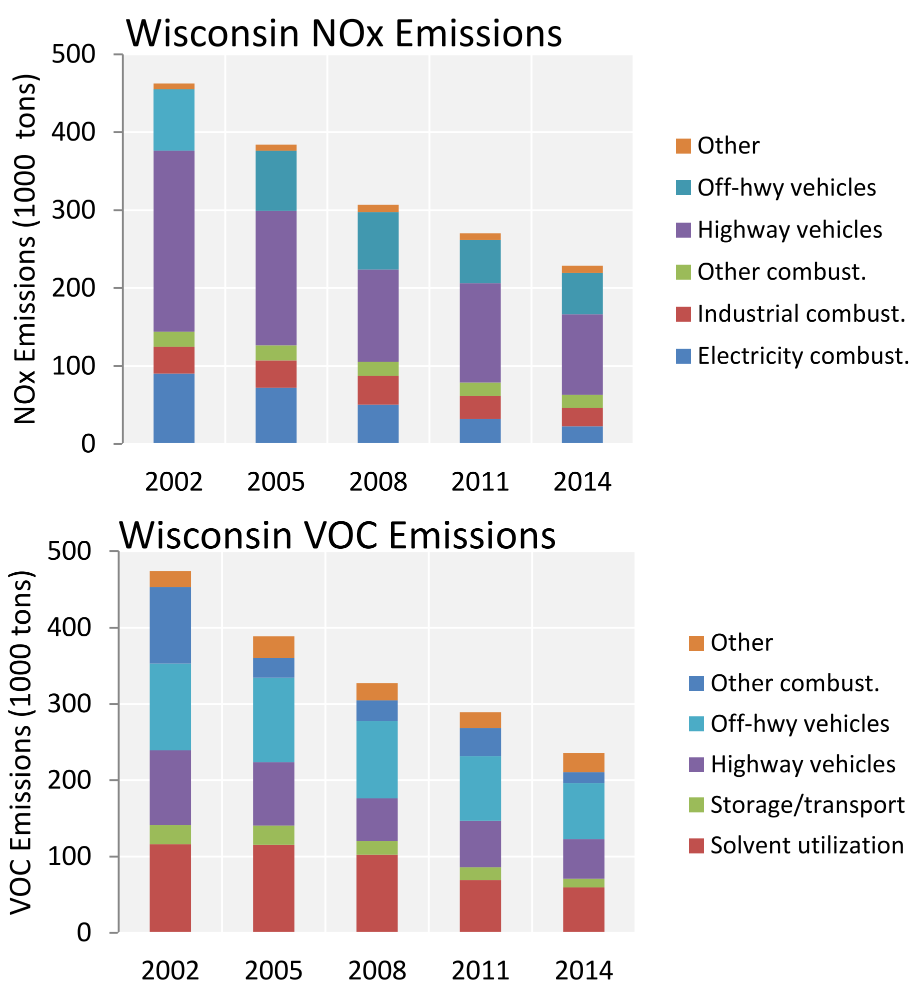
[42] See, for example, EPA (2013) Integrated Science Assessment for Ozone and Related Photochemical Oxidants. http://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=511347

[43] Carbonyl compounds contain a carbon-oxygen double bond.

and 63%, respectively. Vehicle VOC emission reductions resulted from reduced evaporative losses and reduced exhaust levels.

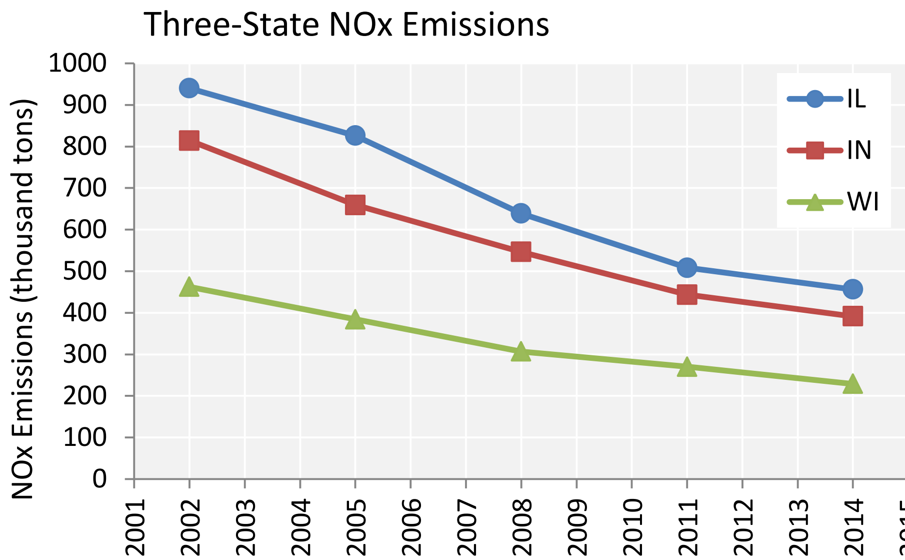
Emissions from sources in Illinois and Indiana have decreased by similar proportions (Figure 5.7)[44], although VOC emissions from these states remained relatively constant from 2011 to 2014. Table 5.3 shows that emissions from the Wisconsin portion of the Chicago nonattainment area are only a tiny fraction of total emissions from the area, accounting for 1.5% to 3.4% of NOx and VOC emissions. Emissions inventories for 2011 and projections for 2017 are discussed in more detail in Chapters 3 and 4. Emissions of both pollutants are projected to continue to decrease through 2017 and beyond, both inside the nonattainment area and throughout the remainder of the three-state area.

**Figure 5.6. Statewide annual NOx (top) and VOC (bottom) emissions by sector for the years 2002 through 2014. Data from the National Emissions Inventory (NEI), with updates to the mobile source sectors by EPA.[45]**




[44] NOx emissions decreased 55% from Illinois and 52% from Indiana during this timeframe. VOC emissions decreased 42% from Illinois and 34% from Indiana.
[45] Data for 2014 is from https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei. Data from earlier years is from https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data.

**Figure 5.7. Annual statewide emissions of (top) NOx and (bottom) VOCs from the three states in the Chicago nonattainment area. Data sources as cited in Figure 5.6.**



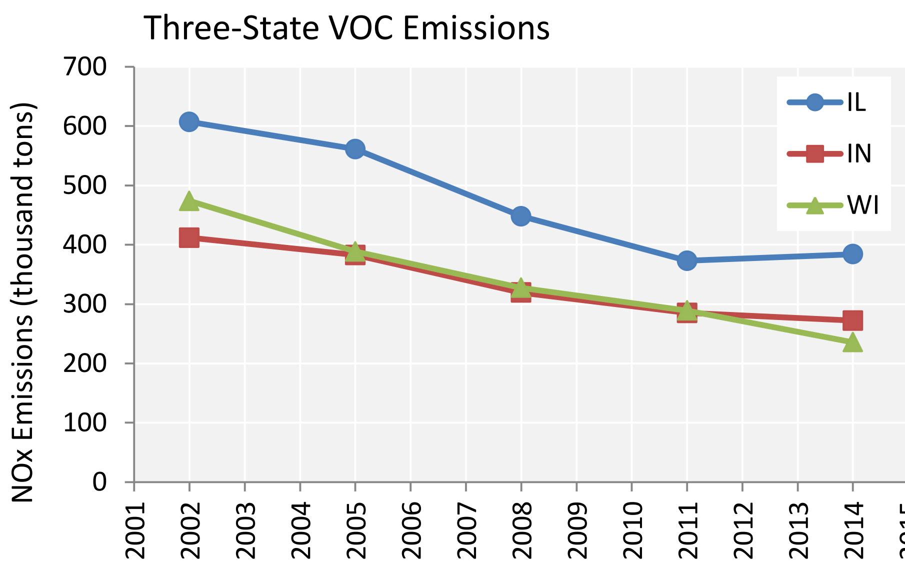



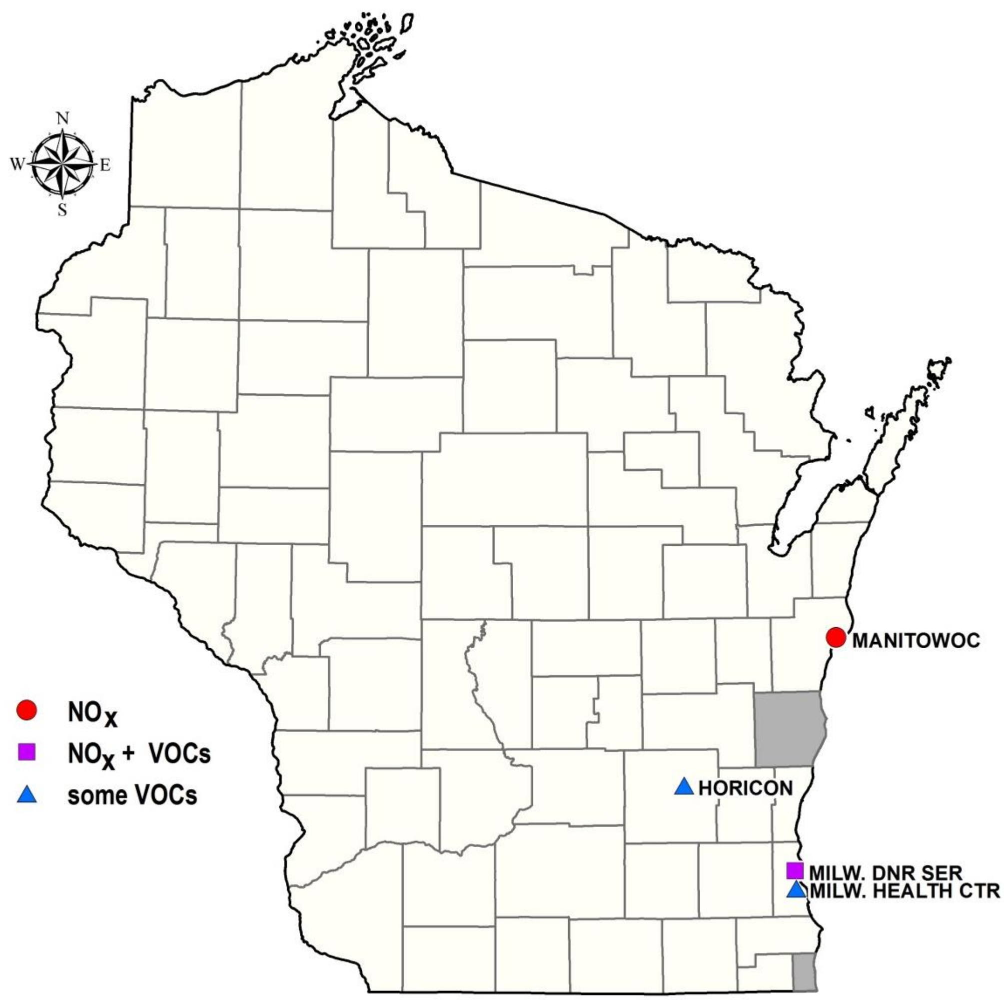

**Table 5.3. Comparison of 2011 and projected 2020 emissions of NOx and VOCs from the portions of each state in the Chicago nonattainment area. (Data were developed by each state for their 2016 redesignation requests for the Chicago nonattainment area.)**

| | NOx emissions | | VOC emissions | |
|---|---|---|---|---|
| **State** | **2011** | **2020** | **2011** | **2020** |
| IL | 614.35 | 345.98 | 517.98 | 380.24 |
| IN | 151.80 | 102.32 | 61.77 | 48.06 |
| WI | 19.11 | 15.73 | 9.30 | 8.20 |
| Total | 785.25 | 464.01 | 588.85 | 436.28 |
| WI % of Total | 2.4% | 3.4% | 1.6% | 1.9% |

### 5.3.2. Trends in Ambient NOx Concentrations in Wisconsin

WDNR monitored ambient NOx concentrations in 2015 at two locations in the eastern part of the state (Figure 5.8), one urban (Milwaukee SER) and one rural (Manitowoc).[46] None of these monitors are located within the eastern Kenosha County nonattainment area. However, trends at the existing monitors can provide insight into how ambient concentration along the lakeshore and in nearby inland counties have changed. Note that NOx may be transported significant but variable distances under the same meteorological conditions that transport ozone (discussed in Section 2.2). This means that concentrations measured at a given location may include NOx from both local and regional (upwind) sources.

**Figure 5.8. Monitoring locations for ambient NOx and VOCs in Wisconsin. The eastern Kenosha County and Sheboygan County nonattainment areas are shaded in gray.**



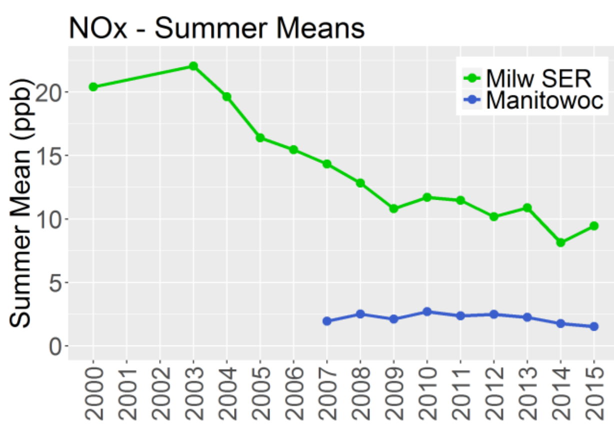

[46] Monitoring NOx and VOC concentrations is relatively complicated, labor-intensive and expensive. Consequently, measurements of these pollutants in Wisconsin (and in most states) have been very limited, both spatially and temporally (i.e., many measurements are only made in the summer). It is also worth noting that there is only one location in the state at which both NOx and VOCs are measured (Milwaukee SER).

Average summer NOx concentrations were highest in all years at the urban (Milwaukee SER) monitor, followed by Manitowoc, which is located along the northern Lake Michigan shoreline (Figure 5.9). Average NOx concentrations at the Milwaukee SER monitor have decreased significantly since monitoring began in 2000. From 2000 to 2015, mean summer NOx concentrations decreased 54%, with the largest changes coming between 2003 and 2009 (Figure 5.9). NOx concentrations have continued to decrease, although the rate of decrease appears to have slowed. The 54% reduction in ambient NOx concentrations at Milwaukee SER (54% from 2000 to 2015) is similar in size to the reduction in NOx emissions from the entire state of Wisconsin (51% from 2002 to 2014; Figure 5.6) over a similar time period. The dip in concentrations in 2009 likely reflects the effect of the economic recession on economic activity.

NOx concentrations at Manitowoc increased slightly from 2007, when measurements began, until 2010 and have decreased fairly steadily since then. However, given the much lower concentration of NOx at Manitowoc, the magnitude of these changes is much smaller than at Milwaukee SER.

NOx concentrations in Kenosha County are likely heavily influenced by transport from the rest of the Chicago area. NOx concentrations are trending down at Illinois's Chicago monitors (as shown in Appendix 10) at similar rates to the trends shown for Milwaukee. The finding that monitored concentrations at the downwind Manitowoc monitor are also decreasing suggests a linkage between upwind and downwind NOx trends. This all suggests that ambient NOx concentrations in Kenosha County are likely decreasing. However, the magnitude of the NOx concentrations and concentration decreases in Kenosha County are unknown due to the lack of NOx monitoring data in Kenosha County.

**Figure 5.9. Trends in ambient NOx concentrations at Wisconsin monitors during the summer months (June-August).**



### 5.3.3. Trends in Ambient VOC Concentrations in Wisconsin

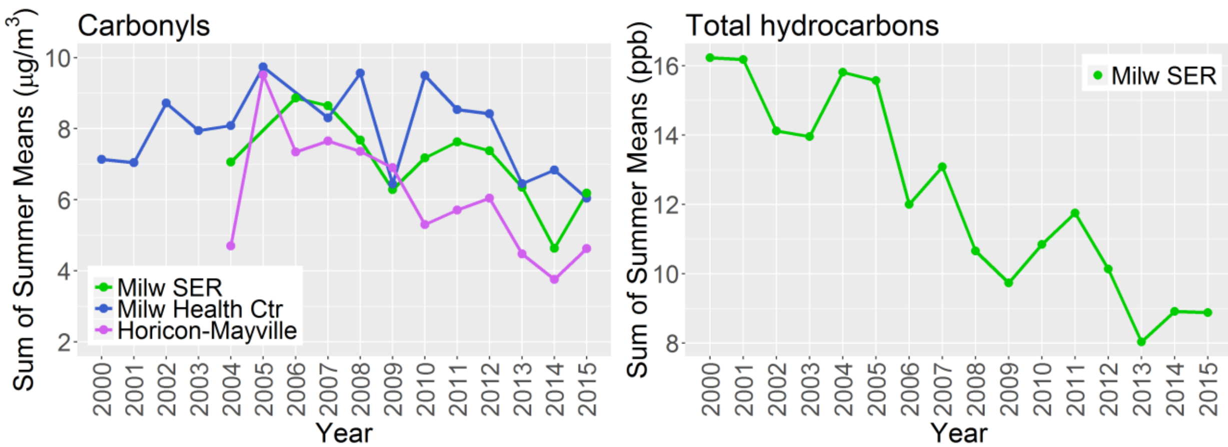
WDNR measured concentrations of 56 VOC compounds at one urban location (Milwaukee SER) and a smaller set of VOC compound measurements at two other locations, one urban (Milwaukee SER) and one rural (Horicon; Figure 5.8).[46] None of these monitors is located within the current Kenosha County nonattainment area. However, as with NOx, trends at the existing monitors can provide insight about concentration changes in the region. The VOC compounds monitored at the Milwaukee SER site included 53 hydrocarbons and three carbonyls (formaldehyde, acetaldehyde and acetone). At the other two monitors, the compounds measured included the three carbonyls and a smaller subset of hydrocarbons. A complete listing of the VOCs measured at the different sites, along with their concentrations for a subset of years, is in Appendix 10. This document shows trends in the sums of compound classes, with VOCs separated into carbonyl and hydrocarbon classes. Because only a subset of hydrocarbons were measured at the Milwaukee Health Center and Horicon-Mayville sites, hydrocarbon sums are not shown here for those sites. Appendix 10 also shows trends in sub-classes of hydrocarbons (including n-alkanes, branched and cyclic hydrocarbons, unsaturated hydrocarbons, aromatic hydrocarbons and isoprene). VOCs were measured year-round at the Horicon-Mayville and Milwaukee Health Center sites but only monitored during the summer months (June-August) at the Milwaukee SER site.

Summer average concentrations of carbonyls were lowest at the rural Horicon-Mayville site and highest at the Milwaukee Health Center site in most years (Figure 5.10). There was a clear though uneven decrease in carbonyls at the Milwaukee SER and Horicon-Mayville sites.[47] The trend at the Milwaukee Health Center site was more variable. However, concentrations at this monitor decreased fairly consistently from 2010 to 2015.[48] Overall, carbonyl concentrations decreased by 12%-15% at the Milwaukee monitors and 2% at Horicon-Mayville over each site's monitoring period (Figure 5.10). However, reductions from concentration peaks (around 2005-2006) were significantly greater.

[47] The minimum in carbonyl VOCs in 2009 at both Milwaukee sites likely reflects decreased economic activity during the recession. Carbonyl concentrations appeared especially low in 2004, the first year of measurement at both the Milwaukee SER and Horicon-Mayville sites. This may be because the summer of 2004 was very cool, which can affect formation of secondary VOCs like formaldehyde and acetaldehyde.

[48] The larger amount of variability at the Milwaukee Health Center site likely results because these samples are only collected once every 12 days (as opposed to every 6 days at Milwaukee SER currently), so that fewer measurements are averaged together for each summer. As a result, one unusual measurement can have a greater influence on the average.

**Figure 5.10. Trends in summer (June-August) mean concentrations of two different classes of VOCs: (left) carbonyls and (right) hydrocarbons. Hydrocarbons are not shown for the Milwaukee Health Center or Horicon-Mayville monitors because only a few compounds were measured at these sites.**



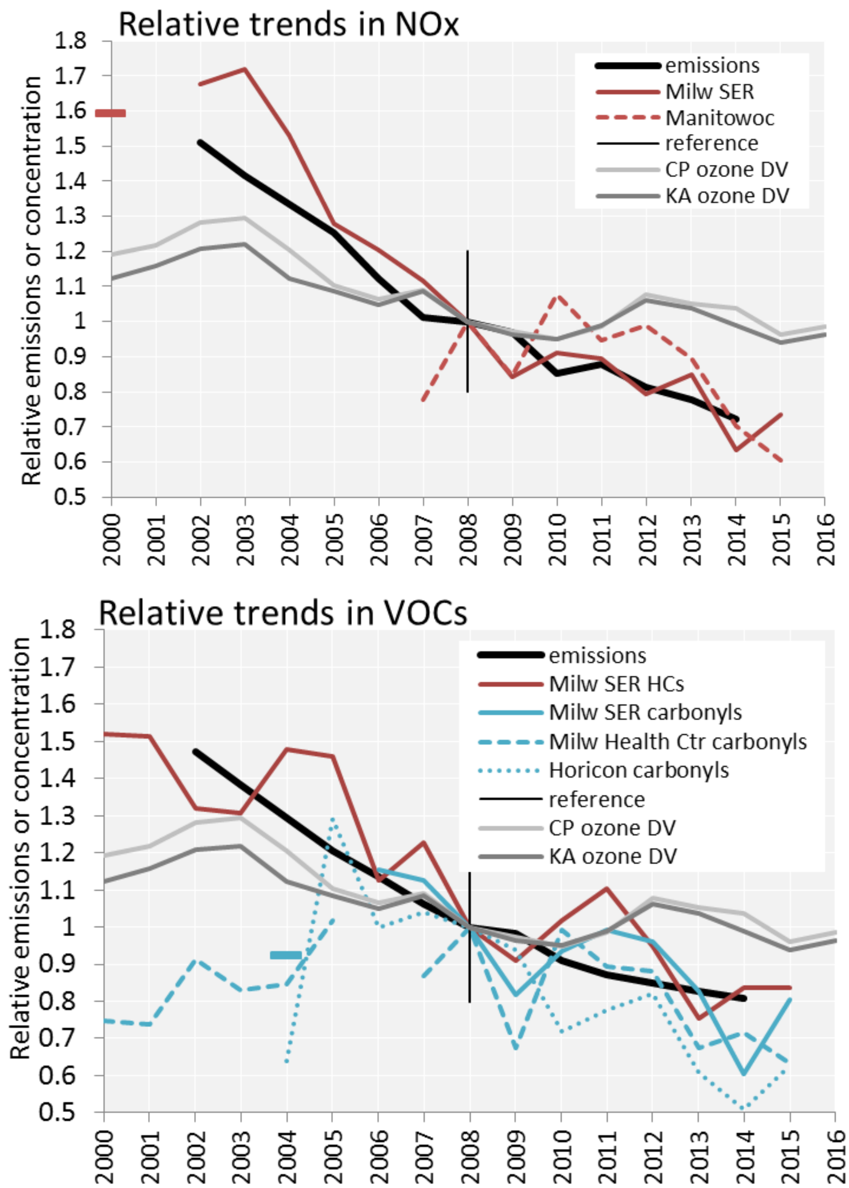

Summer average total hydrocarbons at the Milwaukee SER site showed a large (45%) but variable decrease between 2000 and 2015 (Figure 5.10). This is similar in magnitude to the reduction in VOC emissions from the entire state over a similar time period (50% from 2002 to 2014; Figure 5.6). Concentrations of all of the sub-classes of anthropogenic hydrocarbons also decreased during this time period (Appendix 10). As discussed for NOx, the minimum in 2009, and likely the lower concentrations in 2008 and 2010, probably reflect decreased emissions due to lower economic activity because of the recession. 2008 and 2009 also reflected summers with lower peak and average temperatures, conditions that would reduce seasonal average rates of evaporative fuel and uncontrolled solvent emissions of VOCs. Appendix 10 shows graphical trends in these hydrocarbon compound class averages, as well as showing the concentrations and percent changes in concentrations of individual VOC compounds.

VOC concentrations in Kenosha County are likely also decreasing, as found for the nearby Milwaukee monitors, as well as the inland rural monitor at Horicon. However, the magnitude of the concentrations and concentration decreases in Kenosha County is unknown due to the lack of VOC monitoring in the county.

### 5.3.4. Comparison of Trends in Emissions and Monitored Concentrations

Figure 5.11 compares trends in emissions and monitored concentrations of ozone precursors, as well as monitored ozone concentrations. All trends are normalized to their value in 2008 in order to directly compare the different parameters. This comparison shows that monitored NOx concentrations in Milwaukee tracked inventoried statewide NOx emissions relatively well (Figure 5.11). NOx emissions and concentrations in Milwaukee were both 1.5-1.7 times higher in 2002 relative to 2008. NOx emissions and Milwaukee concentrations in 2014 decreased by similar amounts from their 2008 values. NOx concentrations at the downwind, rural Manitowoc monitor were much lower than those in Milwaukee and were more decoupled from statewide emissions, although they showed similar reductions in 2014 relative to 2008.

**Figure 5.11. Trends in (top) NOx and (bottom) VOC statewide emissions and monitored concentrations in Wisconsin, along with ozone design values at the Chiwaukee Prairie (CP) and Kohler Andrae (KA, in Sheboygan County) monitors. All values were normalized to their value in 2008 to allow comparisons of relative reductions over time. HC = hydrocarbon VOCs, and carbonyls are a class of VOCs including formaldehyde, acetaldehyde and acetone. Emissions data is from EPA (https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data).**



Similarly, trends in hydrocarbon VOCs at the Milwaukee SER monitor tracked statewide VOC emissions fairly well, although monitored concentrations were more variable than emissions (Figure 5.11). Emissions and monitored hydrocarbon concentrations both decreased from 1.3-1.5 times 2008 levels in 2002 to 0.8 times 2008 levels in 2014. Monitored concentrations of carbonyl VOCs were more variable than were hydrocarbons but also roughly follow the emission trends. In particular, urban carbonyl concentrations have seemed to track emissions since roughly 2006. Most hydrocarbon VOCs are directly emitted from sources, whereas carbonyls can be formed from reactions in the atmosphere, so it is unsurprising that these two types of VOCs have somewhat different trends. However, overall, monitored VOC concentrations have decreased as VOC emissions have decreased.

While monitored ozone concentrations have decreased during this time period, the magnitude of this decrease has not tracked NOx or VOC emission or concentration trends very closely (Figure 5.11). Ozone concentrations have decreased at a much slower rate than have either precursor emissions or monitored precursor concentrations. This slower rate of reductions likely results from a variety of factors that affect ozone formation and cause its concentrations to be nonlinear with the concentrations of ozone precursor concentrations. These factors include:

- Meteorological variability between years.
- The nonlinearity of ozone chemistry.
- The influence of ozone transported from upwind regions in the U.S. and from other countries.

The role of these different factors in contributing to ozone formation and trends are discussed in more detail in Sections 5.2 and 5.4.

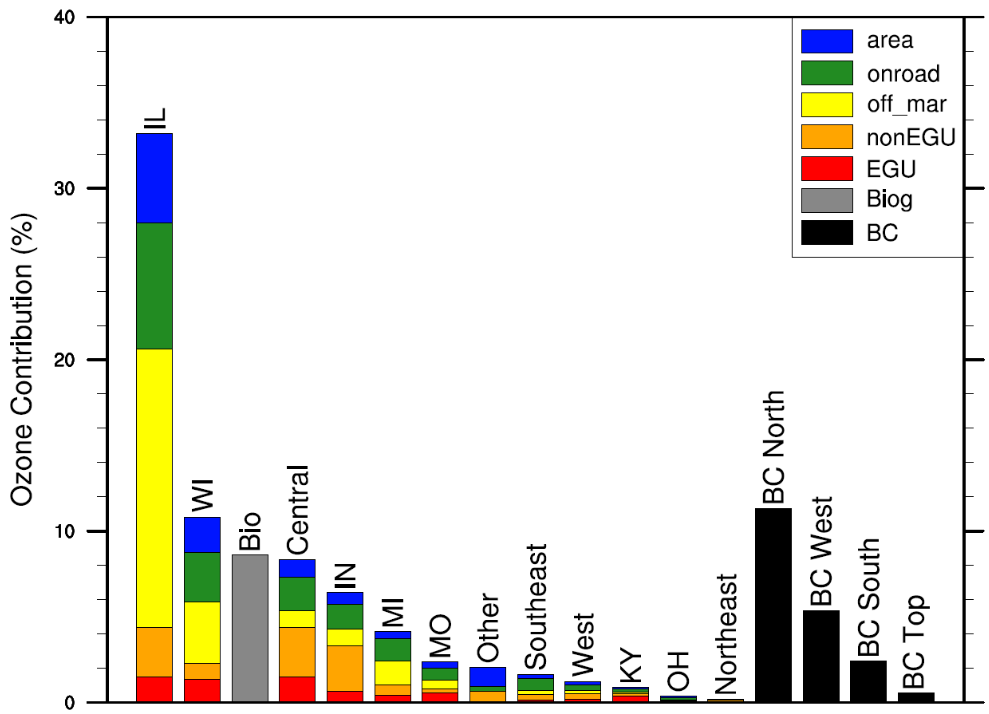
## 5.4. Influence of Transport and Chemistry on Ozone Trends

Ozone concentrations can be influenced by several other factors besides the local concentration of ozone precursors and meteorology. These factors include transport from upwind areas and ozone formation chemistry. This part of the document examines the role of each of these factors in driving ozone concentrations in Kenosha County. These analyses highlight the importance of interstate transport in delivering ozone to the Chiwaukee Prairie monitor and underscore the need for more information on current ozone chemistry in this region.

### 5.4.1. Influence of Transport on Ozone, NOx and VOC Concentrations

One of the most important factors driving high ozone concentrations in Wisconsin's ozone nonattainment areas is transport of ozone and ozone precursors from upwind areas. Recent source apportionment modeling from LADCO found that out-of-state emissions were responsible for approximately 89% of the measured ozone concentrations at the Chiwaukee Prairie monitor; in contrast, Wisconsin sources contributed less than 11% (Figure 5.12). Six nearby states together contributed 47% of the measured ozone. In particular, Illinois and Indiana contributed 33% and 6% of the measured ozone, respectively. Contributions from outside the U.S. ("boundary conditions") and from natural sources ("biogenics") contributed 28%. This modeling similarly showed that out-of-state contributions dominate measured ozone concentrations at the state's other ozone nonattainment area, Sheboygan County. The transport of such large amounts of ozone and ozone precursors from areas outside Wisconsin significantly limits the state's ability to reduce high ozone concentrations within its borders.

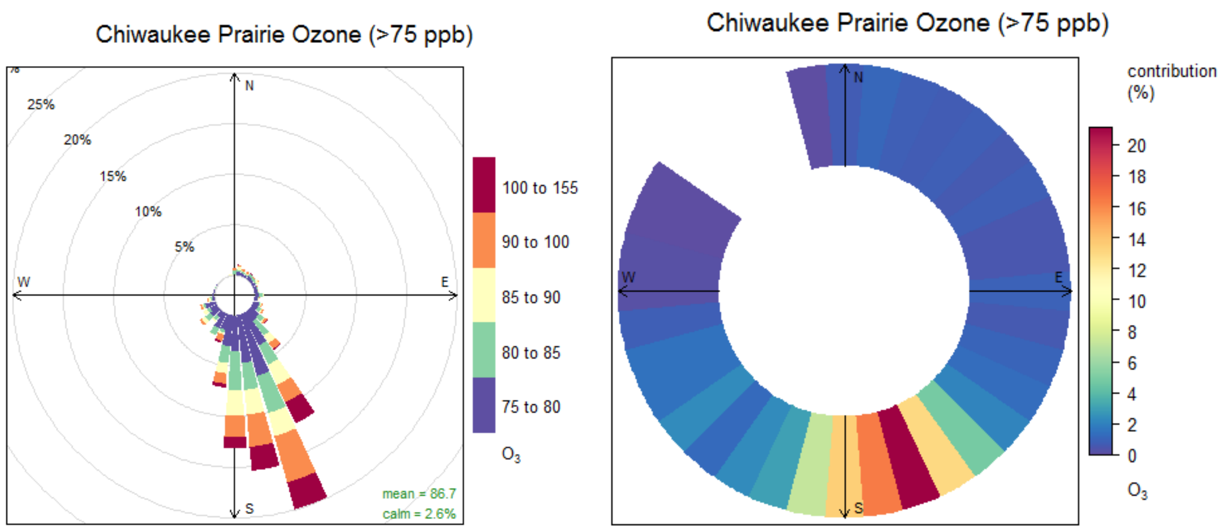
**Figure 5.12. Ozone source apportionment modeling from LADCO for Kenosha. Colors correspond to emission source categories, as discussed in Chapter 3.[49]**




To further examine the role of transport on ozone at any given site, it is informative to investigate how pollutant concentrations vary with wind direction. Winds from different directions transport pollutants from different upwind origins. The coastline around the Chiwaukee Prairie monitor is oriented more or less in a straight north-south direction (Figure 1.1). Figure 5.13 shows one-hour ozone concentrations and wind data at this monitor for hours when ozone concentrations exceeded the standard. This analysis showed that high ozone concentrations almost always occurred when winds were from the south-southeast (Figure 5.13). Roughly 64% of ozone came to the Chiwaukee Prairie monitor from 146°-185° during high-ozone hours. Winds from these directions include lake breeze transport and direct transport from the south over Lake Michigan. Another 19% of the high ozone concentrations came from the south over land, from 186°-265°. This ozone presumably originated from sources to the south but was not carried over Lake Michigan. Only 7% of the ozone came with winds from the north, and only 1% came from over land to the north (e.g., from over Wisconsin's land mass). This analysis indicates that high ozone concentrations almost never occurred when winds came from directly over Wisconsin.

[49] The Central region includes MN, IA, NE, KS, OK, TX, AR and LA. The Southeast region includes MS, AL, GA, FL, TN, VA, NC and SC. The West region includes WA, OR, CA, NV, ID, MT, WY, UT, CO, AZ, NM, ND and SD. The Northeast region includes ME, NH, VT, MA, RI, CT, NY, NJ, PA, DE, MD, and WV. BC is boundary conditions, which are contributions from outside the U.S. Bio and Biog are biogenics.

**Figure 5.13. (left) One-hour ozone concentrations above 75 ppb plotted by wind direction and (right) percent contributions of ozone above 75 ppb from different wind directions for the Chiwaukee Prairie monitor. The length of the paddle in the pollution rose (left) indicates the frequency of that concentration-wind direction combination, and the color indicates the concentration (in ppb). Data are for 2000-2015, as available.**




These findings confirm that ozone concentrations in the nonattainment area are dominated by ozone transported into the area.. Transport from the south, primarily over Lake Michigan but also over land, is the primary cause of the high concentrations of ozone measured at this location. This transport most often occurs during a lake breeze event but may also occur with synoptic southerly winds (see Chapter 2).

### 5.4.2. Influence of Ozone Formation Chemistry on Ozone Concentrations

As discussed in Section 5.3.1, ozone formation is known to be nonlinear with concentrations of NOx and VOCs, and at some points may be sensitive to changes in NOx concentrations and at others sensitive to changes in VOC concentrations. Under other circumstances, primarily in heavily polluted urban centers, high NOx concentrations may react with ozone, lowering its concentration locally via "titration". However, this ozone generally reforms downwind. Precursor concentrations can also affect the rates at which ozone is formed via complex chemical processes. Overall, the chemistry of ozone formation is extremely complicated.

Understanding of ozone chemistry in the region is not current. The large changes in NOx and VOC concentrations have likely changed the susceptibility of ozone formation to changes in precursor concentrations, as well as to other factors (as shown for meteorology in the Section 5.2.3). However, the last major field study to make direct measurements of ozone chemistry in the Lake Michigan region ended in 2003.[50] At that time, NOx and VOC concentrations were 1.5

[50] Several field campaigns have been conducted to study ozone over Lake Michigan, most notably the Lake Michigan Ozone Study (LMOS) in 1991 and the LADCO Airplane Project from 1994-2003. A field campaign to help better understand current regional ozone chemistry, the Lake Michigan Ozone Study 2017, is scheduled for

to 2 times higher than today (Figures 5.9 and 5.10), and ozone design values were more than 20 ppb (roughly 30%) higher in Kenosha (Figure 5.1).

Examination of the changes in the weekday/weekend effect on ozone formation demonstrate that ozone chemistry in the region has in fact changed over time. Studies of this effect have been used to gain insight into the sensitivity of ozone concentrations to reductions in NOx emissions. Such studies take advantage of the fact that NOx emissions and concentrations tend to be lower on weekends than during the week (Figure 5.14), primarily due to decreased heavy vehicle traffic. As has been found in other studies in this[51] and other[52] regions, average ozone concentrations at the Chiwaukee Prairie monitor in 2001-2005 increased over the weekend, reaching a maximum on Sunday, when NOx concentrations are at their lowest (Figure 5.14). This effect has been attributed to reducted titration of ozone by high NOx concentrations on weekdays and other related effects.[52,53] Similar findings in the region have been interpreted as suggesting that controlling urban NOx emissions might not be an effective local pollution control strategy.[51]

**Figure 5.14. Average (left) NOx concentrations for the Milwaukee SER monitor and (right) 95th percentile maximum daily 8-hour average (MDA8) ozone for the Chiwaukee Prairie monitor for each day of the week, grouped into five- or six-year groups.**

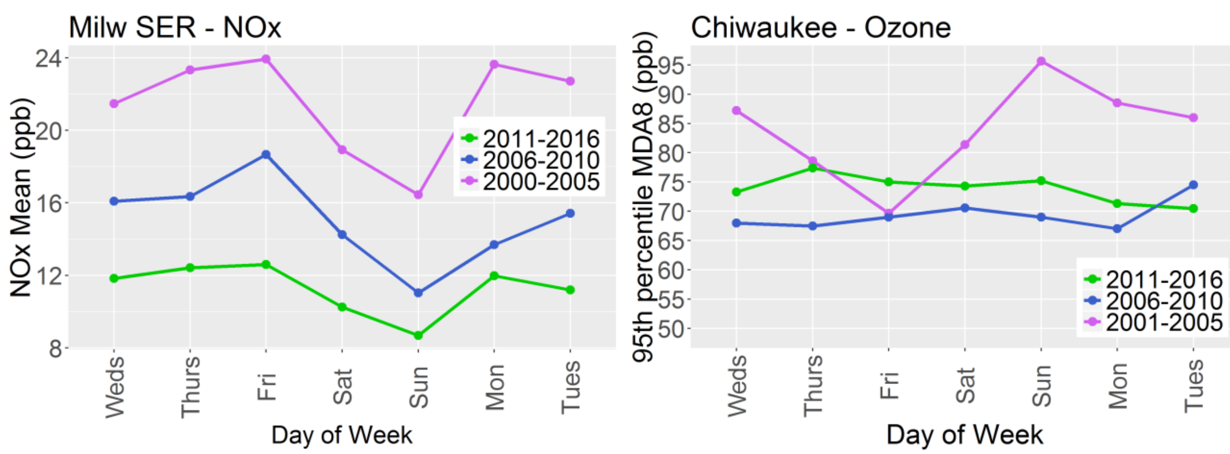



Figure 5.14 shows that the weekday/weekend effect decreased dramatically in 2006-2010. For the most recent time period examined, 2011-2016, average ozone concentrations remained virtually constant between the different days of the week for this site. The same results were found for all sites along Wisconsin's and Illinois's Lake Michigan lakeshore (not shown), as well as in other parts of the country[54]. This updated analysis suggests that ozone formation chemistry has changed over the last 15 years, and any disbenefit to NOx reductions that may have existed

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May-June 2017. The results of this field campaign should allow better understanding of ozone chemistry and more accurate evaluation of control strategies for future attainment demonstrations, if needed.

[51] LADCO (2008) Regional Air Quality Analyses for Ozone, PM2.5, and Regional Haze: Final Technical Support Document, April 25, 2008.
http://www.ladco.org/reports/technical_support_document/tsd/tsd_version_iv_april_25_2008_final.pdf

[52] For example, Murphy et al. (2007) The weekend effect within and downwind of Sacramento – Part 1: Observations of ozone, nitrogen oxides, and VOC reactivity. *Atmos. Chem. Phys.*, **7**, 5327-5339.

[53] These effects may, however, be complicated by the relatively long lifetimes of ozone and ozone precursors, such that ozone formed on one day might affect a site a day or two later.

[54] Wolff et al. (2013) The vanishing ozone weekday/weekend effect. *J. Air Waste Mgmt. Assoc.*, **63**: 292-299.

in the early 2000s appears to be gone. However, other lines of evidence suggest that a NOx disbenefit may continue in urban centers, and more work is required to fully evalute the current chemistry of ozone formation in this region.

### 5.5. Conclusion

These weight of evidence analyses support the modeled projection of attainment in eastern Kenosha County. As shown above, monitored ozone concentrations have decreased since 2000. When adjusted to account for meteorological variability, ozone concentrations for equivalent conditions also show a decrease. Emissions of NOx and VOCs from Wisconsin have decreased over each three-year period from 2002 through 2014, as reflected in the periodic annual inventories (NEI) and inclusive of the economic recession in 2008-2010. Similar reductions occurred in Illinois and Indiana emissions. Over this same period, monitored NOx and VOC concentrations along Wisconsin’s Lake Michigan shoreline also decreased, following a similar pattern.

These analyses show that a majority of the ozone measured at the Chiwaukee Prairie monitor was delivered via transport from upwind states, with very little originating from sources in Wisconsin. This demonstrates that controls on sources in upwind states have been essential to reducing ozone concentrations in eastern Kenosha County to date. Such upwind controls will continue to be important for ongoing attainment and maintenance of the 2008 ozone NAAQS in the Wisconsin portion of the Chicago nonattainment area.

# 6. OTHER MODERATE AREA SIP REQUIREMENTS

## 6.1. Transportation Conformity

Transportation conformity is required under CAA section 176 (c) (42 U.S.C 7506(c)) to ensure that federally funded or approved highway and transit activities are consistent with ("conform to") the purpose of the SIP. "Conform to" the purpose of the SIP means that transportation activities will not cause or contribute to new air quality violations, worsen existing violations, or delay timely attainment of the relevant NAAQS or any interim milestones. Transportation conformity applies to designated nonattainment and maintenance areas for transportation-related criteria pollutants: ozone, fine particles ($PM_{2.5}$), coarse particles ($PM_{10}$), carbon monoxide, and nitrogen dioxide. EPA's transportation conformity rule (40 CFR Parts 51 and 93) establishes the criteria and procedures for determining whether metropolitan transportation plans, metropolitan transportation improvement programs, federally supported highways projects, and federally supported transit projects conform to the SIP.

The eastern Kenosha County nonattainment area currently demonstrates transportation conformity using the "Motor Vehicle Emissions Budget (MVEB) Test" (40 CFR 93.119). WDNR submitted an early progress SIP with updated MVEBs for the eastern Kenosha County nonattainment area on January 16, 2015. On April 1, 2015, EPA found the MVEBs for Wisconsin's 8-hour ozone nonattainment area were adequate for use in transportation conformity determinations (80 FR 17428).

EPA requirements outlined in 40 CFR 93.118(e) (4) stipulate that MVEBs for NOx and VOC are established as part of a control strategy implementation plan revision or maintenance plan. MVEBs are necessary to demonstrate conformance of transportation plans and improvement programs with the SIP.

### 6.1.1. Motor Vehicle Emissions Model

The EPA's MOVES2014a model is used to derive estimates of hot summer day emissions for ozone precursors of NOx and VOCs. Numerous variables can affect these emissions, especially the size of the vehicle fleet (the number of vehicles on the road), the fleet's age, the distribution of vehicle types, and the VMT. The transportation information is derived from a travel demand model. Appendix 5 contains key data used to develop inputs to MOVES2014a.[55]

### 6.1.2. Motor Vehicle Emissions Budgets (MVEBs)

Table 6.1 contains the MVEBs for the eastern Kenosha County nonattainment area for the years 2017 and 2018. Since assumptions change over time, it is necessary to have a margin of safety that will accommodate the impact of refined assumptions in the process. 40 CFR 93.101 defines safety margin as the amount by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for RFP, attainment, or maintenance. WDNR increased the on-road mobile source portions of the 2017 and 2018 projected emissions inventories by 7.5% for eastern Kenosha County to account for

[55] The complete set of inputs to MOVES2014a is too lengthy to include in this document. However, electronic copies of the inputs can be obtained from WDNR by sending an email to christopher.bovee@wisconsin.gov or by phone at (608) 266-5542.

uncertainties in future mobile source emissions. Even with this emissions buffer in the modeled demonstration, eastern Kenosha County is forecast to attain the 2008 ozone standard.

For the eastern Kenosha County nonattainment area, transportation conformity will be based on the submitted MVEBs after EPA determines that the budgets meet the adequacy criteria of the transportation conformity rule. Once these budgets are found adequate by EPA, they will replace the MVEBs established for the 2008 ozone early progress plan (80 FR 17428). Table 6.1 identifies the 2017 and 2018 MVEBs for the Wisconsin 2008 ozone attainment plan for use in transportation conformity analyses.

**Table 6.1. Motor vehicle emissions budgets (MVEBs) for eastern Kenosha County for 2017 and 2018.**

| Year | Emissions (tons per hot summer day) | |
|---|---|---|
| | VOC | $NO_x$ |
| 2017 | 1.56 | 3.05 |
| 2018 | 1.44 | 2.75 |

## 6.2. Reasonably Available Control Technology (RACT) Program for NOx

Wisconsin's NOx RACT program was first adopted by the state in July 2007 as codified under s. NR 428.20 to 428.26, Wis. Adm. Code. The program was approved by EPA into the SIP in October 2009 (75 FR 64155). This program was established to fulfill NOx RACT requirements for southeast Wisconsin counties, including eastern Kenosha County, that were designated moderate nonattainment under the 1997 ozone NAAQS.

WDNR has determined that Wisconsin's current NOx RACT program fulfills RACT requirements under the 2008 ozone NAAQS. The basis for this determination is:

1) Wisconsin's existing NOx RACT program applies to major sources with a potential-to-emit of 100 tons per year and thus meets the necessary applicability requirements.

2) A review of control technology indicates that a new assessment of control technology conducted for the 2008 ozone NAAQS would not change the determination of RACT under Wisconsin's existing program.

### 6.2.1. Major Source Applicability

EPA set applicability of RACT for non-CTG facilities at an emissions threshold of 100 tons per year (TPY) or more based on a facility's PTE[56]. Wisconsin applied this threshold in setting emission limitations for the current RACT program, which was originally promulgated to fulfill requirements for moderate nonattainment counties. Since EPA has already approved Wisconsin's RACT program for moderate nonattainment areas, this existing program likewise satisfies RACT applicability for Kenosha's moderate nonattainment designation under the 2008 ozone NAAQS.

[56] EPA, 1988, *Issues Relating to VOC Regulation Cutpoints, Deficiencies, and Deviations, Clarification to Appendix D of November 24, 1987 Federal Register,* May 25, 1988.

### 6.2.2. Control Technology

The 2008 ozone implementation rule provides that states can show that existing NOx RACT programs fulfill requirements for the 2008 NAAQS[57]. EPA states this demonstration should be based on a review of RACT control technologies for conditions in 2008. If this review indicates there would be no incremental difference in control technologies between the existing program and the updated assessment, the existing program can be certified as meeting RACT under the 2008 NAAQS. Even in the case that an updated RACT could result in additional emission reductions, EPA indicates that such an action would likely not be cost-effective. EPA states:

> *"In cases where controls were applied due to the 1-hour or 1997 NAAQS ozone RACT requirement, we expect any incremental emissions reductions from the application of a second round of RACT controls may be small and, therefore, the cost for advancing that small additional increment of reduction may not be reasonable."*

Wisconsin's NOx RACT program was first implemented in 2007 based on an assessment of the control technologies and cost information available at that time. As a result, WDNR expects little, if any, change in the assessment of RACT control technology between 2007 and 2008, as required under the implementation rule. The RACT assessments would be based on essentially the same information.

However, to ensure this conclusion is correct, WDNR reviewed the current Wisconsin RACT requirements that could apply for emission units operating in eastern Kenosha County in 2008. The RACT source categories and control technologies found applicable are presented in Table 6.2. WDNR's review showed that two coal-fired boilers operated at the Pleasant Prairie power plant fall in the RACT source category of coal-fired boilers greater than 1,000 mmBtu per hour. These two boilers accounted for approximately 95% of 2008 $NO_x$ emissions. WDNR also identified other emission units that could potentially be subject to RACT emission limits if they were larger or operated more frequently regardless of facility PTE. This exercise provided insight into other types of sources that could potentially be subject to RACT in the future in eastern Kenosha County. After reviewing the identified source categories and applicable control technologies, WDNR has concluded there would be no change in RACT if an updated assessment of control technology were performed based on 2008, or even 2015, information.

[57] EPA, 2015, *Implementation of the 2008 National Ambient Air Quality Standards for Ozone: Requirements for State Implementation Plans*, 80 FR 12279, March 6, 2015.

**Table 6.2. RACT control technology required for different source categories under Wisconsin's NOx RACT program.**

| Source Category | RACT Control Technology |
|---|---|
| Coal-fired boilers > 1000 mmBtu/hr | SCR |
| IC engine emergency generators | Exempt |
| Natural gas-fired boiler > 100 mmBtu/hr* | LNB/OFA/GR |
| Natural gas-fired process heaters > 100 mmBtu/hr* | Low NOx Burners |
| Asphalt plants > 65 mmBtu/hr* | Low NOx Burners |
| IC engines > 500 hp* | 80 – 90% Control (various technologies) |

*The WDNR found that these types of emission sources operate in the eastern Kenosha nonattainment area. However, the sources are not above thresholds for applicability of RACT emission limitations.
SCR = Selective Catalytic Reduction, LNB = Low NOx Burner, OFA = Overfire Air, GR = Gas Recirculation.

Thus, based on equivalency in major source applicability and RACT control technology, the WDNR concludes that Wisconsin's current NOx RACT program under ss. NR 428.20 to 25 fulfills RACT requirements for the 2008 ozone NAAQS.

### 6.3. Reasonably Available Control Technology (RACT) Program for VOCs

Section 182(b)(2) of the CAA requires states with moderate nonattainment areas to implement RACT under section 172(c)(1) with respect to each of the following:

- Each category of VOC sources in the nonattainment area covered by an EPA control technique guideline (CTG) document issued between the date of the enactment of the 1990 CAA and the date of attainment.

- All VOC sources in the area covered by any CTG issued before the enactment date of the 1990 CAA.

- All other major stationary VOC sources that are located in ozone nonattainment areas.

As a part of its SIP, the WDNR has adopted and implemented administrative rules requiring all existing major stationary sources of VOCs in ozone nonattainment areas to meet VOC RACT. These rules apply to all of Kenosha County because of its nonattainment status under the 1997 ozone NAAQS. These VOC RACT/CTG requirements are codified under chapters NR 419 through 424, Wis. Adm. Code. The list of the CTGs in place in Wisconsin is provided in Appendix 8. All of these CTG requirements were implemented and effective prior to the 2011 base year. Also in Appendix 8, Wisconsin is making a *negative declaration* for the listed CTG source categories where Wisconsin has determined that there are no identified sources in the eastern Kenosha 2008 ozone NAAQS nonattainment area meeting the applicability criteria recommended in the specified CTG documents. In addition, Wisconsin has adopted MACT rules further controlling air toxics, which include many VOCs, from major sources throughout the state.

All of the above-listed Wisconsin administrative rules and federal regulations collectively comprise a comprehensive VOC emissions control program covering all high-emitting stationary sources of VOCs in the eastern Kenosha County nonattainment area. Consequently, the WDNR has determined that these VOC RACT requirements meet the VOC RACT mandate of Subpart 2 of the federal CAA.

### 6.4. Evaluation of Reasonably Available Control Measures (RACM)

CAA Section 172(c)(1) requires that states implement any reasonably available control measures necessary for attainment of the NAAQS. As detailed in 40 CFR 51.1108(d), any control measures needed for attainment must be implemented by the beginning of the attainment year ozone season, April 15, 2017. With this submittal, Wisconsin is demonstrating that attainment is achieved and therefore no additional control measures are required for that purpose.

However, additional control measures are required if it can advance the attainment date by a year or more. This means that any measures advancing the attainment date by a year would have needed to be in place by April 15, 2016. Since this date has already passed, the WDNR has concluded there is no possibility of implementing any level of additional control prior to this date. Accordingly, no additional controls or emission reductions requirements in Kenosha County are applicable for RACM under the 2008 ozone NAAQS.

### 6.5. Motor Vehicle I/M Program

The general purpose of motor vehicle I/M programs is to reduce emissions from in-use motor vehicles in need of repairs and thereby contribute to state and local efforts to improve air quality and to attain the NAAQS. Wisconsin's I/M program has been in operation since 1984. It was originally implemented in accordance with the 1977 CAA Amendments and operated in the six counties of Kenosha, Milwaukee, Ozaukee, Racine, Washington and Waukesha. Sheboygan County was added to the program in July 1993, resulting in a seven-county program area that has remained to the present. Vehicles were originally tested by measuring tailpipe emissions using a steady-state idle test. Tampering inspections were added in 1989. The I/M program is jointly administered by WDNR and the Wisconsin Department of Transportation.

The 1990 CAA Amendments set additional requirements for I/M programs. For moderate areas, a "basic" program was required under section 182(b)(4). For serious or worse areas (which included Kenosha County at that time), an "enhanced" program was required under section 182(c)(3). EPA's requirements for basic and enhanced I/M programs are found in 40 CFR part 51, subpart S.

Wisconsin's I/M program transitioned to an enhanced program in December 1995. The major enhancement involved adding new test procedures to more effectively identify high-emitting vehicles. These new test procedures included a transient emissions test in which tailpipe emissions were measured while the vehicle was driven on a dynamometer (a treadmill-type device). Improving repairs and public convenience were also major focuses of the enhancement effort.

Since July of 2001, all model year (MY) 1996 and later cars and light trucks have been inspected by scanning the vehicle's computerized second generation on-board diagnostic (OBDII) system instead of measuring tailpipe emissions. As of July 2008, the program dropped tailpipe testing entirely and has inspected all vehicles by scanning the OBDII system. This change was the result of statutory changes in the State's 2007-2009 biennial budget which exempted model years of vehicles not federally-required to be equipped with the OBDII technology (MY 1995 and earlier cars and light trucks and MY 2006 and earlier heavy trucks). To help offset the emissions reductions lost from exempting the pre-OBDII vehicles, the program increased the testable fleet for MYs 2007 and later by adding gasoline-powered vehicles between 10,001 to 14,000 pounds gross vehicle weight rating (GVWR) and diesel-powered vehicles of all weights up to 14,000 pounds GVWR.

EPA fully approved Wisconsin's I/M program on August 16, 2001 (66 FR 42949), including the program's legal authority and administrative requirements in the Wisconsin Statutes and Wisconsin Administrative Code. On June 7, 2012, WDNR submitted a SIP revision to EPA covering all the changes to the program since EPA fully approved the program in 2001. This submittal included a demonstration under section 110(l) of the CAA addressing lost emission reductions associated with the program changes. The EPA approved this SIP revision on September 19, 2013 (78 FR 57501).

Legal authority and administrative requirements for the Wisconsin I/M program are found in sections 110.20 and 285.30 of the Wisconsin Statutes and Chapters NR 485 and Trans 131 of the Wisconsin Administrative Code.

## 7. PUBLIC PARTICIPATION

In accordance with section 110(a)(2) of the CAA, the WDNR published a notice on the WDNR website (http://dnr.wi.gov/topic/AirQuality/Input.html) on February 13, 2017 stating that it would hold a public hearing on this 2008 ozone NAAQS attainment plan for eastern Kenosha County. The WDNR also posted the notice of availability of this request on the WDNR website. This public hearing took place on Wednesday, March 15, 2017 at 10:30 am at the Southwest Neighborhood Library in Kenosha (7979 38th Ave, Kenosha, WI 53142) in Activities Room A. The attainment plan was available for public comment through March 16, 2017.

The WDNR received one written public comment concurring with the mobile source emission budgets included in the attainment plan and no comments critical of the request. Accordingly, no further response to comments is necessary.

## 8. CONCLUSION

In submitting this attainment plan, Wisconsin is fulfilling its CAA SIP requirements for the eastern Kenosha County moderate nonattainment area for the 2008 ozone NAAQS. Air quality modeling projects that eastern Kenosha County will attain the 2008 ozone NAAQS by the July 20, 2018 moderate area attainment date, as will the rest of the Chicago nonattainment area. Additional air quality monitoring data confirms that concentrations of ozone (when adjusted for meteorology) and ozone precursors have decreased dramatically over the last 15 years in the nonattainment area. Wisconsin has met the required RFP emission reductions due to an array of permanent and enforceable measures. The state has also met all other obligations required of moderate nonattainment areas.

# APPENDIX 1

# 2011 Wisconsin Emission Inventory Documentation

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# ABBREVIATIONS

| | |
|---|---|
| AI | Active Ingredient |
| BTU | British Thermal Unit |
| CAMD | Clean Air Markets Division |
| CLF | Crop Life Foundation |
| DOE | Department of Energy |
| DPR | Department of Pesticide Regulation |
| EGU | Electric Generating Unit |
| EIA | Energy Information Administration |
| EIIP | Emission Inventory Improvement Program |
| EP | Emission Potential |
| ERTAC | Eastern Regional Technical Advisory Committee |
| FIRE | Factor Information Retrieval |
| FHWA | Federal Highway Administration |
| FIFRA | Federal Insecticide, Fungicide, and Rodenticide Act |
| HAP | Hazardous Air Pollutants |
| HPMS | Highway Performance Monitoring System |
| IC | Internal Combustion |
| LADCO | Lake Michigan Air Directors Consortium |
| LPG | Liquid Petroleum Gas |
| MACT | Maximum Achievable Control Technology |
| MAR | Commercial Marine Aircraft and Rail Locomotive |
| MCD | Minor Civil Divisions |
| MOVES | Motor Vehicle Emission Simulator |
| MPO | Metropolitan Planning Organization |
| NAICS | North American Industrial Classification System |
| NEC | Not Elsewhere Classified |
| NEI | National Emissions Inventory |
| NMIM | National Mobile Inventory Model |
| NOx | Nitrogen Oxides |
| OBD | On-Board Diagnostics |
| OSHA | Occupational Safety and Health Administration |
| PAD | Petroleum Administration for Defense |
| PM | Particulate Matter |
| POTW | Publicly Owned Treatment Work |
| RIA | Regulatory Impact Analysis |
| SAF | Spatial Apportioning Factor |
| SCC | Source Classification Code |
| SED | State Energy Data |
| SEDS | State Energy Data System |
| SEWRPC | Southeastern Wis. Regional Planning Commission |

| | |
|---|---|
| SIP | State Implementation Plan |
| SLT | State, Local and Tribal |
| VMT | Vehicle-Miles of Travel |
| VOC | Volatile Organic Compounds |
| WDNR | Wisconsin Department of Natural Resources |

## 1. Introduction

This appendix provides additional information for the sector-specific nitrogen oxides (NOx) and volatile organic compounds (VOC) tons per summer day (tpsd) emission estimates in section 3.2 (2011 Base Year Inventory for RFP) of the Wisconsin Department of Natural Resources (WDNR) eastern Kenosha County ozone attainment demonstration. For the U.S. Environmental Protection Agency (EPA) to approve an attainment demonstration for ozone, a state must show that improvement in air quality is due to permanent and enforceable reductions in emissions. This is accomplished in part by developing and comparing a nonattainment year (2011) emissions inventory and attainment year (2017) emissions inventory.

## 2. Emissions Calculation Methodologies

### 2.1 Point Sources

Point sources are industrial, commercial or institutional stationary facilities which are normally located in permanent sites, and which emit specific air pollutants in great enough quantities to warrant individual quantification. To better enable detailed control evaluations, the point source emission inventories (EIs) include all reporting sources at that facility regardless of the magnitude of reported emissions. For this attainment demonstration portable point sources, such as asphalt plants and rock crushers, were reported under nonpoint sources to be consistent with other states. The 2011 point source emission inventory was created using annually reported point source emissions, the EPA's Clean Air Markets Division (CAMD) database and approved EPA techniques for emissions calculation (e.g., emission factors). Additional details for electric generating unit (EGU) emissions are located in Appendix 2.

Whenever feasible, federal, state and local controls were factored into the emission calculations. Emissions were estimated by collecting process-level information from each facility that qualifies for inclusion into the state's point source database. In Wisconsin, this information is normally collected via an internet or a computer diskette submittal, and subsequently loaded into the point source database. Process, boiler, fugitive and tank emissions are typically calculated using throughput information multiplied by an emission factor for that process. Emission factor sources included mass balance, stack testing, continuous emissions monitors, engineering judgment and EPA's Factor Information Retrieval (FIRE) database. Missing data elements such as Source Classification Codes (SCC), North American Industrial Classification System (NAICS) codes and seasonal throughput percentages were added into the state's point source database. Process level confidential data were removed while retaining any associated emissions.

### 2.2 Nonpoint (Area) Sources

Nonpoint sources are stationary sources that are too small and/or too numerous to be tracked individually in the point source inventory; the nonpoint inventory quantifies emissions collectively. These sources include commercial/institutional, industrial and residential sources such as gasoline stations, dry cleaners, consumer and commercial products, industrial solvent use, auto refinishing and wood combustion.

At least every three years state and local agencies are required to submit emissions data to EPA in order to develop the periodic National Emissions Inventory (NEI). The NEI is a comprehensive and detailed estimate of annual total air emissions of both criteria and hazardous air pollutants (HAPs) from all air emissions sources. The NEI is prepared by the EPA based primarily upon emissions estimates and emissions model inputs provided by State, Local and Tribal (SLT) air agencies, and supplemented by data developed by the EPA. These inventories are used to measure overall emission reduction trends and include emission estimates from stationary point and nonpoint (area) sources, onroad mobile sources and nonroad mobile sources.

For the 2011 nonattainment year, nonpoint source NOx and VOC emissions inventory estimates were based on 2011 NEI version 2, unless indicated otherwise in the category-specific methodologies provided below. EPA has approved Wisconsin's 2011 NEI values. These emissions were typically calculated using population, gasoline consumption, employment, crop acreages and other activity surrogates associated with the source categories. These categories mainly include industrial, commercial and institutional fuel combustion, solvent utilization, residential wood combustion and agricultural emissions. For each source category, any point source activity or emissions were subtracted from total category-specific activity or emissions to calculate nonpoint category-specific emissions and avoid double counting. Emission factors were derived from local data, local or national surveys and EPA procedural guidance for the development of emission inventories. Emission calculation methodologies used in developing 2011 nonpoint emissions inventory are described in sections 2.2.1 through 2.2.6.

In order to obtain the area source emissions for partial Kenosha County, the whole county emission estimates were allocated to the partial county ozone nonattainment area based on the population data. The partial-county population was identified based on the relative population of the Minor Civil Divisions (MCDs) in the nonattainment area in comparison to the entire county. For 2011, 77% of the county's population was estimated to live in the nonattainment area.

### 2.2.1 Stationary Source Fuel Combustion

#### 2.2.1.1 Industrial Source Fuel Combustion

The fuel combustion at stationary nonpoint sources within the industrial sector is presented in this section. This component is not reported in the point source inventory as the emissions are too small. For Kenosha county, industrial fuel combustion emissions were computed for the following fuel types: distillate oil, residual oil, liquid petroleum gas (LPG), natural gas, kerosene, and wood. As carried over from 2008 National Emissions Inventory (NEI), it was assumed that coal has not been consumed in Kenosha County under industrial source fuel combustion category.

**Pollutants Calculated**: $NO_x$, VOC

**Activity Data:**
Total sales statistics for the industrial sector energy consumption in Wisconsin were obtained from the U.S. Department of Energy (DOE)'s Energy Information Administration (EIA). Their

annual publication, the State Energy Data (SED) report, provides total consumption for most fuel oils and kerosene.[1] A separate EIA data source was used for distillate fuel oil. Year 2009 SED were used to estimate 2011 emissions because these were the latest year consumption data available at the time this work was performed in 2012.

**Emission Factors:**
The EPA has compiled criteria and hazardous air pollutant emission factors for nonpoint source industrial fuel combustion categories.[2] Since only VOC and $NO_x$ were considered in developing this redesignation request emission estimates, the emission factors for these two pollutants are listed in the table 1.

Table 1: Emission Factors for Industrial Source Fuel Combustion (lb / unit of fuel throughput)

| Pollutant | EIS Pollutant code | (TON) Coal Bit/ Subbit | (1000 gal) Distillate Oil - blr | (1000 gal) Diesel - eng | (1000 gal) Residual Oil | (1000 gal) Liquid Petroleum Gas | (MMCF) Natural Gas | (1000 gal) Kerosene | (TON) Wood |
|---|---|---|---|---|---|---|---|---|---|
| Nitrogen Oxides | NOx | 11.000 | 20.000 | 604.000 | 55.000 | 14.230 | 100.000 | 19.290 | 0.220 |
| Volatile Organic Compounds | VOC | 0.050 | 0.200 | - | 0.280 | 0.520 | 5.500 | 0.190 | 0.017 |

**Fuel Consumption Adjustments**:
Fuel consumption associated with non-energy purposes in the industrial sector were adjusted by subtracting the volume of fuel consumption for non-energy uses from the volume of total fuel combustion.

**Emissions Calculation:**
In calculating emissions for industrial fuel combustion, state-level fuel consumption estimates were first developed, which represent the relevant activity. These were then allocated to the county-level, and then the resulting county-level consumption estimates were multiplied by appropriate emission factors.

General equation for emissions calculation is:

$$Emissions = (Fuel\ Use\ in\ Wisconsin) \times (Emission\ Factor\ per\ Pollutant)$$

To avoid double counting, point source estimates were subtracted from total emissions:

$$Emissions_{Area} = \left(Emissions_{Total\ Stationary}\right) - (Emission_{\ Point})$$

### 2.2.1.1.a Distillate Oil

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2102004000 | Stationary Source Fuel Combustion | Industrial | Distillate Oil | Total: Boilers and IC Engines |

[1] U.S. Energy Information Administration, http://www.eia.gov
[2] Emission factors from EPA: ici_fuel_combustion_by_state directory at ftp://ftp.epa.gov/EmisInventory/2011nei/doc/, accessed on 10-23-2012

This industrial sector category included all boilers and internal combustion (IC) engines that use distillate oil as fuel. The activity is estimated in thousand barrels of distillate oil consumed using the EIA's fuel oil and kerosene sales as the data source. To avoid double-counting of distillate oil consumption between the nonpoint and nonroad sector emission inventories, EPA used more detailed distillate oil consumption estimates reported in EIA's Fuel Oil and Kerosene Sales, and assumptions used in the regulatory impact analysis (RIA) for EPA's nonroad diesel emissions rulemaking.[3,4]

For fuels where boiler and engine emission factors are considered and only one emission factor was available, that single emission factor was applied to both the boiler and engine types. The Eastern Regional Technical Advisory Committee (ERTAC) approved emission factors based on nonpoint compilation performed by EPA and were used for emissions estimation. In developing the 2011 NEI, distillate fuel oil types No.1, No.2 and No.4 were combined for the emissions calculation since the fraction of fuel oil No.4 is relatively small.

#### 2.2.1.1.b Residual Oil

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2102005000 | Stationary Source Fuel Combustion | Industrial | Residual Oil | Total: All Boiler Types |

This industrial sector category included all boilers that use residual oil as fuel. The activity is estimated in thousand barrels of residual oil consumed using the EIA's State Energy Data System (SEDS) as the data source.

#### 2.2.1.1.c Natural Gas

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2102006000 | Stationary Source Fuel Combustion | Industrial | Natural Gas | Total: Boilers and IC Engines |

This industrial sector category included all boilers and IC engines that use natural gas as fuel. The activity is estimated in million cubic feet of natural gas consumed using EIA's SEDS as the data source.

#### 2.2.1.1.d Liquid Petroleum Gas (LPG)

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2102007000 | Stationary Source Fuel Combustion | Industrial | Liquefied Petroleum Gas (LPG) | Total: All Combustor Types |

This industrial sector category included all boilers that use LPG as fuel. The activity is estimated in thousand barrels of LPG consumed using EIA's SEDS as the data source.

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[3] Energy Information Administration, U.S. Department of Energy, *Fuel Oil and Kerosene Sales*, data available from http://www.eia.gov/dnav/pet/pet_cons_821use_dcu_nus_a.htm.

[4] U.S. Environmental Protection Agency, "Draft Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines," EPA420-R-03-008, Office of Transportation and Air Quality, April 2003.

### 2.2.1.1.e Wood

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2102008000 | Stationary Source Fuel Combustion | Industrial | Wood | Total: All Boiler Types |

This industrial sector category included all boilers that use wood as fuel. The activity is estimated in tons of wood consumed. The emission factors are from webFIRE.

### 2.2.1.1.f Kerosene

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2102011000 | Stationary Source Fuel Combustion | Industrial | Kerosene | Total: All Boiler Types |

This industrial sector category included all boilers that use kerosene as fuel. The activity is estimated in thousand barrels of kerosene consumed using EIA's SEDS as the data source.

### 2.2.1.2 Commercial/Institutional Fuel Combustion

The emission estimates for fuel combustion at stationary nonpoint sources within the commercial/institutional sector is presented in this section for Kenosha County. Emissions were computed for the following fuel types: coal, distillate oil, residual oil, LPG, natural gas, and kerosene.

**Pollutants**: $NO_x$, VOC

**Activity Data**:
EIA survey data developed by the DOE is the source for activity data. However, such survey information included in SEDS reports requires certain adjustments to identify the commercial/institutional coal consumption. To estimate 2011 emissions, year 2009 data were used as these were the latest year consumption data available at the time this work was performed in 2012.

**Emission Factors:**
ERTAC approved emission factors based on nonpoint compilation performed by EPA were used for emissions estimates of most of the fuel categories except wood. The EPA has compiled criteria and hazardous air pollutant emission factors for nonpoint source commercial/institutional fuel combustion categories[5].The emission factors for commercial/institutional wood combustion were downloaded from WebFIRE, the EPA's online emissions factor repository, retrieval and development tool (Table 2).

Table 2: Emission Factors for Commercial/Institutional Fuel Combustion (lb /unit of fuel throughput)

[5] Emission factors from EPA: ici_fuel_combustion_by_state directory at ftp://ftp.epa.gov/EmisInventory/2011nei/doc/, accessed on 10-23-2012

| Pollutant | EIS Pollutant code | (TON) Coal Bit/ Subbit | (1000 gal) Distillate Oil - blr | (1000 gal) Diesel-eng | (1000 gal) Residual Oil | (1000 gal) Liquid Petroleum Gas | (MMCF) Natural Gas | (1000 gal) Kerosene | (TON) Wood |
|---|---|---|---|---|---|---|---|---|---|
| Nitrogen Oxides | NOx | 11.000 | 20.000 | 604.000 | 55.000 | 8.698 | 100.000 | 19.290 | 2.860 |
| Volatile Organic Compounds | VOC | 0.050 | 0.340 | - | 1.130 | 0.478 | 5.500 | 0.190 | 0.221 |

**Point Source Adjustments**
Emissions assigned for point sources should subtract from the total emissions to estimate the adjusted area source emissions. To make such emissions adjustment for areas sources, activity data was used. The activity assigned for point sources was subtracted from the total activity to estimate the area source activity.

### 2.2.1.2.a Coal

This category covers air emissions from coal combustion in the commercial/institutional sector for space and water heating. The category includes small boilers, furnaces, heaters, and other heating units that are not inventoried as point sources. This sector represents the coal combustion in wholesale and retail businesses, health institutions, social and educational institutions, and Federal, state and local government institutions.

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2103002000 | Stationary Source Fuel Combustion | Commercial/Institutional | Bituminous/Subbituminous Coal | Total: All Boiler Types |

**Pollutants**: $NO_x$

Activity data for commercial/institutional coal combustion in Wisconsin were obtained from the EIA's SED Report.[6] It was assumed that only bituminous/subbituminous coal is used in space heating and water heating equipment that combust coal.

**Control Adjustments**
Regulations for coal combustion are generally applicable to point sources and do not apply to the area sources in this category.

**County Allocation of State Activity Data**
State-level commercial/institutional fuel combustion by fuel type was allocated to each county using the ratio of the number of commercial/institutional sector employees in each county to the total number of commercial/institutional sector employees in the state. Initially prepared state-wide emission estimations were allocated into county-level using adjustments based employment

[6] U.S. Energy Information Administration, http://www.eia.gov/state/?sid=WI

data and heating degree days. The employment information was obtained from the State Department of Labor.[7]

Commercial/Institutional Spatial Apportioning Factor (SAF) for Inventory County:

$$SAF_{Coal,Inventory\ County} = \frac{HDD_{Inventory\ County} * SE_{Coal,Inventory\ County}}{\sum_{\substack{All\ Counties \\ in\ State}} (HDD_{County} * SE_{Coal,County})}$$

where:
$HDD_{Inventory\ County}$ = annual heating degree days for inventory county
$SE_{Coal,\ Inventory\ County}$ = Standard Industrial Classification (SIC) 50-99 employment numbers for Inventory County
$HDD_{County}$ = annual heating degree days for each county in the state
$SE_{Coal,\ County}$ = SIC 50-99 employment for each county in the state

The spatial apportioning factor is used to allocate the state coal total to the county-level using the following equation:

$$Fuel_{Coal,Inventory\ County} = SAF_{Coal,Inventory\ County} \times Fuel_{Coal,Total\ State}$$

where:
$Fuel_{Coal,Inventory\ County}$ = total coal consumed annually in the inventory county
$Fuel_{Coal,Total\ State}$ = total coal consumed annually in the state
$SAF_{Coal,Inventory\ County}$ = spatial apportioning factor for coal in inventory county

Annual commercial/institutional emissions for coal were calculated using following equation:

$$Emissions_{coal,commercial/Institutional} = (Fuel_{Coal\ ,Inventory\ County} \times EF_{Coal,Commercial/Institutional})/2000$$

where:
$Fuel_{Coal,Inventory\ County}$ = total fuel type *x* consumed annually in the inventory county
$EF_{Coal,Commercial/Institutional}$= commercial/institutional emission factor for coal

### 2.2.1.2.b Fuel Oil: Distillate Oil, Residual Oil, and Kerosene

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2103004000 | Stationary Source Fuel Combustion | Commercial/Institutional | Distillate Oil | Total: Boilers and IC Engines |
| 2103005000 | Stationary Source Fuel Combustion | Commercial/Institutional | Residual Oil | Total: All Boiler Types |

[7] Emissions Inventory Improvement Program (EIIP) Area Source Method Abstract – Residential and Commercial/Institutional Fuel Oil and Kerosene Combustion: http://www.epa.gov/ttn/chief/eiip/techreport/volume03

| | | | | |
|---|---|---|---|---|
| 2103011000 | Stationary Source Fuel Combustion | Commercial/Institutional | Kerosene | Total: All Combustor Types |

This category includes small boilers, furnaces, heaters, and other heating units that use distillate oil, residual oil or kerosene as the fuel source and are not inventoried as point sources. Such combustion sources typically occur at wholesale and retail businesses, health institutions, social and educational institutions, and federal, state and local government institutions and are considered in developing the inventory for this category. Distillate oil grades No.1, No.2 and No.4 are combined for emissions calculation.

**Pollutants**: $NO_x$, VOC

The activity is estimated in thousand barrels of fuel oil type consumed. This value represents the number of barrels of distillate oil consumed in this sector during fuel combustion. Fuel oil sales were obtained from the DOE's EIA.[8] Their annual SED report provides total consumption by fuel type for distillate oil, residual oil, and kerosene.

Commercial/Institutional Spatial Apportioning Factor (SAF) for Inventory County:

$$SAF_{Inventory\ County} = \frac{HDD_{Inventory\ County} * SE_{Inventory\ County}}{\sum_{\substack{All\ Counties\\ in\ State}} \left(HDD_{County} * SE_{County}\right)}$$

where:
*HDD* *Inventory County* = annual heating degree days for inventory county
*SE* *Inventory County* = Standard Industrial Classification (SIC) 50-99 employment numbers for inventory county
*HDD* *County* = annual heating degree days for each county in the state
*SE* *County* = SIC 50-99 employment for each county in the state

The spatial apportioning factor is used to allocate the state fuel total to the county level using the following equation:

$$Fuel_{x,Inventory\ County} = SAF_{x,Inventory\ County} \times Fuel_{x,Total\ State}$$

where:
$Fuel_{x,Inventory\ County}$ = total fuel type *x* consumed annually in the inventory county
$Fuel_{x,Total\ State}$ = total fuel type *x* consumed annually in the state
$SAF_{x,Inventory\ County}$ = Spatial Apportioning Factor for fuel type *x* in inventory county
(*Note*: Fuel type *x* could be distillate oil, residual oil, or kerosene.)

Annual commercial/institutional emissions were calculated using following equation:

[8] U.S Department of Energy, Energy Information Administration, Office of Oil and Gas, Petroleum Marketing Monthly, "Annual Report on Sales of Fuel Oil and Kerosene, 2011".

$$Emissions_{Commercial/Institutional} = (Fuel_{x\,,Inventory\ County} \times EF_{x\,,Commercial/Institutional})/2000$$

where:
$Fuel_{x,Inventory\ County}$ = total fuel type *x* consumed annually in the inventory county
$EF_{x,Commercial/Institutional}$ = commercial/institutional emission factor for fuel type *x*

### 2.2.1.2.c Liquid Petroleum Gas (LPG)

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2103007000 | Stationary Source Fuel Combustion | Commercial/Institutional | Liquified Petroleum Gas (LPG) | Total: All Combustor Types |
| 2103006000 | Stationary Source Fuel Combustion | Commercial/Institutional | Natural Gas | Total: Boilers and IC Engines |

This source category covers air emissions from LPG combustion in the commercial/institutional sector. This category includes small boilers, furnaces, heaters, and other heating units that use LPG as fuel and are not inventoried as point sources. Such combustion sources typically occur at wholesale and retail businesses, health institutions, social and educational institutions, and federal, state and local government institutions.[9]

**Pollutants**: $NO_x$, VOC

The activity is estimated in thousand barrels of LPG consumed. The activity data source is the EIA's SEDS.

Annual commercial/institutional LPG combustion related emissions were calculated using following equation:

$$Emissions_{LPG,Commercial/Institutional} = (LPG_{Inventory\ County} \times EF_{LPG\,,commercial/Institutional})/2000$$

where:
$LPG_{Inventory\ County}$ = total annual LPG consumption in the inventory county
$EF_{LPG,commercial/Institutional}$ = commercial/institutional emission factor for LPG

### 2.2.1.2.d Natural Gas

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|

[9] Emissions Inventory Improvement Program (EIIP) Area Source Method Abstract – Natural Gas and LPG Combustion: http://www.epa.gov/ttn/chief/eiip/techreport/volume03

| | | | | |
|---|---|---|---|---|
| 2103006000 | Stationary Source Fuel Combustion | Commercial/Institutional | Natural Gas | Total: Boilers and IC Engines |

This source category covers air emissions from natural gas (NG) combustion in the commercial/institutional sector. This category includes small boilers, furnaces, heaters, and other heating units that use natural gas as the fuel source and are not inventoried as point sources. Such combustion sources typically occur at wholesale and retail businesses, health institutions, social and educational institutions, and federal, state and local government.

**Pollutants**: $NO_x$, VOC

The activity is estimated in million cubic feet of natural gas consumed. The activity data source is the EIA's SEDS.

Annual commercial/institutional natural gas combustion related emissions were calculated using following equation:

$$Emissions_{NG,Commercial/Institutional} = (NG_{Inventory\ County} \times EF_{NG\ ,commercial/Institutional})/2000$$

where:

$NG_{Inventory\ County}$ = total annual natural gas consumption in the inventory county

$EF_{NG,commercial/Institutional}$ = commercial/institutional emission factor for natural gas

### 2.2.1.3 Residential Fuel Combustion

This category covers air emissions from fuel combustion in the residential sector for space and water heating. The category includes small boilers, furnaces, heaters, and other heating units that are not inventoried as point sources. For coal, distillate oil, natural gas, LPG, wood, and kerosene sources listed below, WDNR adopted EPA estimates for 2011 NEI. However, for the completeness of this document, appropriate methods are described in the sections 2.2.1.3.a through 2.2.1.3.f.

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2104001000 | Stationary Source Fuel Combustion | Residential | Anthracite Coal | All Boiler Types |
| 2104002000 | Stationary Source Fuel Combustion | Residential | Bituminous/Subbituminous Coal | All Boiler Types |
| 2104004000 | Stationary Source Fuel Combustion | Residential | Distillate Oil | Total Boilers and IC Engines |
| 2104006000 | Stationary Source Fuel Combustion | Residential | Natural Gas | Total: Boilers and IC Engines |
| 2104007000 | Stationary Source Fuel Combustion | Residential | Liquid Petroleum Gas (LPG) | Total: All Combustion Types |
| 2104011000 | Stationary Source Fuel Combustion | Residential | Kerosene | Total: All Combustor Types |

Activity data for residential fuel combustion were obtained from the DOE's EIA's SED Report.[10] The number of households at county-level that use certain fuel type for heating purposes were accessed from U.S. Census Bureau data. Residential and commercial fuel deliveries were separated out by obtaining samples of sales data from local fuel distributors. Emission factors for $NO_x$ and VOC are from AP-42.[11]

#### 2.2.1.3.a Coal

This sector represents the emission estimations for coal combustion in residential units.

**Pollutants**: NOx

Coal combustion emission factors from AP-42 were used. It was assumed that the residential coal combustion units consume 100% of bituminous/subbituminous coal. Anthracite coal consumption was assumed to be zero percent.

Point source adjustments for area sources were estimated by subtracting the activity data for point sources from total activity values. Regulations for coal combustion are generally applicable to point sources and do not apply to the area sources in this category.[12]

**Emissions Calculation**[13]

Annual emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times (1 - CE_{x,p}) \times EF_{x,p}$$

where:
$E_{x,p}$ = annual emissions for fuel type *x* and pollutant *p* (lb/year),
$FC_x$ = annual county-level fuel consumption for fuel type *x*,
$CE_{x,p}$ = control efficiency for fuel type *x* and pollutant *p*, and
$EF_{x,p}$ = emission factor for fuel type *x* and pollutant *p*.

County level fuel consumption is calculated using:

$$FC_x = A_{State} \text{ x } Ratio_{Anth, Bit} \text{ x } Ratio_{County\ houses}$$

where:
$A_{State}$ = total tons of coal reported by the EIA,
$Ratio_{Anth, Bit}$ = ratio of anthracite and bituminous coal distribution for the residential sector
$Ratio_{County\ houses}$ = county allocation ratio based on number of houses burning coal.

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[10] U.S. Energy Information Administration, http://www.eia.gov/state/?sid=WI

[11] U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.

[12] Residential and Commercial/Institutional Coal Combustion, http://www.epa.gov/ttn/chief/eiip/techreport/volume03/coal.pdf

[13] U.S.EPA, residential_coal_2104001000_2104002000_documentation_2011, accessed from ftp://ftp.epa.gov/EmisInventory/2011nei/doc/

### 2.2.1.3.b Distillate Oil

The distillate oil burned in residential units is covered in this category. For this category, WDNR adopted the EPA estimates for NEI 2011.

Pollutants: $NO_x$, VOC

Activity data is available in the State Energy Data consumption tables published by the EIA.[14] In developing 2011 NEI, year 2009 consumption data were used. To allocate the state-wide distillate oil consumption data to county-level, U.S. Census Bureau's house heating fuel type data were used.[15] In developing 2011 NEI, no control factors were assumed for this category.

**Emission factors**
Criteria pollutant emission factors for distillate oil are from AP-42.[16] For all counties in the United States, the distillate oil consumed by residential combustion is assumed to be No. 2 fuel oil with a heating value of 140,000 Btu per gallon.

**Emissions Calculation**
To calculate emissions, state-level distillate oil consumption was obtained from the EIA and allocated to the county level using the activity data and emissions factors. The county-level oil consumption is multiplied by the emission factors to calculate emissions as:

$$E_{x,p} = FC_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type $x$ and pollutant $p$
$FC_x$ = annual fuel consumption for fuel type $x$
$EF_{x,p}$ = emission factor for fuel type $x$ and pollutant $p$

And $FC_x = A_{State} \text{ x } (H_{county} / H_{State})$

where:

$A_{State}$ = State activity data from EIA
$H_{County}$ = number of houses in the county using distillate oil as the primary heating fuel
$H_{State}$ = number of houses in the state using distillate oil as the primary heating fuel

### 2.2.1.3.c Natural Gas

The natural gas that is burned in residential units is covered in this category.

[14] U.S. Department of Energy, Energy Information Administration (EIA). State Energy Data 2009 Consumption. Washington, DC 2012. Internet Address: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_phy.csv, accessed February 2012.
[15] https://www.census.gov/hhes/www/housing/census/historic/fuels.html
[16] U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.

**Pollutants:** $NO_x$, VOC

Activity data is available in the SED consumption tables published by the EIA.[17] Year 2009 consumption data were used to develop 2011 NEI. To allocate the state-wide natural gas consumption data to county-level, U.S. Census Bureau's house heating fuel type data were used.[18] State natural gas consumption was allocated to each county using the ratio of the number of houses burning natural gas in each county to the total number of houses burning natural gas in the State. In developing 2011 NEI, no control factors were assumed for this category.

Criteria pollutant emission factors for natural gas are from AP-42.[19]

**Emissions Calculation**

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type *x* and pollutant *p*,
$FC_x$ = annual fuel consumption for fuel type *x*,
$EF_{x,p}$ = emission factor for fuel type *x* and pollutant *p*,

and $FC_x = A_{State} \text{ x } (H_{county} / H_{State})$

where :

$A_{State}$ = state activity data from EIA,
$H_{County}$ = number of houses in the county using natural gas as the primary heating fuel,
$H_{State}$ = number of houses in the state using natural gas as the primary heating fuel.

### 2.2.1.3.d Liquid Propane Gas (LPG)

The LPG that is burned in residential units is covered in this category.

**Pollutants:** $NO_x$, VOC

Activity data is available in the SED consumption tables published by the EIA.[20] In developing 2011 NEI, year 2009 volume of LPG consumed was used. To allocate the state-wide LPG

[17] U.S. Department of Energy, Energy Information Administration (EIA). State Energy Data 2009 Consumption. Washington, DC 2012. Internet Address: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_phy.csv, accessed February 2012.
[18] https://www.census.gov/hhes/www/housing/census/historic/fuels.html
[19] U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.
[20] U.S. Department of Energy, Energy Information Administration (EIA). State Energy Data 2009 Consumption. Washington, DC 2012. Internet Address: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_phy.csv, accessed February 2012.

consumption data to county-level, U.S. Census Bureau's house heating fuel type data were used.[21] State LPG consumption was allocated to each county using the ratio of the number of houses burning LPG in each county to the total number of houses burning LPG in the state. In developing 2011 NEI, no control factors were assumed for this category.

Criteria pollutant emission factors for LPG are from AP-42.[22] Some emission factors were revised based on recommendations by an ERTAC advisory panel composed of state and EPA personnel.[23]

**Emissions Calculation**

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type *x* and pollutant *p*,
$FC_x$ = annual fuel consumption for fuel type *x*,
$EF_{x,p}$ = emission factor for fuel type *x* and pollutant *p*,

And $FC_x = A_{State} \text{ x } (H_{County} / H_{State})$

where :

$A_{State}$ = state activity data from EIA
$H_{County}$ = number of houses in the county using LPG as the primary heating fuel
$H_{State}$ = number of houses in the state using LPG as the primary heating fuel.

### 2.2.1.3.e Wood

Residential wood combustion primarily includes wood burning in different types of woodstoves and fireplaces. To develop activity data for residential wood burning, there are two main methods; residential wood survey and Census Bureau/ EIA data approach. Since WDNR adopted EPA estimates for residential wood burning category, the data presented were generated using Census Bureau's EIA approach.

**Pollutants:** $NO_x$, VOC

Residential wood burned at the state level is apportioned to the county level using U.S. Census data on households that use wood as a primary fuel. The equation is:

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[21] https://www.census.gov/hhes/www/housing/census/historic/fuels.html
[22] U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.
[23] ftp://ftp.epa.gov/EmisInventory/2011nei/doc/

$$Wood\ Consumption_{Inventory\ County} = Wood\ Consumption_{\ State} \times \frac{Wood\ Burning\ Hourseholds_{Invnetory\ County}}{Wood\ Burning\ Households_{\ State}}$$

State level wood use (in cords) is available in the EIA's SED Report. State and county statistics on wood-burning households are available from the U.S. Census Bureau. Cords of wood are converted to pounds of wood using factors provided in AP-42, Appendix A.[24]

**Emissions Calculation**

Emissions are calculated for each county using emission factors and activity data:

$$\mathrm{E}_{Wood,p} = Wood\ Consumption_{Inventory\ County} \times \mathrm{EF}_{Wood,p}$$

where:

$\mathrm{E}_{Wood,p}$ = annual emissions for wood for pollutant $p$
$Wood\ Consumption_{Inventory\ County}$ = annual wood consumption in inventory county
$\mathrm{EF}_{Wood,p}$ = emission factor for wood for pollutant $p$

**2.2.1.3.f Kerosene**

Kerosene burned in residential units is covered in this category. Residential heating, cooking, and other equipment operations using kerosene are included in the emission estimates.

Activity data is available in the State Energy Data consumption tables published by the EIA.[25] In developing 2011 NEI, year 2009 volume of kerosene consumed was used. To allocate the state-level kerosene consumption data to county-level, U.S. Census Bureau's house heating fuel type data were used.[26] State kerosene consumption was allocated to each county using the ratio of the number of houses burning kerosene in each county to the total number of houses burning kerosene in the state. In developing 2011 NEI, no control factors were assumed for this category.

Criteria pollutant emission factors for kerosene are from AP-42. Emission factors for distillate oil were used for kerosene, but the distillate oil emission factors were multiplied by a factor of 135/140 to convert them for this use. This factor is based on the ratio of the heat content of kerosene (135,000 Btu/gallon) to the heat content of distillate oil (140,000 Btu/gallon). [27]

**Emissions Calculation**

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[24] http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii02_apr2001.pdf
[25] U.S. Department of Energy, Energy Information Administration (EIA). State Energy Data 2009 Consumption. Washington, DC 2012. Internet Address: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_phy.csv, accessed February 2012.
[26] https://www.census.gov/hhes/www/housing/census/historic/fuels.html
[27] U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, 5th Edition, AP-42, Volume I: Stationary Point and Area Sources. Research Triangle Park, North Carolina. 1996.

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = FC_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for fuel type *x* and pollutant *p*,
$FC_x$ = annual fuel consumption for fuel type *x*,
$EF_{x,p}$ = emission factor for fuel type *x* and pollutant *p*,

And $FC_x = A_{State}$ x $(H_{county} / H_{State})$
where:

$A_{State}$ = state activity data from EIA
$H_{County}$ = number of houses in the county using kerosene as the primary heating fuel
$H_{State}$ = number of houses in the state using kerosene as the primary heating fuel

### 2.2.2. Industrial Processes: Food and Kindred Products-Commercial Cooking

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2302002100 | Industrial Processes | Food and Kindred Products: SIC 20 | Commercial Cooking-Charbroiling | Conveyorized Charbroiling |
| 2302002200 | Industrial Processes | Food and Kindred Products: SIC 20 | Commercial Cooking-Charbroiling | Under-fired Charbroiling |
| 2302003000 | Industrial Processes | Food and Kindred Products: SIC 20 | Commercial Cooking-Frying | Deep Fat Frying |
| 2302003100 | Industrial Processes | Food and Kindred Products: SIC 20 | Commercial Cooking-Frying | Flat Griddle Frying |
| 2302003200 | Industrial Processes | Food and Kindred Products: SIC 20 | Commercial Cooking-Frying | Clamshell Griddle Frying |

In developing 2011 NEI, WDNR adopted EPA estimates for commercial cooking categories. This source category covers air emissions from all types of commercial meat cooking based on five equipment types listed above.

Chain-driven (conveyorized) charbroilers have conveyor belts to carry the meat, broiling the top and the bottom of the food simultaneously, through the flame area mostly using natural gas. This appliance normally produces lower particulate matter (PM) and VOC emissions than under-fired charbroilers.

Under-fired charbroilers contribute the bulk of emissions for the commercial cooking sector. The equipment consists of three main components - a heating source mostly burning natural gas, a high-temperature radiant surface to hold the food, and a slotted grill.  When grease from the meat falls onto the high-temperature radiant surface, both PM and VOC emissions occur.

Deep Fat Fryers use an exposed hot metal surfaces filled with cooking oil that is continuously heating. When the raw food is cooked in deep fat fryers, most of the water at the surface of the product vaporizes during the cooking process generating oil mist and oil distillation, resulting PM and VOC emissions.

Griddles consist of an exposed metal plate used to cook food quickly with a small quantity of oil. The emissions include light oil particulates causing PM and VOC emissions. In this process of cooking, the food is not immersed in heated oil. Most griddles are gas fired, but fuel type does not affect emissions of PM or VOC.

Clam Shell Griddles employs a two-sided cooking configuration, lowering an upper hot plate on top of the food product to cook that side while a lower plate cooks the bottom of the product. The cooking time and the emissions are relatively low for this method.

**Activity**
County-level population data, obtained from the US Census Bureau's county-level population estimates for the 2010 Census were used as the activity.[28]

**Emission factors**
Per capita emission factors for each Source Classification Code (SCC) and pollutant were developed and reviewed by ERTAC advisory panel composed of state and EPA representatives.

**Control Factors**
No control factors were directly applied to develop the commercial cooking categories in 2011 NEI.

**Emission Estimation**
Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = A_x \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for category *x* and pollutant *p*;
$A_x$ = 2010 county-level population data associated with category *x*;
$EF_{x,p}$ = emission factor for category *x* and pollutant *p* (lb/person).

### 2.2.3 Solvent Utilization

#### 2.2.3.1 Surface Coating

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2401001000 | Solvent Utilization | Surface Coating | Architectural Surface Coating | Total: All Solvent Types |
| 2401005000 | Solvent Utilization | Surface Coating | Automobile Refinishing: SIC 7532 | Total: All Solvent Types |

[28] DOC, 2011: U.S. Department of Commerce, Bureau of the Census, *County Intercensal Estimates (2000-2010)*, Washington, DC. http://www.census.gov/popest/data/intercensal/county/county2010.html

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2401065000 | Solvent Utilization | Surface Coating | Electronic and Other Electrical: SIC 36 - 363 | Total: All Solvent Types |
| 2401015000 | Solvent Utilization | Surface Coating | Factory Finished Wood: SIC 2426 thru 242 | Total: All Solvent Types |
| 2401100000 | Solvent Utilization | Surface Coating | Industrial Maintenance Coatings | Total: All Solvent Types |
| 2401055000 | Solvent Utilization | Surface Coating | Machinery and Equipment: SIC 35 | Total: All Solvent Types |
| 2401080000 | Solvent Utilization | Surface Coating | Marine: SIC 373 | Total: All Solvent Types |
| 2401025000 | Solvent Utilization | Surface Coating | Metal Furniture: SIC 25 | Total: All Solvent Types |
| 2401090000 | Solvent Utilization | Surface Coating | Miscellaneous Manufacturing | Total: All Solvent Types |
| 2401070000 | Solvent Utilization | Surface Coating | Motor Vehicles: SIC 371 | Total: All Solvent Types |
| 2401200000 | Solvent Utilization | Surface Coating | Other Special Purpose Coatings | Total: All Solvent Types |
| 2401030000 | Solvent Utilization | Surface Coating | Paper, Film, Foil: SIC 26 | Total: All Solvent Types |
| 2401020000 | Solvent Utilization | Surface Coating | Wood Furniture: SIC 25 | Total: All Solvent Types |
| 2401008000 | Solvent Utilization | Surface Coating | Traffic Markings | Total: All Solvent Types |

For most of the surface coatings, solvents containing VOCs are used if the coatings are not water-based. During application, and as the coating dries, VOCs are emitted into the atmosphere. To estimate the emissions by primary sources from surface coating operations, the amount of coating used and the VOC content of the coating have been considered. While the coating dries and hardens, VOCs are emitted as reaction byproducts. To estimate the emissions by secondary sources, the amount of solvents used to clean such application equipment is used.

Product reformulation, product substitution and/or recycling of unused coating may be practiced in order to control the amount of primary emissions. Water-based coatings, powder coatings, and low-organic solvent coatings could be substituted as a control approach. However, since Occupational Safety and Health Administration (OSHA) regulations limit worker exposure to solvents, OSHA rules can indirectly affect the VOC content of coatings and the solvents used in them. The OSHA exposure limits vary with compound toxicity and as a result, manufacturers must consider the composition of coatings during product development to minimize the exposure hazards.

### 2.2.3.1.a Non-Industrial Surface Coating: Architectural Coating

In developing 2011 NEI, WDNR adopted EPA estimates from the architectural surface coating category. Architectural surface coating is an area source that occurs from home owners and contractors painting homes, buildings, and signs. These operations consist of applying a thin layer of coating such as paint, paint primer, varnish, or lacquer to architectural surfaces, and the use of solvents as thinners and for cleanup.[29]

[29] Emission Inventory Improvement Program, Technical Report Series Volume 3: Area Sources, Chapter 3: Architectural Surface Coating

**Pollutant:** VOC

The activity is determined as the per capita usage factor by dividing the national total architectural surface coating quantities for organic solvent and water based coatings by the U.S. population for that year. The population data is available from U.S. Census Bureau.[30]

To estimate the VOC emitted by this source category, the amount of VOC in surface coatings should be determined using one of the two methods listed here. The first approach is the surveying architectural surface coating use in the inventory area. The survey should include product type, product amount distributed by type, product density, and VOC content of the product. The second method uses a population-based estimation. Again, there are two population-based approaches: (1) National average per-gallon emission factors applied to national per capita usage rates, or; (2) Regulatory state or local per-gallon emission limits applied to national per capita usage rates.[30]

**Spatial Allocation**
In preparation of an inventory, spatial allocation could perform in two possible approaches: (1) allocation of state or regional activity to a county-level, and (2) allocation of county-level emission estimates to a modeling grid cell.

Since this source category is almost always used in and on buildings where people live or work, considering the square footage is a preferred method for spatial allocation. Such databases are available in the tax assessor’s office and accessible for use in a state inventory. Use land use data from county planning departments or population distributions available from the Census Bureau are used for these spatial approaches.

**Temporal Resolution**
Seasonal influence on architectural surface coating temporally apportions the emissions estimates into different quarters for a particular year. Since temperatures below $50^{o}$F are not suitable for painting, the first and fourth quarters limit the activity by decreasing the surface coating usage in most areas. Majority of the activity occurs during the second and third quarters which cover the months of April through September. During this active season, it is assumed that coating usage may take place 7 days a week.

**Emissions Calculation**:
The following equation was used to estimate the total amount of VOC emitted in the inventory area from architectural surface coating operations.[31]

$$ASE_{VOC} = \sum_{c=1}^{C} \sum_{s=1}^{S} TAC_{c,s} \times SC_{c,s} \times F_{VOC,s}$$

where:
$ASE_{VOC}$ = total emissions of *VOC* from architectural surface coating operations, for all coatings (*C*) with all solvents (*S*)

[30] U.S. Census Bureau, “Population Estimates,” at http://www.census.gov/popest/estimates.html.
[31] Emission Inventory Improvement Program, Technical Report Series Volume 3: Area Sources, Chapter 3: Architectural Surface Coating

$TAC_{s,c}$ = total architectural surface coating consumed in the inventory area for each coating ($c$) with each solvent ($s$) containing $VOC$
$SC_{c,s}$ = amount of solvent ($s$) in each coating ($c$)
$F_{VOC,s}$ = fraction of $VOC$ in each solvent ($s$)

**Point Source Adjustments**
Usually, the application of architectural surface coating is generally defined as an area source; it is not required to subtract point source emission estimates from the total. Uncertainty may apply on the variability of per capita paint usage. For example, per capita usage may be lower than the national average in urban areas of high-density housing, in milder climates, or where wooden buildings are not common. Also, paint usage may be higher in corrosive environments or in areas where wooden structures predominate. The solvent content of the same paint is also variable. The total quantities of paint used or the type of paints used are very different from the national average.

### 2.2.3.1.b Industrial Surface Coating

Industrial surface coating includes paints, enamels, varnishes, lacquers, and other product finishes. Some of those coatings contain a solvent-based liquid carrier; others use a water-based liquid carrier but still contain a small portion of solvents. Solvents are also used to clean up painting equipment.

**Pollutant**: VOC

In developing 2011 NEI, WDNR updated the EPA provided emissions estimates for most surface coating categories using total employment data for each county and adopted EPA estimates for industrial maintenance, traffic markings, and other special purposes categories as listed in table 3.

Table 3: List of Industrial Surface Coating Categories as updated or adopted by WDNR for 2011

| SCC | SCC Level 3 | WDNR updated EPA estimates | WDNR adopted EPA estimates |
|---|---|---|---|
| 2401005000 | Automobile refinishing | Yes | - |
| 2401065000 | Electronic and other electrical coatings | Yes | - |
| 2401015000 | Factory finished wood | Yes | - |
| 2401100000 | Industrial maintenance | - | Yes |
| 2401055000 | Machinery and equipment | Yes | - |
| 2401080000 | Marine manufacturing | Yes | - |
| 2401025000 | Metal furniture | Yes | - |
| 2401090000 | Miscellaneous manufacturing | Yes | - |
| 2401070000 | Motor vehicles | Yes | - |
| 2401200000 | Other Special Purposes | - | Yes |
| 2401030000 | Paper, Film and Foil | Yes | - |

| | | | |
|---|---|---|---|
| 2401020000 | Wood Furniture | Yes | - |
| 2401008000 | Traffic Markings | - | Yes |

2010 county level employment data, state-level employment data and county business pattern data were downloaded from U.S. Census Bureau. Activity data is defined the pounds of solvent sold divided by the county employment for a specific category. Emissions factors developed by ERTAC solvent working group were used for the calculations. Emission factors define the pounds of VOC per employee per year. Final emissions were calculated from adjusted county employment values and emission factors. Adjusted county employment values indicate the total employment in each county for a surface coating category based on the county business patterns.

**Emissions Calculation**
2010 county level employment data, state-level employment data and county business pattern data were downloaded from U.S. Census Bureau. Emissions factors, developed by ERTAC solvent working group, define the pounds of VOC per employee per year and were used for the calculations. Final emissions were calculated from adjusted county employment values and emission factors. Adjusted county employment values indicate the total employment in each county for automobile refinishing category based on county business patterns. Application of controls requires information about control efficiency, rule effectiveness and rule penetration. For example, VOC content of the surface coating products could control by regulation.

The emissions for categories listed in Table 3 except industrial maintenance, traffic markings, and other special purposes categories could be calculated using following equations.

The basic calculation is:

$$Emissions = (Adjusted\ County\ Employment) \times (Emission\ Factor)$$

The calculation in detail is:

$$Emissions_s = \frac{Emp_{i,s} \times EF_s \times [1 - (RE \times RP \times EC)]}{2000} - Emissions_{Point\ Sources,s}$$

where:
$Emissions_s$ = VOC emissions in tons per year from surface coating category *s*
$Emp_{i,s}$ = number of employees in inventory county for surface coating category *s*
$EF_s$ = VOC emission factor for surface coating category *s*
$CE$ = control efficiency
$RE$ = rule effectiveness
$RP$ = rule penetration
$Emissions_{Point\ Sources,s}$ = Point source emissions from surface coating category *s*

For calculating VOC emissions from industrial maintenance and other special purpose categories, following basic equation was used.

$$Emissions = (Population) \times (Per\ Capita\ Emission\ Factor)$$

County-level population estimates were downloaded from the U.S. Census Bureau. Emission factors used for the calculation were developed by ERTAC solvent working group.
For calculating VOC emissions from traffic markings, following basic equation was used.

$$Emissions = (Number\ of\ Road\ Miles\ Paved) \times (Emission\ Factor\ per\ Road\ Mile)$$

The activity data was determined using the road miles paved obtained from the Department of Transportation. Emission factors were developed by ERTAC solvent working group.

### 2.2.3.2 Degreasing

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2415000000 | Solvent Utilization | Degreasing | All Processes/All Industries | Total: All Solvent Types |

**Pollutant**: VOC

In developing 2011 NEI for this category, WDNR updated the EPA estimated emissions using adjusted total employment data for each county. The state-wide employment data was allocated to county-level using County Business Patterns for the counties of Wisconsin.[32] EPA provided emission factors for VOC.[33]

The basic calculation is:

$$Emissions = (Adjusted\ County\ Employment) \times (Emission\ Factor)$$

To adjust point source emissions, the degreasing emissions from facilities identified as point sources were subtracted from the area source inventory to avoid double counting. Application of controls requires information about control efficiency, rule effectiveness and rule penetration.

The calculation in detail is:

$$Emissions_d = \left[\frac{Emp_i \times EF_d}{2000} \times [1 - (CE_d \times RE_d \times RP_d)]\right] - Emissions_{Point\ Sources,d}$$

where:
$Emissions_d$ = emissions of VOC in tons/day from degreasing
$Emp_i$ = 2010 employment of County *i*
$EF_d$ = VOC emissions factor for degreasing
$CE_d$ = control efficiency for degreasing
$RE_d$ = rule effectiveness for degreasing
$RP_d$ = rule penetration for degreasing
$Emissions_{Point\ Sources,d}$ = point source emissions from degreasing

[32] U.S. Census Bureau, 2010 County Business Patterns accessed from http://www.census.gov/econ/cbp/download/index.htm and/or http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl
[33] ftp://ftp.epa.gov/EmisInventory/2011nei/doc/

### 2.2.3.3 Dry Cleaning

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2420000000 | Solvent Utilization | Dry Cleaning | All Processes | Total: All Solvent Types |

Dry cleaning facilities utilize solvents in their cleaning process which causes the emission of VOCs into the ambient air. WDNR updated the EPA estimated emissions using the adjusted total employment data for each county.

**Pollutants**: VOC

The basic calculation is:

$$Emissions = (Adjusted\ County\ Employment) \times (Emission\ Factor)$$

Activity data included the employee estimates allocated to counties based on county business patterns in Wisconsin.[33] The EPA provided emission factors that were developed by ERTAC.

Emissions are calculated for each county using emission factors and activity data:

$Emissions_{i,p}$ = ($Emp_i$) x (Emission Factor $_p$)

where:
Emissions $_{i,p}$= annual emissions for inventory county *i* and pollutant *p*
Emp $_i$ = adjusted employment data associated with county *i*
Emission Factor $_p$ = emission factor for pollutant *y*

### 2.2.3.4 Graphic Arts

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2425000000 | Solvent Utilization | Graphic Arts | All Processes | Total: All Solvent Types |

Graphic arts include operations that are involved in the printing of newspapers, magazines, books and other printed materials. There are six basic types of graphic arts methods: lithography, gravure, letterpress, flexography, screen printing and metal decorating called platelets. In developing 2011 NEI, WDNR updated the EPA provided emissions estimates using the adjusted total employment data for each county.

Activity data includes the specific type of printing operation and total number of employees involve in each of those operation types.[34] Emission factors define the pounds of VOC per capita

[34] U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Employment Statistics”, found at http://www.bls.gov/oes/current/oes_dc.htm

per year as developed by ERTAC. Types of printing ink and the type of product and the production volume are also important in estimating emissions.

It is assumed that emissions from graphic arts industry are distributed uniformly throughout the year as no significant seasonal fluctuations in the production of this category were observed. To determine seasonal emissions, the fraction of the year that corresponds to the season of interest can be multiplied by annual emissions to obtain seasonal emissions.[35]

**Emission calculation**

The basic calculation is:
$Emissions_{i,p}$ = ($Emp_i$) x (Emission Factor $_p$)

where:
Emissions $_{i,p}$= annual emissions for inventory county *i* and pollutant *p*
Emp $_i$ = adjusted employment data associated with county *i*
Emission Factor $_p$ = emission factor for pollutant *y*

Adjustment for point sources:

$$Emissions_{Area\ Sources} = Emissions_{All\ Stationary\ Sources} - Emissions_{Point\ Sources}$$

### 2.2.3.5 Miscellaneous Non-industrial: Consumer and Commercial

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2460600000 | Solvent Utilization | Miscellaneous Non-industrial: Consumer and Commercial | All Adhesives and Sealants | Total: All Solvent Types |
| 2460400000 | Solvent Utilization | Miscellaneous Non-industrial: Consumer and Commercial | All Automotive Aftermarket Products | Total: All Solvent Types |
| 2460200000 | Solvent Utilization | Miscellaneous Non-industrial: Consumer and Commercial | All Household Cleaning Products | Total: All Solvent Types |
| 2460500000 | Solvent Utilization | Miscellaneous Non-industrial: Consumer and Commercial | All Coatings and Related Products | Total: All Solvent Types |
| 2460800000 | Solvent Utilization | Miscellaneous Non-industrial: Consumer and Commercial | All FIFRA Related Products | Total: All Solvent Types |
| 2460900000 | Solvent Utilization | Miscellaneous Non-industrial: Consumer and Commercial | Miscellaneous Products (Not Otherwise Covered) | Total: All Solvent Types |
| 2460100000 | Solvent Utilization | Miscellaneous Non-industrial: Consumer and Commercial | Personal Care Products | Total: All Solvent Types |

**Pollutant**: VOC

[35] http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii07.pdf

In developing 2011 NEI, WDNR adopted EPA estimated emissions.

**Emissions Calculation**

Emissions are calculated for each county using emission factors and activity as:

$$E_{x,p} = A \times EF_{x,p}$$

where:

$E_{x,p}$ = annual emissions for category *x* and pollutant *p*;
A = 2010 county-level population;
$EF_{x,p}$ = emission factor for category *x* and pollutant *p* (lb/person).

The emission factors used in the emission estimates were developed by ERTAC.

Non-industrial solvents that are used in commercial or consumer applications and may emit VOCs are estimated under several different categories: adhesives and sealants, automotive aftermarket products, household cleaning products, coatings and related products, Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) related products, personal care products, and other related miscellaneous products. Adhesives and sealants category includes cements, glues, and pastes. These compounds form a bond between one or more substrates. For auto aftermarket category, two main types of products are detailing products and maintenance and repair products. The detailing products sub-category includes the products used for cosmetic purposes on cleaning, polishing, and waxing. The maintenance and repair sub-category includes products used as engine and part cleaners, carburetor fuel injector cleaners, lubricants, antifreeze, radiator cleaners, and brake fluids.

Household products include hard surface cleaners, laundry products, fabric and carpet care products, dishwashing products, waxes and polishes, air fresheners, shoe and leather care products, and other miscellaneous household products. Coatings and related products category includes aerosol spray paint and other coating-related products. FIFRA regulated products include consumer pesticides that are used in home, garden, and other commercial disinfectant and antimicrobial applications. Personal care products include hair care products, deodorants, antiperspirants, perfumes, colognes, and nail care products.

There may be uncertainties for the emission estimations in these categories due to fluctuations in per capita usage for different geographical locations with seasonal variations. The changes associated with product formulations may also influence the estimates.

### 2.2.3.6 Miscellaneous Non-industrial: Commercial

### 2.2.3.6.a Agricultural pesticide Application

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2461850000 | Solvent Utilization | Miscellaneous Non-industrial: Commercial | Pesticide Application: Agricultural | All processes |

Pesticides are substances used to control nuisance species and can be classified by targeted pest group: weeds (herbicides), insects (insecticides), fungi (fungicides), and rodents (rodenticides). They can be further described by their chemical characteristics: synthetics, non-synthetics (petroleum products), and inorganics. Different pesticides are made through various combinations of the pest-killing material, also called the active ingredient (AI), and various solvents. The solvents act as carriers for AI. Both types of ingredients contain VOC that may be emitted to the air during application or after application as a result of evaporation. In estimating potential VOC emissions, the crop-specific and regional specific pesticide application rates should be considered.[36]

Emissions were estimated by summing the product of the activity data and the emissions factor for each pesticide and crop type at the county-level:

$$\text{Total VOC Emissions}_{County} = \Sigma\,(A_{Pesticide,Crop} \times EF)$$

The default emission factor is expressed as the pounds of VOC that evaporate per pound of pesticide AI applied and was calculated using the following equation:

$$EF = ER \times VOC$$

where: EF = emission factor (lb VOC / lb AI)
ER = evaporation rate of applied pesticide (expressed as a fraction)
VOC = weighted pesticide VOC content (lb VOC / lb AI)

The equations discussed here are based on EPA recommendations provided in the Emissions Inventory Improvement Program (EIIP) guidance.[37]

The pesticide specific VOC emission potential (EP) of reactive organic gases (i.e., the weight percentage of product that contributes to VOC emissions) and the weight percent of active ingredient from the Department of Pesticide Regulation (DPR) database were used to calculate the weighted average VOC content.

$$VOC = \Sigma_{pesticides}[((AI/(\%AI/100))*(EP/100))/AI]*[(AI/(\%AI/100))/T]$$

where: VOC = weighted pesticide VOC content (lb VOC / lb AI)
AI = active ingredient applied (lb)
%AI = weight percent of AI in pesticide mixture
EP = emissions potential of reactive organic gases (expressed as % of pesticide weight)
T = total weight of all pesticides applied (lb)

[36] Agricultural_Pesticides_2461850000_Documentation downloaded from ftp://ftp.epa.gov/EmisInventory/2011nei/doc/
[37] United States Environmental Protection Agency, "*Pesticides - Agricultural and Nonagricultural*", Vol. 3, Ch. 9, Section 5.1, p. 9.5-4, Emissions Inventory Improvement Program, June 2001.

The AI applied was calculated from the AI application rates reported in the Crop Life Foundation (CLF) database and the harvested acres reported in the Department of Agriculture's Census of Agriculture. The national pesticide usage (T), reported as pounds of pesticides applied, was calculated using the following equation:

$$T = \Sigma_{Pesticides}\ AI/(\%AI/100)$$

The activity for pesticide application is the pounds of active ingredient applied and is calculated using the following equation:

$$A = HA \times R \times I \times AT$$

where: A = pounds of active ingredient applied by pesticide by county
HA = crop-specific harvested acres in county
R = crop-specific pounds of pesticide applied per year per harvested acre
I = pounds of active ingredient per pound of pesticide
AT = percent of crop acres in the state treated with the active ingredient

### 2.2.4 Storage and Transport

#### 2.2.4.1 Portable Fuel Containers: Residential

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2501011011 | Storage and Transport | Petroleum and Petroleum Product Storage | Residential Portable Fuel Containers | Permeation |
| 2501011012 | Storage and Transport | Petroleum and Petroleum Product Storage | Residential Portable Fuel Containers | Evaporation |
| 2501011013 | Storage and Transport | Petroleum and Petroleum Product Storage | Residential Portable Fuel Containers | Spillage During Transport |
| 2501011014 | Storage and Transport | Petroleum and Petroleum Product Storage | Residential Portable Fuel Containers | Refilling at the Pump-Vapor Displacement |
| 2501011015 | Storage and Transport | Petroleum and Petroleum Product Storage | Residential Portable Fuel Containers | Refilling at the Pump-Spillage |
| 2501011016 | Storage and Transport | Petroleum and Petroleum Product Storage | Residential Portable Fuel Containers | Refueling Equipment-Vapor Displacement |
| 2501011017 | Storage and Transport | Petroleum and Petroleum Product Storage | Residential Portable Fuel Containers | Refueling Equipment-Spillage |

For 2011 NEI, WDNR adopted the EPA estimated emissions for residential portable fuel containers. However, for this attainment demonstration, WDNR back-calculated VOC emissions for these categories from EPA's 2017 and 2025 emission estimates in its 2011 Emissions Modeling Platform, Version 6.2.[38] This was done due to a suspected methodology change by EPA (which led to significantly lower VOC emission estimates) for VOC emission estimates for these categories after 2011. Back-calculating 2011 emissions from EPA's 2017 and 2025 estimates is assumed to more accurately reflect EPA's updated methodology after 2011.

[38] ftp://ftp.epa.gov/EmisInventory/2011v6/v2platform/2017emissions/

These categories are associated with the emissions from the fuel containers commonly known as "gas cans" and contribute VOC emissions to the ambient air in different ways.

### 2.2.4.2 Portable Fuel Containers: Commercial

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2501012011 | Storage and Transport | Petroleum and Petroleum Product Storage | Commercial Portable Fuel Containers | Permeation |
| 2501012012 | Storage and Transport | Petroleum and Petroleum Product Storage | Commercial Portable Fuel Containers | Evaporation |
| 2501012013 | Storage and Transport | Petroleum and Petroleum Product Storage | Commercial Portable Fuel Containers | Spillage During Transport |
| 2501012014 | Storage and Transport | Petroleum and Petroleum Product Storage | Commercial Portable Fuel Containers | Refilling at the Pump-Vapor Displacement |
| 2501012015 | Storage and Transport | Petroleum and Petroleum Product Storage | Commercial Portable Fuel Containers | Refilling at the Pump-Spillage |
| 2501012016 | Storage and Transport | Petroleum and Petroleum Product Storage | Commercial Portable Fuel Containers | Refueling Equipment-Vapor Displacement |
| 2501012017 | Storage and Transport | Petroleum and Petroleum Product Storage | Commercial Portable Fuel Containers | Refueling Equipment-Spillage |

WDNR did not adopt the EPA estimated 2011 emissions for commercial portable fuel containers due to a suspected methodology change by EPA (which led to significantly lower VOC emission estimates) for VOC emission estimates for these categories after 2011. Instead, WDNR staff back-calculated VOC emissions for these categories from EPA's 2017 and 2025 emission estimates in its 2011 Emissions Modeling Platform, Version 6.2.

### 2.2.4.3 Petroleum and Petroleum Product Storage

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2501050120 | Storage and Transport | Petroleum and Petroleum Product Storage | Bulk Terminals: All Evaporative Losses | Gasoline |
| 2501055120 | Storage and Transport | Petroleum and Petroleum Product Storage | Bulk Plants: All Evaporative Losses | Gasoline |
| 2501060051 | Storage and Transport | Petroleum and Petroleum Product Storage | Gasoline Service Stations | Stage 1: Submerged Filling |
| 2501060052 | Storage and Transport | Petroleum and Petroleum Product Storage | Gasoline Service Stations | Stage 1: Splash Filling |
| 2501060053 | Storage and Transport | Petroleum and Petroleum Product Storage | Gasoline Service Stations | Stage 1: Balanced Submerged Filling |
| 2501060201 | Storage and Transport | Petroleum and Petroleum Product Storage | Gasoline Service Stations | Underground Tank: Breathing and Emptying |
| 2501060100 | Storage and Transport | Petroleum and Petroleum Product Storage | Gasoline Service Stations | Stage 2: Total Refueling |
| 2501070100 | Storage and Transport | Petroleum and Petroleum Product Storage | Diesel Service Stations | Stage 2: Total Refueling |
| 2505030120 | Storage and Transport | Petroleum and Petroleum Product Storage | Truck | Gasoline |
| 2505040120 | Storage and Transport | Petroleum and Petroleum Product Storage | Pipeline | Gasoline |

For 2011 NEI, WDNR adopted the EPA estimated data for emissions from the petroleum and petroleum product storage categories, except for SCC 2501060100 which was estimated by WDNR staff. For the completeness of this document, the emission estimation approaches to determine VOC content in each category is discussed below. The information discussed for these categories are directly from EIIP's Gasoline Marketing document and EPA's Gasoline Distribution Stage I Documentation, unless indicated otherwise below.[39,40]

**Pollutants**: VOC

These emissions occur as gasoline vapors are released into the atmosphere. Stage I emissions are produced by displacement of gasoline vapors from the storage tanks during the transfer of gasoline from tank trucks to storage tanks at the service station and released into the atmosphere. These Stage I processes are subject to EPA's maximum available control technology (MACT) standards for gasoline distribution. Emissions from gasoline distribution at bulk terminals and bulk plants take place when gasoline is loaded into a storage tank or tank truck, from working losses (for fixed roof tanks), and from working losses and roof seals (for floating roof tanks). Working losses consist of both breathing and emptying losses. The procedures and equations discussed for the categories of bulk gasoline terminals listed above are based on EIIP.[40]

Total gasoline distribution is used as the activity. The Federal Highway Administration (FHWA) annually publishes Highway Statistics, which contains gasoline consumption data for each state. County-wide estimates can be made by apportioning these statewide totals by the percentage of state gasoline station sales occurring within each county. County-wide service station gasoline sales data are available from the Bureau of the Census's Census of Retail Trade.

Emissions from tank trucks in transit occur when gasoline vapor evaporates from (1) loaded tank trucks during transportation of gasoline from bulk terminals/plants to service stations, and (2) empty tank trucks returning from service stations to bulk terminals/plants. Pipeline emissions result from the valves and pumps found at pipeline pumping stations and from the valves, pumps, and storage tanks at pipeline breakout stations. Stage I gasoline distribution emissions also occur when gasoline vapors are displaced from storage tanks during unloading of gasoline from tank trucks at service stations (Gasoline Service Station Unloading) and from gasoline vapors evaporating from service station storage tanks and from the lines going to the pumps (Underground Storage Tank Breathing and Emptying).[41]

There are no generally accepted activity-based VOC emission factors for the pipelines and bulk terminals sectors because they are generally treated as point sources whose emissions are estimated using site-specific information. For both categories, EPA allocated national VOC emissions in a two-step manner. First, EPA allocated emissions based on 2008 gasoline supply data reported by the U.S. DOE. Next, EPA allocated emissions based on employment data reported in the 2007 County Business Patterns.[41]

The basic equation for emission estimation is:

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[39] EIIP, Chapter 11, Gasoline Marketing (Stage I & Stage II): http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii11_apr2001.pdf

[40] Gasoline_Distribution_Statge I_Documentation_2011: ftp://ftp.epa.gov/EmisInventory/2011nei/doc/

$$Emissions = Emission\ Factor\ \times Activity\ Level$$

Detailed equations for category-wise emission estimations are listed below.

### 2.2.4.3.a Gasoline Distribution Stage I, Bulk plant

Emissions from gasoline distribution at bulk plants take place when gasoline is loaded into a storage tank or tank truck, from working losses (for fixed roof tanks), and from working losses and roof seals (for floating roof tanks). Working losses consist of both breathing and emptying losses.

$$E_{voc} = C_g \times P \times EF_{voc}$$

where:
$E_{voc}$ = national VOC emissions
$C_g$ = national gasoline consumption
$P$ = proportion passing through bulk plants
$EF_{voc}$ = VOC emission factor

### 2.2.4.3.b Gasoline Distribution Stage I, Submerged Filling and Balanced Submerged Filling

This category estimates the VOC emissions from displacement of gasoline vapors from the storage tanks during the transfer of gasoline from tank trucks to storage tanks at the service station.

$$E_i = \frac{\left(G_i \times F_{i,method} \times EF_{method}\right) + \left(G_i \times F_{i,method} \times EF_{method}\right)}{2000}$$

where:
$E_i$ = emissions of VOC in tons per day from tank truck unloading per county *i*
$G_i$ = gallons of gasoline sold in county *i* during 2011
$F_{i,method}$ = fraction of gasoline dispensed per county *i* per filling method (balanced submerged or submerged) during 2011
$EF_{method}$ = emission factor per filling method for tank truck unloading

### 2.2.4.3.c Gasoline Distribution Stage I, Pipeline (SCC: 2505040120) and Bulk Terminal

Pipeline emissions result from the valves and pumps found at pipeline pumping stations and from the valves, pumps, and storage tanks at pipeline breakout stations. Emissions from gasoline distribution at bulk terminals takes place when gasoline is loaded into a storage tank or tank truck, from working losses (for fixed roof tanks), and from working losses and roof seals (for floating roof tanks). Working losses consist of both breathing and emptying losses. There are no generally accepted activity based VOC emission factors for the pipelines and bulk terminals sectors because they are generally treated as point sources whose emissions are estimated using site-specific information. For pipelines, EPA allocated emissions to Petroleum Administration for Defense (PAD) districts based on the total amount of finished motor gasoline moved by pipeline in each PAD district in the inventory year. EPA allocated pipeline emissions in each PAD district to counties based on County Business Patterns employment data. Because employment data for NAICS code 48691 (Pipeline Transportation of Refined Petroleum Products) are often withheld due to confidentiality reasons, EPA used the number of employees in NAICS code 42471 (Petroleum Bulk Stations and Terminals) for this allocation.[41]

### 2.2.4.3.d Gasoline Distribution Stage I, Tank Trucks in Transit

Emissions from gasoline tank trucks in transit include the evaporation of petroleum vapor from loaded tank trucks during transportation of gasoline from bulk plants/terminals to the service stations or other dispensing outlets and from empty tank trucks. These losses are caused by leaking delivery trucks, pressure in the tank, and thermal effects on the vapor and on the liquid.

$$E_{TT} = \frac{(Fuel_i \times A \times EF_{TT})}{2000}$$

$E_{TT}$ = emissions of VOC in tons per day from tank trucks in transit
$Fuel_i$ = thousand gallons of fuel sold in county *i*
$A$ = throughput adjustment factor
$EF_{TT}$ = emission factor for tank trucks in transit

### 2.2.4.3.e Gasoline Service Station, Underground Tank Breathing and Empting

Underground tank breathing occurs when gasoline is drawn out of the tanks and into the pump lines. During this process air moves into the tank evaporating gasoline and emitting vapors.

Emission factor is the amount of VOC per thousand gallons of fuel throughput.

Point source adjustments: No subtraction of point sources from total emissions is necessary for this category.

Emission calculation:

$$E_{utb} = \frac{(E_i \times EF_{utb})}{2000}$$

where:
$E_{utb}$ = emissions of VOC in tons per day from underground tank breathing and empting
$F_i$ = thousand gallons of fuel sold in county *i*
$EF_{utb}$ = emission factor for underground tank breathing and empting

### 2.2.4.3.f Gasoline Service Stations, Stage II: Total Refueling

Stage II displacement of gasoline vapors from vehicle gasoline tanks during vehicle refueling is discussed in this category. Refueling emissions have two mechanisms of introducing emissions to the environment: (1) vapor displacement from the vehicle fuel tank during refilling; and (2) gasoline spillage during refueling. For this category, a point source adjustment is not necessary.

Stage II refueling emissions for 2011 were estimated by WDNR staff using the EPA's MOVES2014a model with the same activity inputs used for the onroad modeling. (The geographical coverage of the MOVES2014a modeling was limited to the eastern nonattainment portion of Kenosha County.) During 2011, a Stage II vapor recovery program (vapor recovery nozzles at gas pumps) was in effect in nine eastern Wisconsin counties, including Kenosha County. To model the effects of this program, MOVES2014a provides the following two inputs: (1) vapor displacement reductions and (2) spillage reductions.

WDNR used a vapor displacement reduction of 56%. This value is specified in EPA guidance for programs with minimal inspection frequency (less than annual).[41]

WDNR used a spillage reduction percentage of 50%. This percentage is the standard percentage used in the MOVES2014a model for all areas in the United States having a Stage II vapor recovery program.

### 2.2.5 Waste Disposal

#### 2.2.5.1 Publicly Owned Treatment Works (POTW)

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2630020000 | Waste Disposal, Treatment, and Recovery | Wastewater Treatment | Public Owned | Total Processed |

For 2011 NEI, WDNR adopted the EPA estimated data for emissions from the publicly owned treatment works category. POTWs includes intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment used to treat wastewater generated by multiple sources from industrial, commercial, and domestic sectors.

**Pollutants**: VOC

Flow rate, measured in million gallons per day, is considered as the activity. The emission factor for VOC, in pounds of VOC per million gallons of waste water discharged, was provided by ERTAC.

**Adjustment for point sources**

[41] "Procedures for Emission Inventory Preparation; Volume IV: Mobile Sources", Section 3.3.6.1, U.S. EPA, EPA-420-R-92-009, December 1992. (The reduction percentages in this document and section are specified for use in the EPA's current technical guidance for the MOVES model: "MOVES2014 and MOVES2014a Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity", EPA-420-B-15-093, November 2015.)

It is important to note that the emission estimates for this category represent total emissions. It is necessary to determine whether there are point source emissions in SCCs 50100701 through 50100781 and 50100791 through 50182599 that need to be subtracted to yield the nonpoint source emission estimates for this category.

Emission Calculations:

Annual VOC emissions were calculated using the following equation:

$$E_{POTW} = \frac{F_{i,j} \times EF_{POTW} \times 365}{2000}$$

where:
$E_{POTW}$ = VOC emissions in tons per year
$F_{i,j}$ = Daily flow into POTW $j$ in county $i$
$EF_{POTW}$ = VOC emission factor for POTW

State-wide emissions were allocated to county-level using county proportion of population data.[42]

### 2.2.6 Miscellaneous Non-Industrial not elsewhere classified (NEC)

#### 2.2.6.1 Other Combustion: Cremation

| SCC | SCC Level 1 | SCC Level 2 | SCC Level 3 | SCC Level 4 |
|---|---|---|---|---|
| 2810060100 | Miscellaneous Area Sources | Other Combustion | Cremation | Humans |

The WDNR adopted EPA's estimates for this category. The EPA estimates may be adjusted by updating the number of bodies cremated in year 2008 in provided spread sheets. The Cremation Association of North America's estimate of the percentage of bodies cremated in the United States in 2008 and the average body weight of bodies cremated during an emission test evaluation of a crematory at Woodlawn Cemetery in Bronx, New York is available for online access.[43, 44] Emission factors are available in WebFIRE. The estimated number of deaths in each state in the United States for a specific year could be obtained from the National Center for Health Statistic's Report.

**Emission Calculation**

$$E_C = \frac{N_C \times W_{Avg} \times EF_C}{2000}$$

where:

[42] U.S. Census Bureau, "Population Estimates," at http://www.census.gov/popest/estimates.html.
[43] Cremation Association of North America, *2007 Statistics and Projections to the Year 2025: 2008 Preliminary Data*, August 2009, available at http://www.cremationassociation.org/
[44] U.S. Environmental Protection Agency, Emission Test Evaluation of a Crematory at Woodlawn Cemetery in the Bronx, NY, Final Test Report, Vol. 1. Office of Air Quality Planning and Standard Emission Measurement Center, Research Triangle Park, NC, September 1999.

$E_C$ = emissions from crematories
$N_C$ = number of bodies cremated in a specific year in a county
$W_{Avg}$ = average body weight in pounds
$EF_C$ = emission factor per pollutant for cremation

## 2.3 Onroad Mobile Sources

Onroad mobile sources are motorized mobile equipment that are primarily used on public roadways. Examples of onroad mobile sources include cars, trucks, buses and road motorcycles. The emissions reported in this document were estimated by the Motor Vehicle Emission Simulator (MOVES), the EPA's recommended mobile source model. The version used was MOVES2014a. All estimates were made in accordance with the following EPA technical guidance:

- MOVES2014a User's Guide (U.S. EPA, Office of Transportation and Air Quality, Assessment and Standards Division, November 2015, EPA 420-B-15-095).
- MOVES2014 and MOVES2014a Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity (U.S. EPA, Office of Transportation and Air Quality, Assessment and Standards Division, November 2015, EPA-420-B-15-093).

The onroad mobile NOx and VOC emissions for the eastern Kenosha County nonattainment area for 2011 (as well as the 2017 and 2018 projections) are presented in Appendix 5, broken down by source type (vehicle class), fuel type and road type. Tables summarizing vehicle activity data are presented in Appendix 5 after the emissions tables.

### 2.3.1 Transportation Data

The modeling inputs to MOVES include detailed transportation data (e.g., vehicle-miles of travel by vehicle class, road class and hour of day, and average speed distributions), requiring support from the Metropolitan Planning Organization (MPO) covering the nonattainment area.

The gubernatorially designated MPO for the Kenosha urbanized area is the Southeastern Wisconsin Regional Planning Commission (SEWRPC). Under state law SEWRPC is responsible for preparing travel and traffic estimates and forecasts within their seven-county region, which includes Kenosha County. SEWRPC maintains transportation network inventory data, including traffic counts by the Wisconsin Department of Transportation (WDOT) and local agencies. SEWRPC has developed and validated travel simulation models to estimate and forecast vehicle-miles of travel (VMT) and average speed distributions for their region. SEWRPC provided WDNR MOVES input files for the eastern Kenosha County nonattainment area for 2011 (as well as 2017, 2020 and 2030 projections) for the following:

- Annual VMT by vehicle class
- Average speed distributions
- VMT distributions by road type and vehicle class
- Hourly VMT distributions
- Fraction of restricted access travel on ramps

SEWRPC provided WDNR 2011 data in November 2016 (updated from previous data provided July 2014) and the data for the projection years during February 2016.

### 2.3.2 Descriptions of MOVES Modeling Inputs

#### 2.3.2.1 Vehicle-Miles of Travel (VMT)

SEWRPC provided WDNR VMT data for 2011, broken down by five Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS) vehicle classes for all travel in Kenosha County on Interstate Highway 94 and to the east. The data were obtained from their transportation network inventory data and travel demand model.

As recommended in the EPA technical guidance, the onroad inventories are based on *summer weekday* VMT, where "weekday" includes all five weekdays, Monday to Friday. WDNR defined "summer" as the three months of June, July and August. Since SEWRPC's travel demand model outputs traffic volumes for an *average weekday* (all 12 months, where "weekday" consists of only the four days, Monday to Thursday), SEWRPC adjusted their model output, based on temporal adjustment factors previously agreed upon by WDNR and SEWRPC. The net result of these adjustments is that the summer weekday (Monday-Friday) VMT is greater than the average weekday (Monday-Thursday) VMT by 6.487%.

To obtain the 6.487% VMT increase through the MOVES modeling, SEWRPC and WDNR cooperatively used temporal adjustment factors as follows: First, SEWRPC provided WDNR annual VMT data for input into MOVES by multiplying their average weekday VMT from their travel demand model by 335.84. WDNR then ran MOVES2014a for a July weekday using temporal adjustment factors of 0.092096 for July and 0.762365 for weekday to arrive at a summer (July) weekday VMT which equaled the SEWRPC-provided annual VMT divided by 315.38. The net results of these adjustments is increasing SEWRPC's average weekday VMT by a factor of 335.84/315.38 = 1.06487, the adjustment factor agreed to by WDNR and SEWRPC.

#### 2.3.2.2 VMT by Hour of Day and Weekday vs. Weekend

SEWRPC provided hourly VMT fractions based on output from their travel demand model.

#### 2.3.2.3 Vehicle Population

WDNR estimated vehicle populations for each vehicle class by dividing annual VMT by the MOVES defaults for average annual mileage accumulation.

#### 2.3.2.4 Average Speed Distribution

SEWRPC provided speed distributions, in MOVES input format, for the eastern Kenosha County nonattainment area, developed from their transportation inventory data and travel simulation models.

#### 2.3.2.5 Vehicle Age Distribution

Local vehicle age distributions were developed for five source types: passenger cars, passenger trucks, light commercial trucks, intercity buses and school buses. The EPA default distributions were used for the other eight source types: motorcycles, transit buses and six medium to heavy truck classes. WDNR calculated the local distributions from a file of select fields from the state's registration database as of March 2014, provided by the WDOT. WDNR calculated a 2014 distribution for a seven county region including Kenosha County. WDNR adjusted the 2014 distributions back to 2011based on differences between the EPA default age distributions for those two years.

#### 2.3.2.6 Road Type Distribution

SEWRPC provided road type distributions for the eastern Kenosha County nonattainment area developed from their transportation inventory data.

#### 2.3.2.7 Ramp Fraction

SEWRPC provided WDNR the fraction of driving time on ramps for restricted access roadways developed from their transportation inventory data.

#### 2.3.2.8 Fuel Formulation and Supply

The MOVES defaults currently provide the best available fuel data and therefore were used.

#### 2.3.2.9 Vehicle Inspection and Maintenance Program

Kenosha County is within the seven-county southeastern Wisconsin vehicle inspection program region. On-Board Diagnostic (OBD) checks were assumed for most model year 1996 and newer passenger cars, passenger trucks and light commercial trucks.

#### 2.3.2.10 Meteorology Data

Temperatures conducive to peak ozone formation were assumed for the summer weekday modeling. The WDNR has consistently used the same minimum and maximum temperatures for onroad modeling for ozone state implementation plans (SIP's) since the early 1990's. The temperatures were developed from an analysis of peak ozone days and have minimum/maximum values of 70/94 degrees Fahrenheit for Kenosha County.

## 2.4 Nonroad Mobile Sources

Nonroad mobile sources are motorized mobile equipment and other small and large engines that are primarily used off public roadways. Examples of nonroad mobile sources include commercial marine, construction, lawn and garden, locomotive and agricultural equipment.

For purposes of inventory calculation, nonroad mobile sources are divided into two major groups:

- Commercial Marine, Aircraft and Rail Locomotive (MAR)
- All other nonroad categories

Nonroad categories other than MAR include:

- Recreational vehicles
- Construction equipment
- Industrial equipment
- Lawn and garden equipment
- Agricultural equipment
- Commercial equipment
- Logging equipment
- Underground mining equipment
- Oil field equipment
- Pleasure craft
- Railway maintenance equipment

A detailed listing of the nonroad emissions for each of the over 200 nonroad source subcategories, which include both the MAR and non-MAR subcategories, is presented in Appendix 6.

### 2.4.1 Non-MAR Sources

The 2011 nonroad emissions for the non-MAR categories were developed using the EPA's MOVES2014a model, using hot summer day temperatures. The model was run for Kenosha County for the months of June, July and August. Hot summer day emissions were calculated by dividing the total emissions over these three months by 92 (the number of days in the three months). Emissions were then allocated to the eastern Kenosha County nonattainment area based on surrogates such as population, land area and water area, depending on the category, as described below in section 2.4.3

### 2.4.2 MAR Sources

Annual emissions for the MAR categories were obtained from the EPA's 2011 Emissions Modeling Platform, Version 6.3. This modeling platform provides county-wide annual emission estimates for the year 2011 and projections for the year 2017. County-wide emissions were allocated to the eastern Kenosha County nonattainment area based on airport location for aircraft and rail link location for rail locomotives, provided in Version 6.2 of EPA's Modeling Platform.

(Such location-specific information was not available in Version 6.3.) All commercial marine emissions were allocated to the nonattainment area, since all those emissions originate from Lake Michigan. More detail on the allocations to the nonattainment area are described below in section 2.4.3. Summer day emissions were estimated by applying annual to summer day ratios for each of the three MAR categories provided in the LADCO modeling inventory for the year 2007. These ratios (annual/summer day) are:

- Commercial Marine: 268.16 for NOx; 263.90 for VOC
- Aircraft: 361.11 for NOx; 357.35 for VOC
- Rail Locomotive: 362.00 for both NOx and VOC

### 2.4.3 Allocation of Emissions to Nonattainment Area

Given the vast variety of nonroad mobile sources, several surrogates were employed to estimate the proportion of county-wide emissions in the nonattainment area. The surrogates used are as follows:

#### 2.4.3.1 Land Area

The land area in the nonattainment area comprises 30.9% of the total county land area. But if one excludes the City of Kenosha, where no significant agricultural activity occurs, this percentage becomes 24.2%.

The nonroad categories allocated to the nonattainment area based on land area are: Agriculture, Logging, Oilfields, Recreational, and Underground Mining. The 24.2% factor was used for agriculture and the 30.9% factor was used for the other four categories.

#### 2.4.3.2 Population

Based on 2010 census and 2015 and 2020 population projections provided by the Wisconsin Department of Administration, 77.2% of the county's population was in the nonattainment area during 2011 and 77.3% will be in the nonattainment area during 2017 and 2018.

The nonroad categories allocated to the nonattainment area based on population are: Commercial, Construction, Industrial, and Lawn & Garden.

#### 2.4.3.3 Water Area

Data were obtained from the database for the EPA's National Mobile Inventory Model (NMIM), version dated May 4, 2009, the EPA's nonroad emissions estimation model prior to MOVES. Based on the external files (WI_WIB.ALO and WI_WOB.ALO) in that database, there are 81 square kilometers of water area in Kenosha County, with 56 square kilometers in the nonattainment area (all part of Lake Michigan) and 25 square kilometers outside the nonattainment area (several inland lakes). Thus, 56/81 = 69.1% of the county's surface water is in the nonattainment area. The nonroad category allocated to the nonattainment area based on water area is: Pleasure Craft.

#### 2.4.3.4 Lake Michigan Shoreline

All (100.0%) of the Lake Michigan shoreline is in the nonattainment area. The nonroad category allocated to the nonattainment area based on Lake Michigan shoreline is Commercial Marine, since all commercial marine emissions attributable to Kenosha County come from vessels traveling on Lake Michigan past the county. Kenosha County does not have any ports, inland lakes or inland rivers with commercial marine activity.

#### 2.4.3.5 Airport Location

The EPA's 2011 Modeling Platform, version 6.2, provides the emissions and geographical location (longitude and latitude) for each airport in the United States for each of the years for that version (2011, 2017 and 2025)

The percentages of Kenosha County aircraft emissions located in the nonattainment area vary by aircraft type and are as follows:

- Military aircraft: 100.0% for all three years (2011, 2017 and 2018) for both NOx and VOC
- General aviation: 60.9% (2011, NOx), 60.8% (2011, VOC), 61.8% (2017, both NOx and VOC) and 62.0% (2018, both NOx and VOC)
- Air taxi: 97.5% (2011, both NOx and VOC), 98.7% (2017, both NOx and VOC) and 98.9% (2018, both NOx and VOC)

#### 2.4.3.6 Railroad Link Location

The EPA's 2011 Modeling Platform, version 6.2, provides the emissions and location for each link of railway in the United States for each of the years for that version (2011, 2017 and 2025).

The percentages of Kenosha County railroad emissions located in the nonattainment area are: Diesel locomotives, line haul, class I operations: 60.0% for both NOx and VOC for all years. This 60.0% value was also used to allocate the railroad maintenance emissions in Kenosha County to the nonattainment area.

# APPENDIX 2

# EGU Inventory Methodology and Emissions for 2011, 2017 and 2018

This appendix provides the methodology for EGU sector NOx and VOC tons per summer day (tpsd) emission estimates in sections 3.2 (2011 Base Year Inventory for RFP) and 3.3 (2017 & 2018 Projected Year Inventories for RFP) of the Wisconsin Department of Natural Resources (WDNR) eastern Kenosha County attainment plan.

### 2.1 EGU 2011 Base Year Emissions

There is only one EGU point source facility in the eastern Kenosha nonattainment area, the Pleasant Prairie coal-fired power plant. The 2011 NOx emissions, emission rates and fuel consumption for Pleasant Prairie generating units were derived from data reported by the utility to EPA's Clean Air Markets Division (CAMD) database. WDNR used the ozone season day with the 99th percentile highest heat input during the ozone season to represent summer day operations during the 2011 ozone season. Using this 99th percentile value provides a conservative but reasonable representation of maximum summer day operation.

The summer day emissions were then calculated by multiplying the maximum summer day heat input in 2011 by the average emission rate for the 2011 ozone season. The NOx emission rate was derived from the CAMD emissions data for the 2011 ozone season. This base data and the tons per summer day emissions calculated from this data are provided in Table 2.1.1. In 2011, the NOx emissions are 11.05 tpsd.

The VOC summer day emissions are also derived by multiplying the maximum day heat input by an average VOC emission rate. The base data used in the calculation and the resulting emissions are provided in Table 2.1.1. In this case, however, VOC emissions are not monitored by continuous emissions monitors and reported to the CAMD database as is done for NOx. Therefore, the VOC emission rate was derived by dividing the annual VOC emissions reported to the WDNR Air Emissions Inventory (AEI) by the annual heat input reported to the CAMD database for 2011. The data applied in deriving the VOC emission rate are shown in Table 2.1.2. Multiplying these VOC emission rates for each year by the maximum heat input resulted in 0.54 tpsd of VOC in 2011.

Note: emissions from non-electric generating emission units at the plant (i.e., units other than the two coal boilers) are not included because they are insignificant (less than 0.5% of the total plant emissions on a tons per year basis) compared to the coal boiler emissions.

**Table 2.1.1. EGU Summer Day Operation and Emissions.**

| Variable | 2011 |
|---|---|
| Summer Day Heat Input (mmBtu) [1] | 329,924 |
| NOx Rate (lbs/mmBtu) [2] | 0.067 |
| NOx (tpsd) | 11.05 |
| VOC Rate (lbs/mmBtu) [3] | 0.0033 |
| VOC (tpsd) | 0.54 |

[1] Heat input is for the day with the 99th percentile highest heat input during the 2011 ozone season.
[2] Emission rate derived from EPA CAMD ozone season NOx emissions and heat input.
[3] Calculated in Table 2.1.2.

**Table 2.1.2. VOC Annual Emissions and Emission Rate.**

| Variable | 2011 |
|---|---|
| Annual VOC (tons) [1] | 123.4 |
| Annual Heat Input (mmBtu) [2] | 75,084,093 |
| VOC Rate (lbs/mmBtu) [3] | 0.0033 |

[1] Emissions reported to the WDNR Air Emissions Inventory.
[2] Heat input reported to the CAMD database.
[3] Calculated by the equation (annual VOC tons x 2000 lbs/ton) / annual Heat Input (mmBtu).

## 2.2 EGU 2017 and 2018 Projected Emissions.

The Pleasant Prairie power plant is anticipated to continue operation at close to its current levels through the initial maintenance period based on all available modeling studies including EPA's Integrated Planning Model analysis. Following the same methodology as used in calculating 2011 emissions, WDNR projected summer day emissions for the Pleasant Prairie power plant by multiplying a projected maximum daily heat input by a projected average ozone season emission rate. The data used in this calculation and resulting emissions are summarized in Table 2.2.1.

To determine the appropriate projected maximum heat input, the WDNR first evaluated historical maximum day ozone season values for 2010 through 2015 as listed in Table 2.2.2. As for the 2011 inventory year, each maximum daily value is for the day of the $99^{th}$ percentile of all daily values. Based on this approach, the maximum summer day heat input during this time period was 330,759 mmBtu which occurred in 2014. Because this measured value for 2014 exceeds the nominal capacity value of 309,552 mmBtu reported for the plant, the WDNR assumes the power plant would not operate at levels exceeding 2014 operation in the future. Thus 330,759 mmBtu is used to represent the maximum daily heat input for 2017 and 2018.

The WDNR evaluated historical data in determining an appropriate NOx emission rate for calculating projected emissions. Since 2006, the Pleasant Prairie power plant has been subject to a consent decree requiring the operation of a selective catalytic reduction (SCR) system for controlling NOx emissions (refer to section 6 of the eastern Kenosha County ozone redesignation request for additional details). The average ozone season NOx emission rates since 2010 and reflecting operation of the SCR are shown in Table 2.2.2. During this time, the plant NOx emission rates exceeded 0.065 lbs/mmBtu in only one year. In addition, the heat input weighted average for these ozone seasons is 0.064 lbs/mmBtu. Based on this information, the value of 0.065 lbs/mmBtu is a reasonable, conservative representation of the future expected emission rate. This rate is applied in calculating projected summer day emissions for 2017 and 2018.

Based on this information, NOx emissions projected for 2017 and 2018 are calculated to be 10.75 tpsd. It should be noted that the value of 10.75 tpsd is not intended to constitute a daily enforceable emission limitation on the power plant. This value represents the best reasonable approximation of the SCR system, a compliance margin, and projected maximum actual summer day emissions that could be expected going into the future. The NOx emission rate limitation for Pleasant Prairie is 0.08 lbs/mmBtu. Multiplying this emission limit by the nominal heat input capacity allows for emissions as high as 12.4 tons on any given day.

VOC emissions are calculated by assuming the VOC emission factor of 0.0034 lbs/mmBtu demonstrated during the 2014 ozone season will continue through 2018. There is no action anticipated that would significantly reduce this value. Multiplying the maximum day heat input value and this emission rate yields 0.56 tpsd of VOC. The base information used in this calculation and the resulting VOC emissions are shown in Table 2.2.1

**Table 2.2.1. EGU 2017 and 2018 Emissions (tpsd).**

| Variable | Projected Values |
|---|---|
| Summer Day Heat Input (mmBtu) [1] | 330,759 |
| NOx Rate (lbs/mmBtu) [2] | 0.065 |
| NOx (tpsd) | 10.75 |
| VOC Rate (lbs/mmBtu) [3] | 0.0034 |
| VOC (tpsd) | 0.56 |

[1] Heat input is for the day with the 99th percentile highest heat input during each ozone season.
[2] Ozone season NOx emission rates derived from EPA CAMD ozone season NOx emissions and heat input.
[3] The VOC projected emission rate is assumed to be the same as the 2014 derived emission rate. The 2014 rate was derived in the same manner as the 2011 rate in Table 2.1.2, using annual VOC tons of 125.7 and an annual heat input of 74,423,973 mmBtu .

**Table 2.2.2. EGU Ozone Season Maximum Daily Heat Input and NOx Emissions.**

| Year | Ozone Season Average NOx Emission Rate (lbs/mmBtu) [1] | Ozone Season Maximum Daily Heat Input (mmBtu) [2] | Calculated NOx Emissions (tpsd) [3] |
|---|---|---|---|
| 2010 | 0.063 | 316,271 | 9.96 |
| 2011 | 0.067 | 329,924 | 11.05 |
| 2012 | 0.064 | 329,328 | 10.54 |
| 2013 | 0.064 | 319,606 | 10.23 |
| 2014 | 0.065 | 330,759 | 10.75 |
| 2015 | 0.064 | 292,008 | 9.34 |

[1] Derived from ozone season heat input and NOx emissions reported to the CAMD database for each year.
[2] The heat input for the ozone season day with the 99th percentile highest daily heat input.
[3] Calculated by multiplying the ozone season average emission rate by the ozone season maximum daily heat input.

# APPENDIX 3

# Point Non-EGU Emissions for 2011, 2017 and 2018

This appendix provides a list of eastern Kenosha County point source non-EGU tons per summer day (tpsd) emissions by facility identification number (FID) and facility name for 2011, 2017 and 2018. The sum of NOx and VOC emissions from these facilities were used for the non-EGU sector NOx and VOC tpsd emission estimates in sections 3.2 (2011 Base Year Inventory for RFP) and 3.3 (2017 & 2018 Projected Year Inventories for RFP) of the Wisconsin Department of Natural Resources (WDNR) eastern Kenosha County attainment plan.

**Table 3.1. 2011 Point Non-EGU Emissions for Eastern Kenosha County [1]**

| FID | FACILITY NAME | COUNTY | POLLUTANT | 2011 (tpsd) | 2011 (tons) |
|---|---|---|---|---|---|
| 230008350 | KENOSHA STEEL CASTINGS | KENOSHA | NOx | 5.84E-03 | 2.13 |
| 230009450 | OCEAN SPRAY CRANBERRIES INC | KENOSHA | NOx | 2.42E-02 | 8.83 |
| 230012530 | LAMINATED PRODUCTS INC | KENOSHA | NOx | 1.18E-03 | 0.43 |
| 230035410 | MONDI AKROSIL LLC | KENOSHA | NOx | 1.73E-03 | 0.63 |
| 230058180 | WI DOA / UW-PARKSIDE POWER PLANT | KENOSHA | NOx | 1.61E-02 | 5.87 |
| 230059280 | ST CATHERINES MEDICAL CENTER CAMPUS/UHSI | KENOSHA | NOx | 1.17E-02 | 4.26 |
| 230072040 | RUST - OLEUM CORP | KENOSHA | NOx | 4.11E-03 | 1.5 |
| 230094590 | KENOSHA MEDICAL CENTER CAMPUS | KENOSHA | NOx | 1.04E-02 | 3.81 |
| 230099100 | CARTHAGE COLLEGE | KENOSHA | NOx | 1.23E-02 | 4.49 |
| 230105590 | SHILOH - PLEASANT PRAIRIE | KENOSHA | NOx | 0.00E+00 | 0.00 |
| 230117580 | HONEYWELL AUTOMATION AND CONTROL SOLUTIONS | KENOSHA | NOx | 0.00E+00 | 0.00 |
| 230134960 | LMI PACKAGING SOLUTIONS | KENOSHA | NOx | 0.00E+00 | 0.00 |
| 230141780 | ARDENT MILLS LLC | KENOSHA | NOx | 2.74E-05 | 0.01 |
| 230167520 | IEA INC - KENOSHA | KENOSHA | NOx | 7.95E-04 | 0.29 |
| 230198760 | KKSP PRECISION MACHINING LLC | KENOSHA | NOx | 1.92E-04 | 0.07 |
| 230008350 | KENOSHA STEEL CASTINGS | KENOSHA | VOC | 4.29E-02 | 15.66 |
| 230009450 | OCEAN SPRAY CRANBERRIES INC | KENOSHA | VOC | 3.62E-03 | 1.32 |
| 230012530 | LAMINATED PRODUCTS INC | KENOSHA | VOC | 9.01E-03 | 3.29 |
| 230035410 | MONDI AKROSIL LLC | KENOSHA | VOC | 1.89E-03 | 0.69 |
| 230058180 | WI DOA / UW-PARKSIDE POWER PLANT | KENOSHA | VOC | 8.77E-04 | 0.32 |
| 230059280 | ST CATHERINES MEDICAL CENTER CAMPUS/UHSI | KENOSHA | VOC | 6.03E-04 | 0.22 |
| 230072040 | RUST - OLEUM CORP | KENOSHA | VOC | 4.00E-02 | 14.6 |
| 230094590 | KENOSHA MEDICAL CENTER CAMPUS | KENOSHA | VOC | 6.30E-04 | 0.23 |
| 230099100 | CARTHAGE COLLEGE | KENOSHA | VOC | 6.85E-04 | 0.25 |
| 230105590 | SHILOH - PLEASANT PRAIRIE | KENOSHA | VOC | 0.00E+00 | 0.00 |
| 230117580 | HONEYWELL AUTOMATION AND CONTROL SOLUTIONS | KENOSHA | VOC | 3.29E-03 | 1.2 |
| 230134960 | LMI PACKAGING SOLUTIONS | KENOSHA | VOC | 1.79E-02 | 6.52 |

| FID | FACILITY NAME | COUNTY | POLLUTANT | 2011 (tpsd) | 2011 (tons) |
|---|---|---|---|---|---|
| 230141780 | ARDENT MILLS LLC | KENOSHA | VOC | 0.00E+00 | 0.00 |
| 230167520 | IEA INC - KENOSHA | KENOSHA | VOC | 1.08E-02 | 3.94 |
| 230198760 | KKSP PRECISION MACHINING LLC | KENOSHA | VOC | 4.50E-02 | 16.41 |
| | | | | | |
| **TOTAL** | | **KENOSHA** | **NOx** | **0.09** | **32.32** |
| | | | **VOC** | **0.18** | **64.65** |

[1] Tons per summer day (tpsd) emissions were calculated by dividing annual emissions by 365 days.

**Table 3.2. 2017 & 2018 Point Non-EGU Emissions for Eastern Kenosha County**

| FID | FACILITY NAME | NAICS | POLLUTANT | 2011 (tpsd) | 2017 GF [1] | 2018 GF [1] | 2017 (tpsd) | 2018 (tpsd) |
|---|---|---|---|---|---|---|---|---|
| *Existing Sources* | | | | | | | | |
| 230008350 | KENOSHA STEEL CASTINGS | 331513 | NOx | 5.84E-03 | 0.802 | 0.793 | 4.68E-03 | 4.63E-03 |
| 230009450 | OCEAN SPRAY CRANBERRIES INC | 311421 | NOx | 2.42E-02 | 1.111 | 1.122 | 2.69E-02 | 2.71E-02 |
| 230012530 | LAMINATED PRODUCTS INC | N/A | NOx | 1.18E-03 | Shut down | Shut down | Shut down | Shut down |
| 230035410 | MONDI AKROSIL LLC | 322222 | NOx | 1.73E-03 | 0.861 | 0.850 | 1.49E-03 | 1.47E-03 |
| 230058180 | WI DOA / UW-PARKSIDE POWER PLANT | 611310 | NOx | 1.61E-02 | 1.085 | 1.075 | 1.74E-02 | 1.73E-02 |
| 230059280 | ST CATHERINES MEDICAL CENTER CAMPUS/UHSI | 6221 | NOx | 1.17E-02 | 1.084 | 1.072 | 1.26E-02 | 1.25E-02 |
| 230072040 | RUST - OLEUM CORP | 325510 | NOx | 4.11E-03 | 1.047 | 1.086 | 4.30E-03 | 4.46E-03 |
| 230094590 | KENOSHA MEDICAL CENTER CAMPUS | 622110 | NOx | 1.04E-02 | 1.084 | 1.072 | 1.13E-02 | 1.12E-02 |
| 230099100 | CARTHAGE COLLEGE | 611310 | NOx | 1.23E-02 | 1.084 | 1.072 | 1.33E-02 | 1.32E-02 |
| 230105590 | SHILOH - PLEASANT PRAIRIE [2] | 331523 | NOx | 2.39E-02 | 1.105 | 1.107 | 2.64E-02 | 2.65E-02 |
| 230117580 | HONEYWELL AUTOMATION AND CONTROL SOLUTIONS | 335921 | NOx | 0.00E+00 | 1.429 | 1.474 | 0.00E+00 | 0.00E+00 |
| 230134960 | LMI PACKAGING SOLUTIONS | 323111 | NOx | 0.00E+00 | 0.861 | 0.850 | 0.00E+00 | 0.00E+00 |
| 230141780 | ARDENT MILLS LLC | 31121 | NOx | 2.74E-05 | 1.111 | 1.122 | 3.04E-05 | 3.07E-05 |
| 230167520 | IEA INC - KENOSHA | 332322 | NOx | 7.95E-04 | 1.032 | 1.014 | 8.20E-04 | 8.06E-04 |
| 230198760 | KKSP PRECISION MACHINING LLC | 332722 | NOx | 1.92E-04 | 1.032 | 1.014 | 1.98E-04 | 1.94E-04 |
| 230008350 | KENOSHA STEEL CASTINGS | 331513 | VOC | 4.29E-02 | 0.802 | 0.793 | 3.44E-02 | 3.40E-02 |
| 230009450 | OCEAN SPRAY CRANBERRIES INC | 311421 | VOC | 3.62E-03 | 1.111 | 1.122 | 4.02E-03 | 4.06E-03 |
| 230012530 | LAMINATED PRODUCTS INC | N/A | VOC | 9.01E-03 | Shut down | Shut down | Shut down | Shut down |
| 230035410 | MONDI AKROSIL LLC | 322222 | VOC | 1.89E-03 | 0.861 | 0.850 | 1.63E-03 | 1.61E-03 |
| 230058180 | WI DOA / UW-PARKSIDE POWER PLANT | 611310 | VOC | 8.77E-04 | 1.085 | 1.075 | 9.51E-04 | 9.42E-04 |
| 230059280 | ST CATHERINES MEDICAL CENTER CAMPUS/UHSI | 6221 | VOC | 6.03E-04 | 1.084 | 1.072 | 6.53E-04 | 6.46E-04 |

| FID | FACILITY NAME | NAICS | POLLUTANT | 2011 (tpsd) | 2017 GF [1] | 2018 GF [1] | 2017 (tpsd) | 2018 (tpsd) |
|---|---|---|---|---|---|---|---|---|
| 230072040 | RUST - OLEUM CORP | 325510 | VOC | 4.00E-02 | 1.047 | 1.086 | 4.19E-02 | 4.34E-02 |
| 230094590 | KENOSHA MEDICAL CENTER CAMPUS | 622110 | VOC | 6.30E-04 | 1.084 | 1.072 | 6.83E-04 | 6.76E-04 |
| 230099100 | CARTHAGE COLLEGE | 611310 | VOC | 6.85E-04 | 1.084 | 1.072 | 7.42E-04 | 7.35E-04 |
| 230105590 | SHILOH - PLEASANT PRAIRIE [2] | 331523 | VOC | 7.18E-03 | 1.105 | 1.107 | 7.94E-03 | 7.95E-03 |
| 230117580 | HONEYWELL AUTOMATION AND CONTROL SOLUTIONS | 335921 | VOC | 3.29E-03 | 1.429 | 1.474 | 4.70E-03 | 4.85E-03 |
| 230134960 | LMI PACKAGING SOLUTIONS | 323111 | VOC | 1.79E-02 | 0.861 | 0.850 | 1.54E-02 | 1.52E-02 |
| 230141780 | ARDENT MILLS LLC | 31121 | VOC | 0.00E+00 | 1.111 | 1.122 | 0.00E+00 | 0.00E+00 |
| 230167520 | IEA INC - KENOSHA | 332322 | VOC | 1.08E-02 | 1.032 | 1.014 | 1.11E-02 | 1.09E-02 |
| 230198760 | KKSP PRECISION MACHINING LLC | 332722 | VOC | 4.50E-02 | 1.032 | 1.014 | 4.64E-02 | 4.56E-02 |
| | | | | | | | | |
| **Sub-total – Existing Sources** | | | **NOx** | **0.112** | --- | --- | **0.120** | **0.119** |
| | | | **VOC** | **0.184** | --- | --- | **0.171** | **0.171** |
| | | | | | | | | |
| *New & Modified Sources* [3] | | | | | | | | |
| N/A | N/A | N/A | NOx | N/A | N/A | N/A | 0.000 | 0.000 |
| N/A | N/A | N/A | VOC | N/A | N/A | N/A | 0.137 | 0.137 |
| | | | | | | | | |
| **TOTAL (Existing + New/Modified Sources)** | | | **NOx** | **0.11** | --- | --- | **0.12** | **0.12** |
| | | | **VOC** | **0.18** | --- | --- | **0.31** | **0.31** |

[1] GF = Growth factor (see Appendix 7 for how the growth factors were derived).
[2] Projected emissions for FID 230105590 (Shiloh) are based on 2014 tpsd emission estimates, as there were no 2011 emissions reported.
[3] See Appendix 7 for how projected emissions were derived for new and modified sources.

# APPENDIX 4

# Area Source Emissions for 2011, 2017 and 2018

This appendix provides a list of eastern Kenosha County area source tons per summer day (tpsd) emissions by source classification code (SCC) for 2011, 2017 and 2018. The sum of NOx and VOC emissions from the different SCCs were used for the area source sector NOx and VOC tpsd emission estimates in sections 3.2 (2011 Base Year Inventory for RFP) and 3.3 (2017 & 2018 Projected Year Inventories for RFP) of the Wisconsin Department of Natural Resources (WDNR) eastern Kenosha County attainment plan.

**Table 4.1. Area Source 2011 and Projected 2017 and 2018 Emissions for Eastern Kenosha County**

| FIPS | SCC | POLLUTANT | 2011 (tpsd) | 2017 (tpsd) | 2025 (tpsd) | 2018 est (tpsd) |
|---|---|---|---|---|---|---|
| 55059 | 2102002000 | NOx | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2102004001 | NOx | 1.01E-03 | 6.85E-04 | 6.97E-04 | 6.86E-04 |
| 55059 | 2102004002 | NOx | 5.63E-03 | 6.23E-03 | 6.34E-03 | 6.24E-03 |
| 55059 | 2102005000 | NOx | 5.85E-04 | 1.34E-04 | 1.30E-04 | 1.33E-04 |
| 55059 | 2102006000 | NOx | 6.08E-02 | 6.97E-02 | 7.15E-02 | 7.00E-02 |
| 55059 | 2102007000 | NOx | 1.60E-04 | 1.81E-04 | 1.93E-04 | 1.82E-04 |
| 55059 | 2102008000 | NOx | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2102011000 | NOx | 4.82E-05 | 5.33E-05 | 5.44E-05 | 5.35E-05 |
| 55059 | 2103002000 | NOx | 1.28E-02 | 3.57E-03 | 3.57E-03 | 3.57E-03 |
| 55059 | 2103004001 | NOx | 6.81E-03 | 4.00E-03 | 3.99E-03 | 4.00E-03 |
| 55059 | 2103004002 | NOx | 2.31E-01 | 2.21E-01 | 2.21E-01 | 2.21E-01 |
| 55059 | 2103005000 | NOx | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2103006000 | NOx | 1.62E-01 | 1.57E-01 | 1.57E-01 | 1.57E-01 |
| 55059 | 2103007000 | NOx | 1.33E-02 | 1.33E-02 | 1.33E-02 | 1.33E-02 |
| 55059 | 2103008000 | NOx | 1.08E-04 | 1.35E-04 | 1.35E-04 | 1.35E-04 |
| 55059 | 2103011000 | NOx | 2.58E-08 | 2.59E-08 | 2.59E-08 | 2.59E-08 |
| 55059 | 2104004000 | NOx | 9.44E-03 | 9.45E-03 | 9.45E-03 | 9.45E-03 |
| 55059 | 2104006000 | NOx | 4.49E-01 | 4.50E-01 | 4.50E-01 | 4.50E-01 |
| 55059 | 2104007000 | NOx | 1.68E-02 | 1.68E-02 | 1.68E-02 | 1.68E-02 |
| 55059 | 2104008100 | NOx | 1.41E-02 | 1.50E-02 | 1.50E-02 | 1.50E-02 |
| 55059 | 2104008210 | NOx | 9.42E-03 | 8.51E-03 | 8.56E-03 | 8.52E-03 |
| 55059 | 2104008220 | NOx | 3.24E-03 | 3.79E-03 | 3.82E-03 | 3.80E-03 |
| 55059 | 2104008230 | NOx | 9.19E-04 | 1.08E-03 | 1.08E-03 | 1.08E-03 |
| 55059 | 2104008310 | NOx | 4.13E-02 | 3.85E-02 | 3.87E-02 | 3.85E-02 |
| 55059 | 2104008320 | NOx | 1.06E-02 | 1.24E-02 | 1.25E-02 | 1.24E-02 |
| 55059 | 2104008330 | NOx | 1.03E-02 | 1.21E-02 | 1.21E-02 | 1.21E-02 |
| 55059 | 2104008400 | NOx | 3.89E-03 | 6.04E-03 | 6.07E-03 | 6.05E-03 |
| 55059 | 2104008510 | NOx | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

| FIPS | SCC | POLLUTANT | 2011 (tpsd) | 2017 (tpsd) | 2025 (tpsd) | 2018 est (tpsd) |
|---|---|---|---|---|---|---|
| 55059 | 2104008610 | NOx | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2104008700 | NOx | 2.36E-02 | 2.51E-02 | 2.52E-02 | 2.51E-02 |
| 55059 | 2104009000 | NOx | 2.73E-04 | 2.91E-04 | 3.14E-04 | 2.94E-04 |
| 55059 | 2104011000 | NOx | 1.95E-04 | 1.95E-04 | 1.95E-04 | 1.95E-04 |
| 55059 | 2810060100 | NOx | 1.14E-03 | 1.14E-03 | 1.14E-03 | 1.14E-03 |
| 55059 | 2102002000 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2102004001 | VOC | 1.01E-05 | 1.12E-08 | 1.14E-08 | 1.12E-08 |
| 55059 | 2102005000 | VOC | 2.98E-06 | 1.58E-09 | 1.54E-09 | 1.58E-09 |
| 55059 | 2102006000 | VOC | 3.35E-03 | 3.86E-03 | 3.99E-03 | 3.87E-03 |
| 55059 | 2102007000 | VOC | 5.84E-06 | 6.60E-06 | 7.04E-06 | 6.66E-06 |
| 55059 | 2102008000 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2102011000 | VOC | 4.75E-07 | 5.25E-07 | 5.36E-07 | 5.27E-07 |
| 55059 | 2103002000 | VOC | 5.82E-05 | 4.13E-05 | 4.12E-05 | 4.13E-05 |
| 55059 | 2103004001 | VOC | 1.16E-04 | 1.11E-07 | 1.11E-07 | 1.11E-07 |
| 55059 | 2103005000 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2103006000 | VOC | 8.92E-03 | 8.52E-03 | 8.68E-03 | 8.54E-03 |
| 55059 | 2103007000 | VOC | 4.85E-04 | 4.85E-04 | 4.85E-04 | 4.85E-04 |
| 55059 | 2103008000 | VOC | 8.36E-06 | 1.05E-05 | 1.05E-05 | 1.05E-05 |
| 55059 | 2103011000 | VOC | 4.42E-10 | 4.43E-10 | 4.43E-10 | 4.43E-10 |
| 55059 | 2104004000 | VOC | 3.67E-04 | 3.67E-04 | 3.68E-04 | 3.67E-04 |
| 55059 | 2104006000 | VOC | 2.63E-02 | 2.63E-02 | 2.63E-02 | 2.63E-02 |
| 55059 | 2104007000 | VOC | 6.15E-04 | 6.16E-04 | 6.16E-04 | 6.16E-04 |
| 55059 | 2104008100 | VOC | 1.02E-01 | 1.09E-01 | 1.02E-01 | 1.08E-01 |
| 55059 | 2104008210 | VOC | 1.78E-01 | 1.61E-01 | 1.51E-01 | 1.60E-01 |
| 55059 | 2104008220 | VOC | 1.70E-02 | 2.00E-02 | 1.87E-02 | 1.98E-02 |
| 55059 | 2104008230 | VOC | 6.89E-03 | 8.08E-03 | 7.57E-03 | 8.02E-03 |
| 55059 | 2104008310 | VOC | 7.81E-01 | 7.35E-01 | 6.89E-01 | 7.29E-01 |
| 55059 | 2104008320 | VOC | 5.59E-02 | 6.55E-02 | 6.14E-02 | 6.50E-02 |
| 55059 | 2104008330 | VOC | 7.73E-02 | 9.06E-02 | 8.49E-02 | 8.99E-02 |
| 55059 | 2104008400 | VOC | 4.20E-05 | 6.52E-05 | 6.11E-05 | 6.47E-05 |

| FIPS | SCC | POLLUTANT | 2011 (tpsd) | 2017 (tpsd) | 2025 (tpsd) | 2018 est (tpsd) |
|---|---|---|---|---|---|---|
| 55059 | 2104008510 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2104008610 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2104008700 | VOC | 1.71E-01 | 1.82E-01 | 1.71E-01 | 1.81E-01 |
| 55059 | 2104009000 | VOC | 1.41E-03 | 1.50E-03 | 1.62E-03 | 1.51E-03 |
| 55059 | 2104011000 | VOC | 7.57E-06 | 7.58E-06 | 7.58E-06 | 7.58E-06 |
| 55059 | 2302002100 | VOC | 2.81E-03 | 2.81E-03 | 2.81E-03 | 2.81E-03 |
| 55059 | 2302002200 | VOC | 7.78E-03 | 7.79E-03 | 7.79E-03 | 7.79E-03 |
| 55059 | 2302003000 | VOC | 1.36E-03 | 1.36E-03 | 1.36E-03 | 1.36E-03 |
| 55059 | 2302003100 | VOC | 1.02E-03 | 1.02E-03 | 1.02E-03 | 1.02E-03 |
| 55059 | 2302003200 | VOC | 4.85E-05 | 4.85E-05 | 4.85E-05 | 4.85E-05 |
| 55059 | 2401001000 | VOC | 4.12E-01 | 4.13E-01 | 4.13E-01 | 4.13E-01 |
| 55059 | 2401005000 | VOC | 6.61E-02 | 6.62E-02 | 6.62E-02 | 6.62E-02 |
| 55059 | 2401008000 | VOC | 3.38E-04 | 3.38E-04 | 3.38E-04 | 3.38E-04 |
| 55059 | 2401015000 | VOC | 2.54E-03 | 2.54E-03 | 2.54E-03 | 2.54E-03 |
| 55059 | 2401020000 | VOC | 9.19E-02 | 9.20E-02 | 9.20E-02 | 9.20E-02 |
| 55059 | 2401025000 | VOC | 2.28E-02 | 2.28E-02 | 2.28E-02 | 2.28E-02 |
| 55059 | 2401055000 | VOC | 1.97E-03 | 1.97E-03 | 1.97E-03 | 1.97E-03 |
| 55059 | 2401065000 | VOC | 6.07E-03 | 6.08E-03 | 6.08E-03 | 6.08E-03 |
| 55059 | 2401070000 | VOC | 1.47E-01 | 1.47E-01 | 1.47E-01 | 1.47E-01 |
| 55059 | 2401080000 | VOC | 2.40E-03 | 2.40E-03 | 2.40E-03 | 2.40E-03 |
| 55059 | 2401090000 | VOC | 7.76E-03 | 7.77E-03 | 7.77E-03 | 7.77E-03 |
| 55059 | 2401100000 | VOC | 1.06E-01 | 1.06E-01 | 1.06E-01 | 1.06E-01 |
| 55059 | 2401200000 | VOC | 1.13E-02 | 1.13E-02 | 1.13E-02 | 1.13E-02 |
| 55059 | 2415000000 | VOC | 2.81E-01 | 2.81E-01 | 2.81E-01 | 2.81E-01 |
| 55059 | 2420000000 | VOC | 2.86E-07 | 2.86E-07 | 2.86E-07 | 2.86E-07 |
| 55059 | 2425000000 | VOC | 1.19E-01 | 1.19E-01 | 1.19E-01 | 1.19E-01 |
| 55059 | 2460100000 | VOC | 3.35E-01 | 3.35E-01 | 3.35E-01 | 3.35E-01 |
| 55059 | 2460200000 | VOC | 3.17E-01 | 3.17E-01 | 3.17E-01 | 3.17E-01 |
| 55059 | 2460400000 | VOC | 2.40E-01 | 2.40E-01 | 2.40E-01 | 2.40E-01 |
| 55059 | 2460500000 | VOC | 1.67E-01 | 1.67E-01 | 1.68E-01 | 1.67E-01 |

| FIPS | SCC | POLLUTANT | 2011 (tpsd) | 2017 (tpsd) | 2025 (tpsd) | 2018 est (tpsd) |
|---|---|---|---|---|---|---|
| 55059 | 2460600000 | VOC | 1.00E-01 | 1.00E-01 | 1.01E-01 | 1.00E-01 |
| 55059 | 2460800000 | VOC | 3.13E-01 | 3.14E-01 | 3.14E-01 | 3.14E-01 |
| 55059 | 2460900000 | VOC | 1.23E-02 | 1.23E-02 | 1.23E-02 | 1.23E-02 |
| 55059 | 2461021000 | VOC | 9.18E-02 | 9.19E-02 | 9.19E-02 | 9.19E-02 |
| 55059 | 2461022000 | VOC | 2.22E-02 | 2.22E-02 | 2.22E-02 | 2.22E-02 |
| 55059 | 2461850000 | VOC | 9.17E-02 | 9.00E-02 | 9.04E-02 | 9.01E-02 |
| 55059 | 2501011011 | VOC | 6.29E-03 | 7.36E-03 | 8.77E-03 | 7.53E-03 |
| 55059 | 2501011012 | VOC | 7.06E-03 | 8.25E-03 | 9.84E-03 | 8.45E-03 |
| 55059 | 2501011013 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2501011014 | VOC | 1.31E-03 | 1.54E-03 | 1.83E-03 | 1.57E-03 |
| 55059 | 2501011015 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2501012011 | VOC | 2.90E-04 | 3.21E-04 | 3.63E-04 | 3.27E-04 |
| 55059 | 2501012012 | VOC | 2.38E-04 | 2.64E-04 | 2.98E-04 | 2.68E-04 |
| 55059 | 2501012013 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2501012014 | VOC | 4.00E-03 | 4.42E-03 | 4.99E-03 | 4.50E-03 |
| 55059 | 2501012015 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2501050120 | VOC | 3.49E-02 | 3.47E-02 | 2.85E-02 | 3.39E-02 |
| 55059 | 2501055120 | VOC | 1.10E-02 | 1.05E-02 | 8.62E-03 | 1.03E-02 |
| 55059 | 2501060051 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2501060052 | VOC | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 55059 | 2501060053 | VOC | 4.09E-02 | 3.92E-02 | 3.21E-02 | 3.83E-02 |
| 55059 | 2501060201 | VOC | 5.58E-02 | 1.28E-01 | 1.26E-01 | 1.26E-01 |
| 55059 | 2501060201 | VOC | 5.58E-02 | 5.35E-02 | 4.39E-02 | 5.23E-02 |
| 55059 | 2501080050 | VOC | 5.08E-02 | 5.09E-02 | 5.09E-02 | 5.09E-02 |
| 55059 | 2501080100 | VOC | 2.64E-03 | 2.64E-03 | 2.64E-03 | 2.64E-03 |
| 55059 | 2505030120 | VOC | 3.65E-03 | 3.50E-03 | 2.87E-03 | 3.42E-03 |
| 55059 | 2505040120 | VOC | 1.20E-02 | 1.19E-02 | 9.76E-03 | 1.16E-02 |
| 55059 | 2630020000 | VOC | 6.60E-03 | 6.61E-03 | 6.61E-03 | 6.61E-03 |
| 55059 | 2801500000 | VOC | 0.00E+00 | 0.00E+00 | 1.25E-06 | 1.56E-07 |
| 55059 | 2810060100 | VOC | 3.99E-06 | 3.99E-06 | 3.99E-06 | 3.99E-06 |

| FIPS | SCC | POLLUTANT | 2011 (tpsd) | 2017 (tpsd) | 2025 (tpsd) | 2018 est (tpsd) |
|---|---|---|---|---|---|---|
| **Total** | | **NOx** | **1.09** | **1.08** | **1.08** | **1.08** |
| | | **VOC** | **4.78** | **4.77** | **4.65** | **4.74** |

*Values marked in red font indicate WDNR staff estimates.

# APPENDIX 5

# Onroad Emissions and Activity Data for 2011, 2017 and 2018

This appendix provides detailed listings of the estimated onroad daily emissions and activity data for eastern Kenosha for 2011, 2017 and 2018. The sum of NOx and VOC emissions from the different onroad source types were used for the onroad sector NOx and VOC tons per summer day (tpsd) emission estimates in sections 3.2 (2011 Base Year Inventory for RFP) and 3.3 (2017 & 2018 Projected Year Inventories for RFP) of the Wisconsin Department of Natural Resources (WDNR) eastern Kenosha County attainment plan.

# Table 5.1

## 2011 Onroad $NO_X$ and VOC Emissions: tons per summer weekday (tpswd) Eastern Kenosha County Nonattainment Area (I-94 and to the East)

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2011 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | Total | Exhaust | Evaporative | Total |
| Motorcycle | Gasoline | Off-Network | 0.0001 | 0.0005 | 0.0289 | 0.0294 |
| Motorcycle | Gasoline | Rural Restricted | 0.0018 | 0.0019 | 0.0006 | 0.0025 |
| Motorcycle | Gasoline | Rural Unrestricted | 0.0036 | 0.0044 | 0.0019 | 0.0063 |
| Motorcycle | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Motorcycle | Gasoline | Urban Unrestricted | 0.0072 | 0.0127 | 0.0067 | 0.0193 |
| Passenger Car | Gasoline | Off-Network | 0.2894 | 0.3109 | 0.3783 | 0.6891 |
| Passenger Car | Gasoline | Rural Restricted | 0.2456 | 0.0472 | 0.0161 | 0.0634 |
| Passenger Car | Gasoline | Rural Unrestricted | 0.1499 | 0.0324 | 0.0149 | 0.0472 |
| Passenger Car | Gasoline | Urban Restricted | 0.0009 | 0.0002 | 0.0001 | 0.0004 |
| Passenger Car | Gasoline | Urban Unrestricted | 0.3860 | 0.0980 | 0.0517 | 0.1497 |
| Passenger Car | Diesel | Off-Network | 0.0013 | 0.0027 | 0.0000 | 0.0027 |
| Passenger Car | Diesel | Rural Restricted | 0.0011 | 0.0005 | 0.0000 | 0.0005 |
| Passenger Car | Diesel | Rural Unrestricted | 0.0007 | 0.0004 | 0.0000 | 0.0004 |
| Passenger Car | Diesel | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Diesel | Urban Unrestricted | 0.0017 | 0.0012 | 0.0000 | 0.0012 |
| Passenger Car | Ethanol (E-85) | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Truck | Gasoline | Off-Network | 0.2883 | 0.3349 | 0.1558 | 0.4906 |
| Passenger Truck | Gasoline | Rural Restricted | 0.2995 | 0.0541 | 0.0075 | 0.0615 |
| Passenger Truck | Gasoline | Rural Unrestricted | 0.1728 | 0.0357 | 0.0069 | 0.0426 |
| Passenger Truck | Gasoline | Urban Restricted | 0.0010 | 0.0003 | 0.0001 | 0.0003 |
| Passenger Truck | Gasoline | Urban Unrestricted | 0.4247 | 0.1058 | 0.0239 | 0.1296 |
| Passenger Truck | Diesel | Off-Network | 0.0043 | 0.0032 | 0.0000 | 0.0032 |
| Passenger Truck | Diesel | Rural Restricted | 0.0132 | 0.0025 | 0.0000 | 0.0025 |
| Passenger Truck | Diesel | Rural Unrestricted | 0.0093 | 0.0019 | 0.0000 | 0.0019 |
| Passenger Truck | Diesel | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Truck | Diesel | Urban Unrestricted | 0.0274 | 0.0058 | 0.0000 | 0.0058 |
| Passenger Truck | Ethanol (E-85) | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0001 |
| Passenger Truck | Ethanol (E-85) | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Truck | Ethanol (E-85) | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Truck | Ethanol (E-85) | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Truck | Ethanol (E-85) | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Gasoline | Off-Network | 0.1005 | 0.1169 | 0.0652 | 0.1821 |
| Light Commercial Truck | Gasoline | Rural Restricted | 0.0962 | 0.0199 | 0.0032 | 0.0231 |
| Light Commercial Truck | Gasoline | Rural Unrestricted | 0.0582 | 0.0146 | 0.0030 | 0.0176 |
| Light Commercial Truck | Gasoline | Urban Restricted | 0.0003 | 0.0001 | 0.0000 | 0.0001 |
| Light Commercial Truck | Gasoline | Urban Unrestricted | 0.1434 | 0.0453 | 0.0103 | 0.0557 |
| Light Commercial Truck | Diesel | Off-Network | 0.0040 | 0.0033 | 0.0000 | 0.0033 |
| Light Commercial Truck | Diesel | Rural Restricted | 0.0116 | 0.0025 | 0.0000 | 0.0025 |
| Light Commercial Truck | Diesel | Rural Unrestricted | 0.0083 | 0.0019 | 0.0000 | 0.0019 |
| Light Commercial Truck | Diesel | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Diesel | Urban Unrestricted | 0.0251 | 0.0059 | 0.0000 | 0.0059 |
| Light Commercial Truck | Ethanol (E-85) | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2011 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | **Total** | Exhaust | Evaporative | **Total** |
| Light Commercial Truck | Ethanol (E-85) | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Intercity Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Intercity Bus | Diesel | Rural Restricted | 0.0030 | 0.0002 | 0.0000 | 0.0002 |
| Intercity Bus | Diesel | Rural Unrestricted | 0.0025 | 0.0002 | 0.0000 | 0.0002 |
| Intercity Bus | Diesel | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Intercity Bus | Diesel | Urban Unrestricted | 0.0067 | 0.0006 | 0.0000 | 0.0006 |
| Transit Bus | Gasoline | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Rural Restricted | 0.0053 | 0.0003 | 0.0000 | 0.0003 |
| Transit Bus | Diesel | Rural Unrestricted | 0.0035 | 0.0003 | 0.0000 | 0.0003 |
| Transit Bus | Diesel | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Urban Unrestricted | 0.0089 | 0.0007 | 0.0000 | 0.0007 |
| Transit Bus | CNG | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Rural Restricted | 0.0004 | 0.0001 | 0.0000 | 0.0001 |
| Transit Bus | CNG | Rural Unrestricted | 0.0003 | 0.0001 | 0.0000 | 0.0001 |
| Transit Bus | CNG | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Urban Unrestricted | 0.0006 | 0.0001 | 0.0000 | 0.0001 |
| School Bus | Gasoline | Off-Network | 0.0000 | 0.0001 | 0.0000 | 0.0001 |
| School Bus | Gasoline | Rural Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Urban Unrestricted | 0.0001 | 0.0001 | 0.0000 | 0.0001 |
| School Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Diesel | Rural Restricted | 0.0069 | 0.0008 | 0.0000 | 0.0008 |
| School Bus | Diesel | Rural Unrestricted | 0.0047 | 0.0008 | 0.0000 | 0.0008 |
| School Bus | Diesel | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Diesel | Urban Unrestricted | 0.0121 | 0.0022 | 0.0000 | 0.0022 |
| Refuse Truck | Gasoline | Off-Network | 0.0001 | 0.0001 | 0.0001 | 0.0002 |
| Refuse Truck | Gasoline | Rural Restricted | 0.0004 | 0.0001 | 0.0000 | 0.0001 |
| Refuse Truck | Gasoline | Rural Unrestricted | 0.0002 | 0.0001 | 0.0000 | 0.0001 |
| Refuse Truck | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Gasoline | Urban Unrestricted | 0.0007 | 0.0003 | 0.0000 | 0.0003 |
| Refuse Truck | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Diesel | Rural Restricted | 0.0200 | 0.0010 | 0.0000 | 0.0010 |
| Refuse Truck | Diesel | Rural Unrestricted | 0.0118 | 0.0008 | 0.0000 | 0.0008 |
| Refuse Truck | Diesel | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Diesel | Urban Unrestricted | 0.0327 | 0.0022 | 0.0000 | 0.0022 |
| Single Unit Short-haul Truck | Gasoline | Off-Network | 0.0218 | 0.0209 | 0.0186 | 0.0395 |
| Single Unit Short-haul Truck | Gasoline | Rural Restricted | 0.0347 | 0.0058 | 0.0005 | 0.0063 |
| Single Unit Short-haul Truck | Gasoline | Rural Unrestricted | 0.0199 | 0.0045 | 0.0005 | 0.0050 |
| Single Unit Short-haul Truck | Gasoline | Urban Restricted | 0.0001 | 0.0001 | 0.0000 | 0.0001 |
| Single Unit Short-haul Truck | Gasoline | Urban Unrestricted | 0.0497 | 0.0175 | 0.0015 | 0.0191 |
| Single Unit Short-haul Truck | Diesel | Off-Network | 0.0061 | 0.0003 | 0.0000 | 0.0003 |
| Single Unit Short-haul Truck | Diesel | Rural Restricted | 0.1345 | 0.0180 | 0.0000 | 0.0180 |
| Single Unit Short-haul Truck | Diesel | Rural Unrestricted | 0.0871 | 0.0144 | 0.0000 | 0.0144 |
| Single Unit Short-haul Truck | Diesel | Urban Restricted | 0.0007 | 0.0001 | 0.0000 | 0.0001 |
| Single Unit Short-haul Truck | Diesel | Urban Unrestricted | 0.2637 | 0.0438 | 0.0000 | 0.0438 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2011 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | **Total** | Exhaust | Evaporative | **Total** |
| Single Unit Long-haul Truck | Gasoline | Off-Network | 0.0006 | 0.0006 | 0.0006 | 0.0012 |
| Single Unit Long-haul Truck | Gasoline | Rural Restricted | 0.0014 | 0.0003 | 0.0000 | 0.0003 |
| Single Unit Long-haul Truck | Gasoline | Rural Unrestricted | 0.0008 | 0.0002 | 0.0000 | 0.0002 |
| Single Unit Long-haul Truck | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Single Unit Long-haul Truck | Gasoline | Urban Unrestricted | 0.0019 | 0.0007 | 0.0001 | 0.0008 |
| Single Unit Long-haul Truck | Diesel | Off-Network | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| Single Unit Long-haul Truck | Diesel | Rural Restricted | 0.0080 | 0.0012 | 0.0000 | 0.0012 |
| Single Unit Long-haul Truck | Diesel | Rural Unrestricted | 0.0052 | 0.0010 | 0.0000 | 0.0010 |
| Single Unit Long-haul Truck | Diesel | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Single Unit Long-haul Truck | Diesel | Urban Unrestricted | 0.0157 | 0.0030 | 0.0000 | 0.0030 |
| Motor Home | Gasoline | Off-Network | 0.0013 | 0.0017 | 0.0043 | 0.0060 |
| Motor Home | Gasoline | Rural Restricted | 0.0037 | 0.0008 | 0.0001 | 0.0009 |
| Motor Home | Gasoline | Rural Unrestricted | 0.0020 | 0.0006 | 0.0001 | 0.0006 |
| Motor Home | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Motor Home | Gasoline | Urban Unrestricted | 0.0050 | 0.0020 | 0.0002 | 0.0023 |
| Motor Home | Diesel | Off-Network | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Motor Home | Diesel | Rural Restricted | 0.0030 | 0.0004 | 0.0000 | 0.0004 |
| Motor Home | Diesel | Rural Unrestricted | 0.0017 | 0.0003 | 0.0000 | 0.0003 |
| Motor Home | Diesel | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Motor Home | Diesel | Urban Unrestricted | 0.0052 | 0.0009 | 0.0000 | 0.0009 |
| Combination Short-haul Truck | Gasoline | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Diesel | Rural Restricted | 0.1689 | 0.0082 | 0.0000 | 0.0082 |
| Combination Short-haul Truck | Diesel | Rural Unrestricted | 0.0263 | 0.0016 | 0.0000 | 0.0016 |
| Combination Short-haul Truck | Diesel | Urban Restricted | 0.0007 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Diesel | Urban Unrestricted | 0.0712 | 0.0048 | 0.0000 | 0.0048 |
| Combination Long-haul Truck | Diesel | Off-Network | 0.5553 | 0.1473 | 0.0000 | 0.1473 |
| Combination Long-haul Truck | Diesel | Rural Restricted | 0.4694 | 0.0230 | 0.0000 | 0.0230 |
| Combination Long-haul Truck | Diesel | Rural Unrestricted | 0.0763 | 0.0046 | 0.0000 | 0.0046 |
| Combination Long-haul Truck | Diesel | Urban Restricted | 0.0020 | 0.0001 | 0.0000 | 0.0001 |
| Combination Long-haul Truck | Diesel | Urban Unrestricted | 0.2066 | 0.0136 | 0.0000 | 0.0136 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **5.1502** | **1.6213** | **0.8017** | **2.4230** |
| | | | | | | |
| Motorcycle | ALL | ALL | 0.0128 | 0.0195 | 0.0381 | 0.0576 |
| Passenger Car | ALL | ALL | 1.0766 | 0.4935 | 0.4611 | 0.9546 |
| Passenger Truck | ALL | ALL | 1.2407 | 0.5441 | 0.1941 | 0.7382 |
| Light Commercial Truck | ALL | ALL | 0.4477 | 0.2105 | 0.0818 | 0.2923 |
| Intercity Bus | ALL | ALL | 0.0122 | 0.0009 | 0.0000 | 0.0009 |
| Transit Bus | ALL | ALL | 0.0192 | 0.0016 | 0.0000 | 0.0016 |
| School Bus | ALL | ALL | 0.0240 | 0.0039 | 0.0000 | 0.0040 |
| Refuse Truck | ALL | ALL | 0.0661 | 0.0045 | 0.0001 | 0.0046 |
| Single Unit Short-haul Truck | ALL | ALL | 0.6182 | 0.1255 | 0.0211 | 0.1466 |
| Single Unit Long-haul Truck | ALL | ALL | 0.0339 | 0.0070 | 0.0007 | 0.0077 |
| Motor Home | ALL | ALL | 0.0220 | 0.0068 | 0.0047 | 0.0114 |
| Combination Short-haul Truck | ALL | ALL | 0.2672 | 0.0146 | 0.0000 | 0.0147 |
| Combination Long-haul Truck | ALL | ALL | 1.3097 | 0.1887 | 0.0000 | 0.1887 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **5.1502** | **1.6213** | **0.8017** | **2.4230** |
| | | | | | | |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2011 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | **Total** | Exhaust | Evaporative | **Total** |
| ALL | Gasoline | ALL | 2.8144 | 1.2922 | 0.8017 | 2.0939 |
| ALL | Diesel | ALL | 2.3343 | 0.3288 | 0.0000 | 0.3288 |
| ALL | CNG | ALL | 0.0014 | 0.0002 | 0.0000 | 0.0002 |
| ALL | Ethanol (E-85) | ALL | 0.0001 | 0.0001 | 0.0000 | 0.0001 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **5.1502** | **1.6213** | **0.8017** | **2.4230** |
| | | | | | | |
| ALL | ALL | Off-Network | 1.2735 | 0.9436 | 0.6517 | 1.5953 |
| ALL | ALL | Rural Restricted | 1.5290 | 0.1887 | 0.0281 | 0.2168 |
| ALL | ALL | Rural Unrestricted | 0.6451 | 0.1207 | 0.0272 | 0.1479 |
| ALL | ALL | Urban Restricted | 0.0063 | 0.0010 | 0.0002 | 0.0012 |
| ALL | ALL | Urban Unrestricted | 1.6963 | 0.3673 | 0.0945 | 0.4618 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **5.1502** | **1.6213** | **0.8017** | **2.4230** |

## Table 5.2

## 2017 Onroad $NO_X$ and VOC Emissions: tons per summer weekday (tpswd) Eastern Kenosha County Nonattainment Area (I-94 and to the East)

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2017 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | Total | Exhaust | Evaporative | Total |
| Motorcycle | Gasoline | Off-Network | 0.0001 | 0.0007 | 0.0299 | 0.0306 |
| Motorcycle | Gasoline | Rural Restricted | 0.0017 | 0.0015 | 0.0006 | 0.0020 |
| Motorcycle | Gasoline | Rural Unrestricted | 0.0031 | 0.0030 | 0.0016 | 0.0046 |
| Motorcycle | Gasoline | Urban Restricted | 0.0002 | 0.0002 | 0.0001 | 0.0003 |
| Motorcycle | Gasoline | Urban Unrestricted | 0.0080 | 0.0115 | 0.0077 | 0.0192 |
| Passenger Car | Gasoline | Off-Network | 0.1774 | 0.2000 | 0.2645 | 0.4646 |
| Passenger Car | Gasoline | Rural Restricted | 0.0932 | 0.0179 | 0.0077 | 0.0256 |
| Passenger Car | Gasoline | Rural Unrestricted | 0.0451 | 0.0091 | 0.0063 | 0.0154 |
| Passenger Car | Gasoline | Urban Restricted | 0.0136 | 0.0026 | 0.0012 | 0.0038 |
| Passenger Car | Gasoline | Urban Unrestricted | 0.1472 | 0.0357 | 0.0302 | 0.0659 |
| Passenger Car | Diesel | Off-Network | 0.0009 | 0.0012 | 0.0000 | 0.0012 |
| Passenger Car | Diesel | Rural Restricted | 0.0006 | 0.0001 | 0.0000 | 0.0001 |
| Passenger Car | Diesel | Rural Unrestricted | 0.0003 | 0.0001 | 0.0000 | 0.0001 |
| Passenger Car | Diesel | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Diesel | Urban Unrestricted | 0.0009 | 0.0003 | 0.0000 | 0.0003 |
| Passenger Car | Ethanol (E-85) | Off-Network | 0.0002 | 0.0003 | 0.0004 | 0.0007 |
| Passenger Car | Ethanol (E-85) | Rural Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Urban Unrestricted | 0.0001 | 0.0000 | 0.0000 | 0.0001 |
| Passenger Truck | Gasoline | Off-Network | 0.1614 | 0.1790 | 0.1203 | 0.2992 |
| Passenger Truck | Gasoline | Rural Restricted | 0.1121 | 0.0213 | 0.0041 | 0.0255 |
| Passenger Truck | Gasoline | Rural Unrestricted | 0.0495 | 0.0098 | 0.0034 | 0.0133 |
| Passenger Truck | Gasoline | Urban Restricted | 0.0163 | 0.0031 | 0.0006 | 0.0038 |
| Passenger Truck | Gasoline | Urban Unrestricted | 0.1528 | 0.0372 | 0.0163 | 0.0535 |
| Passenger Truck | Diesel | Off-Network | 0.0043 | 0.0017 | 0.0000 | 0.0017 |
| Passenger Truck | Diesel | Rural Restricted | 0.0078 | 0.0011 | 0.0000 | 0.0011 |
| Passenger Truck | Diesel | Rural Unrestricted | 0.0046 | 0.0007 | 0.0000 | 0.0007 |
| Passenger Truck | Diesel | Urban Restricted | 0.0012 | 0.0002 | 0.0000 | 0.0002 |
| Passenger Truck | Diesel | Urban Unrestricted | 0.0180 | 0.0028 | 0.0000 | 0.0028 |
| Passenger Truck | Ethanol (E-85) | Off-Network | 0.0005 | 0.0007 | 0.0007 | 0.0014 |
| Passenger Truck | Ethanol (E-85) | Rural Restricted | 0.0004 | 0.0001 | 0.0000 | 0.0001 |
| Passenger Truck | Ethanol (E-85) | Rural Unrestricted | 0.0002 | 0.0000 | 0.0000 | 0.0001 |
| Passenger Truck | Ethanol (E-85) | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Truck | Ethanol (E-85) | Urban Unrestricted | 0.0005 | 0.0001 | 0.0001 | 0.0002 |
| Light Commercial Truck | Gasoline | Off-Network | 0.0685 | 0.0773 | 0.0490 | 0.1263 |
| Light Commercial Truck | Gasoline | Rural Restricted | 0.0429 | 0.0087 | 0.0017 | 0.0104 |
| Light Commercial Truck | Gasoline | Rural Unrestricted | 0.0209 | 0.0048 | 0.0014 | 0.0062 |
| Light Commercial Truck | Gasoline | Urban Restricted | 0.0063 | 0.0013 | 0.0003 | 0.0015 |
| Light Commercial Truck | Gasoline | Urban Unrestricted | 0.0655 | 0.0196 | 0.0067 | 0.0263 |
| Light Commercial Truck | Diesel | Off-Network | 0.0037 | 0.0022 | 0.0000 | 0.0022 |
| Light Commercial Truck | Diesel | Rural Restricted | 0.0066 | 0.0011 | 0.0000 | 0.0011 |
| Light Commercial Truck | Diesel | Rural Unrestricted | 0.0039 | 0.0008 | 0.0000 | 0.0008 |
| Light Commercial Truck | Diesel | Urban Restricted | 0.0010 | 0.0002 | 0.0000 | 0.0002 |
| Light Commercial Truck | Diesel | Urban Unrestricted | 0.0156 | 0.0031 | 0.0000 | 0.0031 |
| Light Commercial Truck | Ethanol (E-85) | Off-Network | 0.0001 | 0.0002 | 0.0001 | 0.0003 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2017 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | **Total** | Exhaust | Evaporative | **Total** |
| Light Commercial Truck | Ethanol (E-85) | Rural Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Urban Unrestricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Intercity Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Intercity Bus | Diesel | Rural Restricted | 0.0022 | 0.0001 | 0.0000 | 0.0001 |
| Intercity Bus | Diesel | Rural Unrestricted | 0.0015 | 0.0001 | 0.0000 | 0.0001 |
| Intercity Bus | Diesel | Urban Restricted | 0.0003 | 0.0000 | 0.0000 | 0.0000 |
| Intercity Bus | Diesel | Urban Unrestricted | 0.0054 | 0.0004 | 0.0000 | 0.0004 |
| Transit Bus | Gasoline | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Rural Restricted | 0.0034 | 0.0002 | 0.0000 | 0.0002 |
| Transit Bus | Diesel | Rural Unrestricted | 0.0019 | 0.0001 | 0.0000 | 0.0001 |
| Transit Bus | Diesel | Urban Restricted | 0.0005 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Urban Unrestricted | 0.0061 | 0.0005 | 0.0000 | 0.0005 |
| Transit Bus | CNG | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Rural Restricted | 0.0003 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Rural Unrestricted | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Urban Unrestricted | 0.0005 | 0.0001 | 0.0000 | 0.0001 |
| School Bus | Gasoline | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Diesel | Rural Restricted | 0.0046 | 0.0005 | 0.0000 | 0.0005 |
| School Bus | Diesel | Rural Unrestricted | 0.0026 | 0.0004 | 0.0000 | 0.0004 |
| School Bus | Diesel | Urban Restricted | 0.0007 | 0.0001 | 0.0000 | 0.0001 |
| School Bus | Diesel | Urban Unrestricted | 0.0085 | 0.0015 | 0.0000 | 0.0015 |
| Refuse Truck | Gasoline | Off-Network | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| Refuse Truck | Gasoline | Rural Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Gasoline | Rural Unrestricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Gasoline | Urban Unrestricted | 0.0003 | 0.0001 | 0.0000 | 0.0001 |
| Refuse Truck | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Diesel | Rural Restricted | 0.0097 | 0.0004 | 0.0000 | 0.0004 |
| Refuse Truck | Diesel | Rural Unrestricted | 0.0048 | 0.0003 | 0.0000 | 0.0003 |
| Refuse Truck | Diesel | Urban Restricted | 0.0014 | 0.0001 | 0.0000 | 0.0001 |
| Refuse Truck | Diesel | Urban Unrestricted | 0.0178 | 0.0011 | 0.0000 | 0.0011 |
| Single Unit Short-haul Truck | Gasoline | Off-Network | 0.0164 | 0.0162 | 0.0158 | 0.0320 |
| Single Unit Short-haul Truck | Gasoline | Rural Restricted | 0.0115 | 0.0022 | 0.0003 | 0.0025 |
| Single Unit Short-haul Truck | Gasoline | Rural Unrestricted | 0.0060 | 0.0014 | 0.0002 | 0.0016 |
| Single Unit Short-haul Truck | Gasoline | Urban Restricted | 0.0017 | 0.0003 | 0.0000 | 0.0004 |
| Single Unit Short-haul Truck | Gasoline | Urban Unrestricted | 0.0195 | 0.0079 | 0.0010 | 0.0090 |
| Single Unit Short-haul Truck | Diesel | Off-Network | 0.0082 | 0.0004 | 0.0000 | 0.0004 |
| Single Unit Short-haul Truck | Diesel | Rural Restricted | 0.0634 | 0.0066 | 0.0000 | 0.0066 |
| Single Unit Short-haul Truck | Diesel | Rural Unrestricted | 0.0337 | 0.0048 | 0.0000 | 0.0048 |
| Single Unit Short-haul Truck | Diesel | Urban Restricted | 0.0094 | 0.0010 | 0.0000 | 0.0010 |
| Single Unit Short-haul Truck | Diesel | Urban Unrestricted | 0.1383 | 0.0199 | 0.0000 | 0.0199 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2017 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | **Total** | Exhaust | Evaporative | **Total** |
| Single Unit Long-haul Truck | Gasoline | Off-Network | 0.0005 | 0.0005 | 0.0005 | 0.0010 |
| Single Unit Long-haul Truck | Gasoline | Rural Restricted | 0.0005 | 0.0001 | 0.0000 | 0.0001 |
| Single Unit Long-haul Truck | Gasoline | Rural Unrestricted | 0.0002 | 0.0001 | 0.0000 | 0.0001 |
| Single Unit Long-haul Truck | Gasoline | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Single Unit Long-haul Truck | Gasoline | Urban Unrestricted | 0.0007 | 0.0003 | 0.0001 | 0.0003 |
| Single Unit Long-haul Truck | Diesel | Off-Network | 0.0003 | 0.0000 | 0.0000 | 0.0000 |
| Single Unit Long-haul Truck | Diesel | Rural Restricted | 0.0039 | 0.0004 | 0.0000 | 0.0004 |
| Single Unit Long-haul Truck | Diesel | Rural Unrestricted | 0.0021 | 0.0003 | 0.0000 | 0.0003 |
| Single Unit Long-haul Truck | Diesel | Urban Restricted | 0.0006 | 0.0001 | 0.0000 | 0.0001 |
| Single Unit Long-haul Truck | Diesel | Urban Unrestricted | 0.0088 | 0.0013 | 0.0000 | 0.0013 |
| Motor Home | Gasoline | Off-Network | 0.0009 | 0.0013 | 0.0036 | 0.0049 |
| Motor Home | Gasoline | Rural Restricted | 0.0019 | 0.0004 | 0.0001 | 0.0005 |
| Motor Home | Gasoline | Rural Unrestricted | 0.0009 | 0.0002 | 0.0000 | 0.0003 |
| Motor Home | Gasoline | Urban Restricted | 0.0003 | 0.0001 | 0.0000 | 0.0001 |
| Motor Home | Gasoline | Urban Unrestricted | 0.0029 | 0.0013 | 0.0002 | 0.0015 |
| Motor Home | Diesel | Off-Network | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| Motor Home | Diesel | Rural Restricted | 0.0023 | 0.0002 | 0.0000 | 0.0002 |
| Motor Home | Diesel | Rural Unrestricted | 0.0010 | 0.0002 | 0.0000 | 0.0002 |
| Motor Home | Diesel | Urban Restricted | 0.0003 | 0.0000 | 0.0000 | 0.0000 |
| Motor Home | Diesel | Urban Unrestricted | 0.0042 | 0.0007 | 0.0000 | 0.0007 |
| Combination Short-haul Truck | Gasoline | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Diesel | Rural Restricted | 0.0828 | 0.0033 | 0.0000 | 0.0033 |
| Combination Short-haul Truck | Diesel | Rural Unrestricted | 0.0107 | 0.0006 | 0.0000 | 0.0006 |
| Combination Short-haul Truck | Diesel | Urban Restricted | 0.0121 | 0.0005 | 0.0000 | 0.0005 |
| Combination Short-haul Truck | Diesel | Urban Unrestricted | 0.0388 | 0.0024 | 0.0000 | 0.0024 |
| Combination Long-haul Truck | Diesel | Off-Network | 0.4902 | 0.1094 | 0.0000 | 0.1094 |
| Combination Long-haul Truck | Diesel | Rural Restricted | 0.2985 | 0.0122 | 0.0000 | 0.0122 |
| Combination Long-haul Truck | Diesel | Rural Unrestricted | 0.0401 | 0.0022 | 0.0000 | 0.0022 |
| Combination Long-haul Truck | Diesel | Urban Restricted | 0.0438 | 0.0018 | 0.0000 | 0.0018 |
| Combination Long-haul Truck | Diesel | Urban Unrestricted | 0.1456 | 0.0090 | 0.0000 | 0.0090 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **2.8346** | **0.8775** | **0.5769** | **1.4544** |
| | | | | | | |
| Motorcycle | ALL | ALL | 0.0132 | 0.0169 | 0.0398 | 0.0568 |
| Passenger Car | ALL | ALL | 0.4799 | 0.2674 | 0.3103 | 0.5777 |
| Passenger Truck | ALL | ALL | 0.5296 | 0.2578 | 0.1456 | 0.4033 |
| Light Commercial Truck | ALL | ALL | 0.2353 | 0.1193 | 0.0592 | 0.1785 |
| Intercity Bus | ALL | ALL | 0.0095 | 0.0006 | 0.0000 | 0.0006 |
| Transit Bus | ALL | ALL | 0.0131 | 0.0011 | 0.0000 | 0.0011 |
| School Bus | ALL | ALL | 0.0165 | 0.0026 | 0.0000 | 0.0026 |
| Refuse Truck | ALL | ALL | 0.0342 | 0.0021 | 0.0001 | 0.0022 |
| Single Unit Short-haul Truck | ALL | ALL | 0.3080 | 0.0606 | 0.0174 | 0.0780 |
| Single Unit Long-haul Truck | ALL | ALL | 0.0176 | 0.0031 | 0.0006 | 0.0037 |
| Motor Home | ALL | ALL | 0.0150 | 0.0045 | 0.0039 | 0.0084 |
| Combination Short-haul Truck | ALL | ALL | 0.1445 | 0.0068 | 0.0000 | 0.0068 |
| Combination Long-haul Truck | ALL | ALL | 1.0183 | 0.1346 | 0.0000 | 0.1346 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **2.8346** | **0.8775** | **0.5769** | **1.4544** |
| | | | | | | |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2017 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | **Total** | Exhaust | Evaporative | **Total** |
| ALL | Gasoline | ALL | 1.2507 | 0.6769 | 0.5755 | 1.2524 |
| ALL | Diesel | ALL | 1.5802 | 0.1988 | 0.0000 | 0.1988 |
| ALL | CNG | ALL | 0.0011 | 0.0002 | 0.0000 | 0.0002 |
| ALL | Ethanol (E-85) | ALL | 0.0025 | 0.0016 | 0.0014 | 0.0030 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **2.8346** | **0.8775** | **0.5769** | **1.4544** |
| | | | | | | |
| ALL | ALL | Off-Network | 0.9340 | 0.5912 | 0.4848 | 1.0760 |
| ALL | ALL | Rural Restricted | 0.7508 | 0.0785 | 0.0145 | 0.0930 |
| ALL | ALL | Rural Unrestricted | 0.2335 | 0.0392 | 0.0130 | 0.0522 |
| ALL | ALL | Urban Restricted | 0.1101 | 0.0116 | 0.0022 | 0.0138 |
| ALL | ALL | Urban Unrestricted | 0.8063 | 0.1570 | 0.0624 | 0.2194 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **2.8346** | **0.8775** | **0.5769** | **1.4544** |
| | | | | | | |
| Safety Margin | | | 7½% | | | 7½% |
| **Emissions Budget** | | | **3.0472** | | | **1.5634** |

## Table 5.3

## 2018 Onroad $NO_X$ and VOC Emissions: tons per summer weekday (tpswd) Eastern Kenosha County Nonattainment Area (I-94 and to the East)

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2018 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | Total | Exhaust | Evaporative | Total |
| Motorcycle | Gasoline | Off-Network | 0.0001 | 0.0007 | 0.0300 | 0.0307 |
| Motorcycle | Gasoline | Rural Restricted | 0.0017 | 0.0014 | 0.0006 | 0.0020 |
| Motorcycle | Gasoline | Rural Unrestricted | 0.0030 | 0.0029 | 0.0015 | 0.0044 |
| Motorcycle | Gasoline | Urban Restricted | 0.0002 | 0.0002 | 0.0001 | 0.0003 |
| Motorcycle | Gasoline | Urban Unrestricted | 0.0081 | 0.0114 | 0.0077 | 0.0191 |
| Passenger Car | Gasoline | Off-Network | 0.1593 | 0.1843 | 0.2496 | 0.4340 |
| Passenger Car | Gasoline | Rural Restricted | 0.0807 | 0.0157 | 0.0072 | 0.0229 |
| Passenger Car | Gasoline | Rural Unrestricted | 0.0369 | 0.0075 | 0.0057 | 0.0132 |
| Passenger Car | Gasoline | Urban Restricted | 0.0118 | 0.0023 | 0.0011 | 0.0034 |
| Passenger Car | Gasoline | Urban Unrestricted | 0.1264 | 0.0308 | 0.0285 | 0.0592 |
| Passenger Car | Diesel | Off-Network | 0.0007 | 0.0009 | 0.0000 | 0.0009 |
| Passenger Car | Diesel | Rural Restricted | 0.0005 | 0.0001 | 0.0000 | 0.0001 |
| Passenger Car | Diesel | Rural Unrestricted | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Diesel | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Diesel | Urban Unrestricted | 0.0007 | 0.0001 | 0.0000 | 0.0001 |
| Passenger Car | Ethanol (E-85) | Off-Network | 0.0003 | 0.0005 | 0.0005 | 0.0010 |
| Passenger Car | Ethanol (E-85) | Rural Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Rural Unrestricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Car | Ethanol (E-85) | Urban Unrestricted | 0.0002 | 0.0000 | 0.0001 | 0.0001 |
| Passenger Truck | Gasoline | Off-Network | 0.1447 | 0.1608 | 0.1161 | 0.2769 |
| Passenger Truck | Gasoline | Rural Restricted | 0.0993 | 0.0189 | 0.0040 | 0.0229 |
| Passenger Truck | Gasoline | Rural Unrestricted | 0.0412 | 0.0081 | 0.0032 | 0.0113 |
| Passenger Truck | Gasoline | Urban Restricted | 0.0145 | 0.0028 | 0.0006 | 0.0034 |
| Passenger Truck | Gasoline | Urban Unrestricted | 0.1340 | 0.0320 | 0.0159 | 0.0479 |
| Passenger Truck | Diesel | Off-Network | 0.0042 | 0.0015 | 0.0000 | 0.0015 |
| Passenger Truck | Diesel | Rural Restricted | 0.0071 | 0.0009 | 0.0000 | 0.0009 |
| Passenger Truck | Diesel | Rural Unrestricted | 0.0040 | 0.0006 | 0.0000 | 0.0006 |
| Passenger Truck | Diesel | Urban Restricted | 0.0010 | 0.0001 | 0.0000 | 0.0001 |
| Passenger Truck | Diesel | Urban Unrestricted | 0.0165 | 0.0024 | 0.0000 | 0.0024 |
| Passenger Truck | Ethanol (E-85) | Off-Network | 0.0008 | 0.0011 | 0.0010 | 0.0021 |
| Passenger Truck | Ethanol (E-85) | Rural Restricted | 0.0006 | 0.0001 | 0.0000 | 0.0001 |
| Passenger Truck | Ethanol (E-85) | Rural Unrestricted | 0.0002 | 0.0000 | 0.0000 | 0.0001 |
| Passenger Truck | Ethanol (E-85) | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Passenger Truck | Ethanol (E-85) | Urban Unrestricted | 0.0007 | 0.0001 | 0.0002 | 0.0003 |
| Light Commercial Truck | Gasoline | Off-Network | 0.0605 | 0.0681 | 0.0453 | 0.1133 |
| Light Commercial Truck | Gasoline | Rural Restricted | 0.0372 | 0.0075 | 0.0016 | 0.0090 |
| Light Commercial Truck | Gasoline | Rural Unrestricted | 0.0171 | 0.0039 | 0.0012 | 0.0051 |
| Light Commercial Truck | Gasoline | Urban Restricted | 0.0054 | 0.0011 | 0.0002 | 0.0013 |
| Light Commercial Truck | Gasoline | Urban Unrestricted | 0.0566 | 0.0166 | 0.0062 | 0.0228 |
| Light Commercial Truck | Diesel | Off-Network | 0.0036 | 0.0021 | 0.0000 | 0.0021 |
| Light Commercial Truck | Diesel | Rural Restricted | 0.0059 | 0.0010 | 0.0000 | 0.0010 |
| Light Commercial Truck | Diesel | Rural Unrestricted | 0.0033 | 0.0006 | 0.0000 | 0.0006 |
| Light Commercial Truck | Diesel | Urban Restricted | 0.0009 | 0.0002 | 0.0000 | 0.0002 |
| Light Commercial Truck | Diesel | Urban Unrestricted | 0.0139 | 0.0028 | 0.0000 | 0.0028 |
| Light Commercial Truck | Ethanol (E-85) | Off-Network | 0.0002 | 0.0003 | 0.0002 | 0.0005 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2018 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | Total | Exhaust | Evaporative | Total |
| Light Commercial Truck | Ethanol (E-85) | Rural Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Light Commercial Truck | Ethanol (E-85) | Urban Unrestricted | 0.0001 | 0.0000 | 0.0000 | 0.0001 |
| Intercity Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Intercity Bus | Diesel | Rural Restricted | 0.0020 | 0.0001 | 0.0000 | 0.0001 |
| Intercity Bus | Diesel | Rural Unrestricted | 0.0013 | 0.0001 | 0.0000 | 0.0001 |
| Intercity Bus | Diesel | Urban Restricted | 0.0003 | 0.0000 | 0.0000 | 0.0000 |
| Intercity Bus | Diesel | Urban Unrestricted | 0.0050 | 0.0004 | 0.0000 | 0.0004 |
| Transit Bus | Gasoline | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Gasoline | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Rural Restricted | 0.0030 | 0.0002 | 0.0000 | 0.0002 |
| Transit Bus | Diesel | Rural Unrestricted | 0.0017 | 0.0001 | 0.0000 | 0.0001 |
| Transit Bus | Diesel | Urban Restricted | 0.0004 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | Diesel | Urban Unrestricted | 0.0056 | 0.0005 | 0.0000 | 0.0005 |
| Transit Bus | CNG | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Rural Restricted | 0.0003 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Rural Unrestricted | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Transit Bus | CNG | Urban Unrestricted | 0.0005 | 0.0001 | 0.0000 | 0.0001 |
| School Bus | Gasoline | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Gasoline | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| School Bus | Diesel | Rural Restricted | 0.0044 | 0.0004 | 0.0000 | 0.0004 |
| School Bus | Diesel | Rural Unrestricted | 0.0023 | 0.0004 | 0.0000 | 0.0004 |
| School Bus | Diesel | Urban Restricted | 0.0006 | 0.0001 | 0.0000 | 0.0001 |
| School Bus | Diesel | Urban Unrestricted | 0.0082 | 0.0015 | 0.0000 | 0.0015 |
| Refuse Truck | Gasoline | Off-Network | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| Refuse Truck | Gasoline | Rural Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Gasoline | Rural Unrestricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Gasoline | Urban Unrestricted | 0.0002 | 0.0001 | 0.0000 | 0.0001 |
| Refuse Truck | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Refuse Truck | Diesel | Rural Restricted | 0.0084 | 0.0003 | 0.0000 | 0.0003 |
| Refuse Truck | Diesel | Rural Unrestricted | 0.0040 | 0.0002 | 0.0000 | 0.0002 |
| Refuse Truck | Diesel | Urban Restricted | 0.0012 | 0.0001 | 0.0000 | 0.0001 |
| Refuse Truck | Diesel | Urban Unrestricted | 0.0156 | 0.0010 | 0.0000 | 0.0010 |
| Single Unit Short-haul Truck | Gasoline | Off-Network | 0.0148 | 0.0148 | 0.0140 | 0.0288 |
| Single Unit Short-haul Truck | Gasoline | Rural Restricted | 0.0101 | 0.0019 | 0.0003 | 0.0021 |
| Single Unit Short-haul Truck | Gasoline | Rural Unrestricted | 0.0051 | 0.0011 | 0.0002 | 0.0013 |
| Single Unit Short-haul Truck | Gasoline | Urban Restricted | 0.0015 | 0.0003 | 0.0000 | 0.0003 |
| Single Unit Short-haul Truck | Gasoline | Urban Unrestricted | 0.0174 | 0.0069 | 0.0009 | 0.0079 |
| Single Unit Short-haul Truck | Diesel | Off-Network | 0.0085 | 0.0004 | 0.0000 | 0.0004 |
| Single Unit Short-haul Truck | Diesel | Rural Restricted | 0.0552 | 0.0056 | 0.0000 | 0.0056 |
| Single Unit Short-haul Truck | Diesel | Rural Unrestricted | 0.0282 | 0.0039 | 0.0000 | 0.0039 |
| Single Unit Short-haul Truck | Diesel | Urban Restricted | 0.0082 | 0.0008 | 0.0000 | 0.0008 |
| Single Unit Short-haul Truck | Diesel | Urban Unrestricted | 0.1214 | 0.0170 | 0.0000 | 0.0170 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2018 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | **Total** | Exhaust | Evaporative | **Total** |
| Single Unit Long-haul Truck | Gasoline | Off-Network | 0.0004 | 0.0004 | 0.0005 | 0.0009 |
| Single Unit Long-haul Truck | Gasoline | Rural Restricted | 0.0004 | 0.0001 | 0.0000 | 0.0001 |
| Single Unit Long-haul Truck | Gasoline | Rural Unrestricted | 0.0002 | 0.0000 | 0.0000 | 0.0001 |
| Single Unit Long-haul Truck | Gasoline | Urban Restricted | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Single Unit Long-haul Truck | Gasoline | Urban Unrestricted | 0.0006 | 0.0002 | 0.0000 | 0.0003 |
| Single Unit Long-haul Truck | Diesel | Off-Network | 0.0003 | 0.0000 | 0.0000 | 0.0000 |
| Single Unit Long-haul Truck | Diesel | Rural Restricted | 0.0035 | 0.0004 | 0.0000 | 0.0004 |
| Single Unit Long-haul Truck | Diesel | Rural Unrestricted | 0.0018 | 0.0003 | 0.0000 | 0.0003 |
| Single Unit Long-haul Truck | Diesel | Urban Restricted | 0.0005 | 0.0001 | 0.0000 | 0.0001 |
| Single Unit Long-haul Truck | Diesel | Urban Unrestricted | 0.0079 | 0.0012 | 0.0000 | 0.0012 |
| Motor Home | Gasoline | Off-Network | 0.0009 | 0.0012 | 0.0032 | 0.0044 |
| Motor Home | Gasoline | Rural Restricted | 0.0016 | 0.0004 | 0.0000 | 0.0004 |
| Motor Home | Gasoline | Rural Unrestricted | 0.0007 | 0.0002 | 0.0000 | 0.0002 |
| Motor Home | Gasoline | Urban Restricted | 0.0002 | 0.0001 | 0.0000 | 0.0001 |
| Motor Home | Gasoline | Urban Unrestricted | 0.0025 | 0.0011 | 0.0002 | 0.0012 |
| Motor Home | Diesel | Off-Network | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| Motor Home | Diesel | Rural Restricted | 0.0021 | 0.0002 | 0.0000 | 0.0002 |
| Motor Home | Diesel | Rural Unrestricted | 0.0009 | 0.0001 | 0.0000 | 0.0001 |
| Motor Home | Diesel | Urban Restricted | 0.0003 | 0.0000 | 0.0000 | 0.0000 |
| Motor Home | Diesel | Urban Unrestricted | 0.0038 | 0.0007 | 0.0000 | 0.0007 |
| Combination Short-haul Truck | Gasoline | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Rural Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Rural Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Urban Restricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Gasoline | Urban Unrestricted | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Diesel | Off-Network | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Combination Short-haul Truck | Diesel | Rural Restricted | 0.0730 | 0.0028 | 0.0000 | 0.0028 |
| Combination Short-haul Truck | Diesel | Rural Unrestricted | 0.0090 | 0.0005 | 0.0000 | 0.0005 |
| Combination Short-haul Truck | Diesel | Urban Restricted | 0.0108 | 0.0004 | 0.0000 | 0.0004 |
| Combination Short-haul Truck | Diesel | Urban Unrestricted | 0.0347 | 0.0021 | 0.0000 | 0.0021 |
| Combination Long-haul Truck | Diesel | Off-Network | 0.4827 | 0.1049 | 0.0000 | 0.1049 |
| Combination Long-haul Truck | Diesel | Rural Restricted | 0.2710 | 0.0110 | 0.0000 | 0.0110 |
| Combination Long-haul Truck | Diesel | Rural Unrestricted | 0.0349 | 0.0019 | 0.0000 | 0.0019 |
| Combination Long-haul Truck | Diesel | Urban Restricted | 0.0400 | 0.0016 | 0.0000 | 0.0016 |
| Combination Long-haul Truck | Diesel | Urban Unrestricted | 0.1338 | 0.0082 | 0.0000 | 0.0082 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **2.5603** | **0.7915** | **0.5479** | **1.3394** |
| | | | | | | |
| Motorcycle | ALL | ALL | 0.0132 | 0.0166 | 0.0399 | 0.0565 |
| Passenger Car | ALL | ALL | 0.4181 | 0.2424 | 0.2927 | 0.5351 |
| Passenger Truck | ALL | ALL | 0.4688 | 0.2295 | 0.1410 | 0.3706 |
| Light Commercial Truck | ALL | ALL | 0.2051 | 0.1042 | 0.0548 | 0.1590 |
| Intercity Bus | ALL | ALL | 0.0087 | 0.0006 | 0.0000 | 0.0006 |
| Transit Bus | ALL | ALL | 0.0118 | 0.0010 | 0.0000 | 0.0010 |
| School Bus | ALL | ALL | 0.0156 | 0.0024 | 0.0000 | 0.0024 |
| Refuse Truck | ALL | ALL | 0.0297 | 0.0018 | 0.0001 | 0.0019 |
| Single Unit Short-haul Truck | ALL | ALL | 0.2704 | 0.0527 | 0.0154 | 0.0682 |
| Single Unit Long-haul Truck | ALL | ALL | 0.0157 | 0.0027 | 0.0005 | 0.0032 |
| Motor Home | ALL | ALL | 0.0133 | 0.0040 | 0.0034 | 0.0074 |
| Combination Short-haul Truck | ALL | ALL | 0.1275 | 0.0059 | 0.0000 | 0.0059 |
| Combination Long-haul Truck | ALL | ALL | 0.9625 | 0.1276 | 0.0000 | 0.1276 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **2.5603** | **0.7915** | **0.5479** | **1.3394** |
| | | | | | | |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area – Year 2018 | | | |
|---|---|---|---|---|---|---|
| | | | $NO_x$ Emissions (tpswd) | VOC Emissions (tpswd) | | |
| | | | **Total** | Exhaust | Evaporative | **Total** |
| ALL | Gasoline | ALL | 1.0961 | 0.6062 | 0.5457 | 1.1519 |
| ALL | Diesel | ALL | 1.4596 | 0.1829 | 0.0000 | 0.1829 |
| ALL | CNG | ALL | 0.0011 | 0.0002 | 0.0000 | 0.0002 |
| ALL | Ethanol (E-85) | ALL | 0.0036 | 0.0023 | 0.0022 | 0.0044 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **2.5603** | **0.7915** | **0.5479** | **1.3394** |
| | | | | | | |
| ALL | ALL | Off-Network | 0.8824 | 0.5422 | 0.4605 | 1.0027 |
| ALL | ALL | Rural Restricted | 0.6685 | 0.0691 | 0.0137 | 0.0828 |
| ALL | ALL | Rural Unrestricted | 0.1964 | 0.0327 | 0.0119 | 0.0447 |
| ALL | ALL | Urban Restricted | 0.0984 | 0.0103 | 0.0021 | 0.0123 |
| ALL | ALL | Urban Unrestricted | 0.7145 | 0.1372 | 0.0597 | 0.1969 |
| | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **2.5603** | **0.7915** | **0.5479** | **1.3394** |
| | | | | | | |
| Safety Margin | | | 7½% | | | 7½% |
| **Emissions Budget** | | | **2.7524** | | | **1.4399** |

## Table 5.4

## Vehicle Activity Data Output from the MOVES2014a Model
## Years 2011, 2017 and 2018
## Eastern Kenosha County Nonattainment Area (I-94 and to the East)

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Vehicle Population | | | Vehicle-Miles of Travel Summer Weekday | | |
| | | | 2011 | 2017 | 2018 | 2011 | 2017 | 2018 |
| Motorcycle | Gasoline | Off-Network | 2,969 | 3,173 | 3,178 | | | |
| Motorcycle | Gasoline | Rural Restricted | | | | 2,432 | 2,401 | 2,425 |
| Motorcycle | Gasoline | Rural Unrestricted | | | | 5,148 | 4,585 | 4,396 |
| Motorcycle | Gasoline | Urban Restricted | | | | 10 | 352 | 357 |
| Motorcycle | Gasoline | Urban Unrestricted | | | | 12,768 | 14,704 | 14,896 |
| Passenger Car | Gasoline | Off-Network | 42,762 | 47,160 | 47,481 | | | |
| Passenger Car | Gasoline | Rural Restricted | | | | 435,605 | 448,094 | 451,703 |
| Passenger Car | Gasoline | Rural Unrestricted | | | | 283,285 | 258,637 | 249,525 |
| Passenger Car | Gasoline | Urban Restricted | | | | 1,778 | 65,698 | 66,503 |
| Passenger Car | Gasoline | Urban Unrestricted | | | | 701,940 | 829,537 | 845,616 |
| Passenger Car | Diesel | Off-Network | 181 | 345 | 364 | | | |
| Passenger Car | Diesel | Rural Restricted | | | | 1,777 | 3,600 | 3,848 |
| Passenger Car | Diesel | Rural Unrestricted | | | | 1,156 | 2,078 | 2,126 |
| Passenger Car | Diesel | Urban Restricted | | | | 7 | 528 | 567 |
| Passenger Car | Diesel | Urban Unrestricted | | | | 2,864 | 6,664 | 7,204 |
| Passenger Car | Ethanol (E-85) | Off-Network | 3 | 107 | 161 | | | |
| Passenger Car | Ethanol (E-85) | Rural Restricted | | | | 39 | 1,101 | 1,645 |
| Passenger Car | Ethanol (E-85) | Rural Unrestricted | | | | 25 | 635 | 909 |
| Passenger Car | Ethanol (E-85) | Urban Restricted | | | | 0 | 161 | 242 |
| Passenger Car | Ethanol (E-85) | Urban Unrestricted | | | | 62 | 2,038 | 3,079 |
| Passenger Truck | Gasoline | Off-Network | 28,658 | 31,268 | 31,387 | | | |
| Passenger Truck | Gasoline | Rural Restricted | | | | 339,190 | 339,477 | 340,077 |
| Passenger Truck | Gasoline | Rural Unrestricted | | | | 220,603 | 195,963 | 187,909 |
| Passenger Truck | Gasoline | Urban Restricted | | | | 1,385 | 49,775 | 50,072 |
| Passenger Truck | Gasoline | Urban Unrestricted | | | | 546,594 | 628,480 | 636,769 |
| Passenger Truck | Diesel | Off-Network | 483 | 599 | 611 | | | |
| Passenger Truck | Diesel | Rural Restricted | | | | 5,928 | 6,648 | 6,750 |
| Passenger Truck | Diesel | Rural Unrestricted | | | | 3,855 | 3,837 | 3,730 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Vehicle Population | | | Vehicle-Miles of Travel Summer Weekday | | |
| | | | 2011 | 2017 | 2018 | 2011 | 2017 | 2018 |
| Passenger Truck | Diesel | Urban Restricted | | | | 24 | 975 | 994 |
| Passenger Truck | Diesel | Urban Unrestricted | | | | 9,552 | 12,307 | 12,639 |
| Passenger Truck | Ethanol (E-85) | Off-Network | 7 | 242 | 368 | | | |
| Passenger Truck | Ethanol (E-85) | Rural Restricted | | | | 86 | 2,886 | 4,347 |
| Passenger Truck | Ethanol (E-85) | Rural Unrestricted | | | | 56 | 1,666 | 2,402 |
| Passenger Truck | Ethanol (E-85) | Urban Restricted | | | | 0 | 423 | 640 |
| Passenger Truck | Ethanol (E-85) | Urban Unrestricted | | | | 138 | 5,342 | 8,139 |
| Light Commercial Truck | Gasoline | Off-Network | 6,736 | 7,636 | 7,684 | | | |
| Light Commercial Truck | Gasoline | Rural Restricted | | | | 74,223 | 78,561 | 79,726 |
| Light Commercial Truck | Gasoline | Rural Unrestricted | | | | 48,273 | 45,350 | 44,053 |
| Light Commercial Truck | Gasoline | Urban Restricted | | | | 303 | 11,519 | 11,739 |
| Light Commercial Truck | Gasoline | Urban Unrestricted | | | | 119,608 | 145,442 | 149,281 |
| Light Commercial Truck | Diesel | Off-Network | 380 | 432 | 440 | | | |
| Light Commercial Truck | Diesel | Rural Restricted | | | | 4,241 | 4,451 | 4,549 |
| Light Commercial Truck | Diesel | Rural Unrestricted | | | | 2,758 | 2,570 | 2,514 |
| Light Commercial Truck | Diesel | Urban Restricted | | | | 17 | 653 | 670 |
| Light Commercial Truck | Diesel | Urban Unrestricted | | | | 6,834 | 8,241 | 8,519 |
| Light Commercial Truck | Ethanol (E-85) | Off-Network | 1 | 49 | 77 | | | |
| Light Commercial Truck | Ethanol (E-85) | Rural Restricted | | | | 16 | 585 | 911 |
| Light Commercial Truck | Ethanol (E-85) | Rural Unrestricted | | | | 10 | 338 | 503 |
| Light Commercial Truck | Ethanol (E-85) | Urban Restricted | | | | 0 | 86 | 134 |
| Light Commercial Truck | Ethanol (E-85) | Urban Unrestricted | | | | 25 | 1,083 | 1,705 |
| Intercity Bus | Diesel | Off-Network | 3 | 4 | 4 | | | |
| Intercity Bus | Diesel | Rural Restricted | | | | 238 | 246 | 249 |
| Intercity Bus | Diesel | Rural Unrestricted | | | | 206 | 188 | 182 |
| Intercity Bus | Diesel | Urban Restricted | | | | 1 | 36 | 37 |
| Intercity Bus | Diesel | Urban Unrestricted | | | | 492 | 587 | 599 |
| Transit Bus | Gasoline | Off-Network | 0 | 0 | 0 | | | |
| Transit Bus | Gasoline | Rural Restricted | | | | 6 | 9 | 9 |
| Transit Bus | Gasoline | Rural Unrestricted | | | | 5 | 7 | 7 |
| Transit Bus | Gasoline | Urban Restricted | | | | 0 | 1 | 1 |
| Transit Bus | Gasoline | Urban Unrestricted | | | | 13 | 21 | 22 |
| Transit Bus | Diesel | Off-Network | 11 | 13 | 13 | | | |
| Transit Bus | Diesel | Rural Restricted | | | | 423 | 415 | 419 |
| Transit Bus | Diesel | Rural Unrestricted | | | | 367 | 317 | 306 |
| Transit Bus | Diesel | Urban Restricted | | | | 2 | 61 | 62 |
| Transit Bus | Diesel | Urban Unrestricted | | | | 876 | 989 | 1,010 |
| Transit Bus | CNG | Off-Network | 1 | 2 | 2 | | | |
| Transit Bus | CNG | Rural Restricted | | | | 57 | 67 | 69 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Vehicle Population | | | Vehicle-Miles of Travel Summer Weekday | | |
| | | | 2011 | 2017 | 2018 | 2011 | 2017 | 2018 |
| Transit Bus | CNG | Rural Unrestricted | | | | 49 | 51 | 50 |
| Transit Bus | CNG | Urban Restricted | | | | 0 | 10 | 10 |
| Transit Bus | CNG | Urban Unrestricted | | | | 118 | 159 | 166 |
| School Bus | Gasoline | Off-Network | 2 | 1 | 1 | | | |
| School Bus | Gasoline | Rural Restricted | | | | 23 | 15 | 15 |
| School Bus | Gasoline | Rural Unrestricted | | | | 20 | 12 | 11 |
| School Bus | Gasoline | Urban Restricted | | | | 0 | 2 | 2 |
| School Bus | Gasoline | Urban Unrestricted | | | | 48 | 37 | 37 |
| School Bus | Diesel | Off-Network | 106 | 130 | 131 | | | |
| School Bus | Diesel | Rural Restricted | | | | 1,295 | 1,349 | 1,361 |
| School Bus | Diesel | Rural Unrestricted | | | | 1,122 | 1,031 | 993 |
| School Bus | Diesel | Urban Restricted | | | | 5 | 198 | 200 |
| School Bus | Diesel | Urban Unrestricted | | | | 2,679 | 3,214 | 3,280 |
| Refuse Truck | Gasoline | Off-Network | 4 | 3 | 3 | | | |
| Refuse Truck | Gasoline | Rural Restricted | | | | 81 | 34 | 29 |
| Refuse Truck | Gasoline | Rural Unrestricted | | | | 50 | 18 | 15 |
| Refuse Truck | Gasoline | Urban Restricted | | | | 0 | 5 | 4 |
| Refuse Truck | Gasoline | Urban Unrestricted | | | | 119 | 57 | 49 |
| Refuse Truck | Diesel | Off-Network | 70 | 87 | 89 | | | |
| Refuse Truck | Diesel | Rural Restricted | | | | 1,833 | 1,911 | 1,936 |
| Refuse Truck | Diesel | Rural Unrestricted | | | | 1,120 | 1,030 | 996 |
| Refuse Truck | Diesel | Urban Restricted | | | | 8 | 280 | 285 |
| Refuse Truck | Diesel | Urban Unrestricted | | | | 2,679 | 3,216 | 3,293 |
| Single Unit Short-haul Truck | Gasoline | Off-Network | 830 | 949 | 954 | | | |
| Single Unit Short-haul Truck | Gasoline | Rural Restricted | | | | 11,934 | 12,651 | 12,884 |
| Single Unit Short-haul Truck | Gasoline | Rural Unrestricted | | | | 7,292 | 6,819 | 6,631 |
| Single Unit Short-haul Truck | Gasoline | Urban Restricted | | | | 49 | 1,855 | 1,897 |
| Single Unit Short-haul Truck | Gasoline | Urban Unrestricted | | | | 17,439 | 21,289 | 21,917 |
| Single Unit Short-haul Truck | Diesel | Off-Network | 1,639 | 1,985 | 2,016 | | | |
| Single Unit Short-haul Truck | Diesel | Rural Restricted | | | | 27,126 | 27,778 | 28,133 |
| Single Unit Short-haul Truck | Diesel | Rural Unrestricted | | | | 16,576 | 14,973 | 14,479 |
| Single Unit Short-haul Truck | Diesel | Urban Restricted | | | | 111 | 4,073 | 4,142 |
| Single Unit Short-haul Truck | Diesel | Urban Unrestricted | | | | 39,640 | 46,745 | 47,858 |
| Single Unit Long-haul Truck | Gasoline | Off-Network | 27 | 20 | 18 | | | |
| Single Unit Long-haul Truck | Gasoline | Rural Restricted | | | | 399 | 134 | 115 |
| Single Unit Long-haul Truck | Gasoline | Rural Unrestricted | | | | 244 | 72 | 59 |
| Single Unit Long-haul Truck | Gasoline | Urban Restricted | | | | 2 | 20 | 17 |
| Single Unit Long-haul Truck | Gasoline | Urban Unrestricted | | | | 583 | 226 | 195 |
| Single Unit Long-haul Truck | Diesel | Off-Network | 76 | 104 | 108 | | | |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Vehicle Population | | | Vehicle-Miles of Travel Summer Weekday | | |
| | | | 2011 | 2017 | 2018 | 2011 | 2017 | 2018 |
| Single Unit Long-haul Truck | Diesel | Rural Restricted | | | | 1,733 | 2,137 | 2,217 |
| Single Unit Long-haul Truck | Diesel | Rural Unrestricted | | | | 1,059 | 1,152 | 1,141 |
| Single Unit Long-haul Truck | Diesel | Urban Restricted | | | | 7 | 313 | 326 |
| Single Unit Long-haul Truck | Diesel | Urban Unrestricted | | | | 2,533 | 3,595 | 3,772 |
| Motor Home | Gasoline | Off-Network | 403 | 433 | 429 | | | |
| Motor Home | Gasoline | Rural Restricted | | | | 942 | 870 | 843 |
| Motor Home | Gasoline | Rural Unrestricted | | | | 575 | 469 | 434 |
| Motor Home | Gasoline | Urban Restricted | | | | 4 | 128 | 124 |
| Motor Home | Gasoline | Urban Unrestricted | | | | 1,376 | 1,464 | 1,435 |
| Motor Home | Diesel | Off-Network | 214 | 304 | 317 | | | |
| Motor Home | Diesel | Rural Restricted | | | | 500 | 611 | 624 |
| Motor Home | Diesel | Rural Unrestricted | | | | 306 | 329 | 321 |
| Motor Home | Diesel | Urban Restricted | | | | 2 | 90 | 92 |
| Motor Home | Diesel | Urban Unrestricted | | | | 731 | 1,028 | 1,061 |
| Combination Short-haul Truck | Gasoline | Off-Network | 0 | 0 | 0 | | | |
| Combination Short-haul Truck | Gasoline | Rural Restricted | | | | 5 | 1 | 1 |
| Combination Short-haul Truck | Gasoline | Rural Unrestricted | | | | 1 | 0 | 0 |
| Combination Short-haul Truck | Gasoline | Urban Restricted | | | | 0 | 0 | 0 |
| Combination Short-haul Truck | Gasoline | Urban Unrestricted | | | | 2 | 1 | 0 |
| Combination Short-haul Truck | Diesel | Off-Network | 223 | 260 | 261 | | | |
| Combination Short-haul Truck | Diesel | Rural Restricted | | | | 13,753 | 15,603 | 16,162 |
| Combination Short-haul Truck | Diesel | Rural Unrestricted | | | | 2,231 | 2,228 | 2,204 |
| Combination Short-haul Truck | Diesel | Urban Restricted | | | | 56 | 2,288 | 2,380 |
| Combination Short-haul Truck | Diesel | Urban Unrestricted | | | | 5,328 | 6,953 | 7,281 |
| Combination Long-haul Truck | Diesel | Off-Network | 235 | 294 | 301 | | | |
| Combination Long-haul Truck | Diesel | Rural Restricted | | | | 48,784 | 48,933 | 49,277 |
| Combination Long-haul Truck | Diesel | Rural Unrestricted | | | | 7,915 | 6,986 | 6,720 |
| Combination Long-haul Truck | Diesel | Urban Restricted | | | | 199 | 7,175 | 7,255 |
| Combination Long-haul Truck | Diesel | Urban Unrestricted | | | | 18,899 | 21,805 | 22,200 |
| | | | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **86,026** | **95,601** | **96,399** | **3,074,892** | **3,463,833** | **3,493,710** |
| | | | | | | | | |
| Motorcycle | ALL | ALL | 2,969 | 3,173 | 3,178 | 20,358 | 22,042 | 22,073 |
| Passenger Car | ALL | ALL | 42,946 | 47,611 | 48,007 | 1,428,539 | 1,618,770 | 1,632,965 |
| Passenger Truck | ALL | ALL | 29,147 | 32,109 | 32,366 | 1,127,411 | 1,247,779 | 1,254,468 |
| Light Commercial Truck | ALL | ALL | 7,117 | 8,118 | 8,201 | 256,310 | 298,877 | 304,303 |
| Intercity Bus | ALL | ALL | 3 | 4 | 4 | 937 | 1,058 | 1,066 |
| Transit Bus | ALL | ALL | 12 | 15 | 15 | 1,917 | 2,106 | 2,131 |
| School Bus | ALL | ALL | 108 | 131 | 132 | 5,192 | 5,857 | 5,900 |

| Source Type | Fuel Type | Road Type | Eastern Kenosha County Nonattainment Area | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Vehicle Population | | | Vehicle-Miles of Travel Summer Weekday | | |
| | | | 2011 | 2017 | 2018 | 2011 | 2017 | 2018 |
| Refuse Truck | ALL | ALL | 75 | 90 | 92 | 5,890 | 6,552 | 6,606 |
| Single Unit Short-haul Truck | ALL | ALL | 2,469 | 2,934 | 2,970 | 120,167 | 136,184 | 137,939 |
| Single Unit Long-haul Truck | ALL | ALL | 104 | 124 | 126 | 6,560 | 7,649 | 7,843 |
| Motor Home | ALL | ALL | 617 | 736 | 746 | 4,436 | 4,987 | 4,934 |
| Combination Short-haul Truck | ALL | ALL | 224 | 260 | 261 | 21,376 | 27,073 | 28,029 |
| Combination Long-haul Truck | ALL | ALL | 235 | 294 | 301 | 75,798 | 84,898 | 85,451 |
| | | | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **86,026** | **95,601** | **96,399** | **3,074,892** | **3,463,833** | **3,493,710** |
| | | | | | | | | |
| ALL | Gasoline | ALL | 82,392 | 90,645 | 91,137 | 2,834,357 | 3,164,791 | 3,181,800 |
| ALL | Diesel | ALL | 3,622 | 4,555 | 4,653 | 239,852 | 282,413 | 286,958 |
| ALL | CNG | ALL | 1 | 2 | 2 | 225 | 286 | 296 |
| ALL | Ethanol (E-85) | ALL | 11 | 398 | 607 | 458 | 16,344 | 24,656 |
| | | | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **86,026** | **95,601** | **96,399** | **3,074,892** | **3,463,833** | **3,493,710** |
| | | | | | | | | |
| ALL | ALL | Off-Network | 86,026 | 95,601 | 96,399 | | | |
| ALL | ALL | Rural Restricted | | | | 972,669 | 1,000,568 | 1,010,322 |
| ALL | ALL | Rural Unrestricted | | | | 604,310 | 551,340 | 532,613 |
| ALL | ALL | Urban Restricted | | | | 3,972 | 146,703 | 148,752 |
| ALL | ALL | Urban Unrestricted | | | | 1,493,941 | 1,765,222 | 1,802,022 |
| | | | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | **86,026** | **95,601** | **96,399** | **3,074,892** | **3,463,833** | **3,493,710** |

# APPENDIX 6

# Nonroad Emissions for 2011, 2017 and 2018

This appendix provides detailed listings of the estimated nonroad emissions data for over 200 subcategories for eastern Kenosha for 2011, 2017 and 2018. The sum of NOx and VOC emissions from the different nonroad source types were used for the onroad sector NOx and VOC tons per summer day (tpsd) emission estimates in sections 3.2 (2011 Base Year Inventory for RFP) and 3.3 (2017 & 2018 Projected Year Inventories for RFP) of the Wisconsin Department of Natural Resources (WDNR) eastern Kenosha County attainment plan.

# Table 6.1

## 2011 Nonroad $NO_X$ and VOC Emissions: tons per summer day (tpsd)
## Kenosha County and Eastern Kenosha County Nonattainment Area (NAA)

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2011 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2011 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2260001010 | Recreational | 2-Stroke Motorcycles: Off-Road | MOVES | 0.0009 | 0.1401 | 30.9% | 30.9% | land area | 0.0003 | 0.0433 |
| 2260001020 | Recreational | 2-Stroke Snowmobiles | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2260001030 | Recreational | 2-Stroke All Terrain Vehicles | MOVES | 0.0013 | 0.1626 | 30.9% | 30.9% | land area | 0.0004 | 0.0502 |
| 2260001060 | Recreational | 2-Stroke Specialty Vehicle Carts | MOVES | 0.0004 | 0.0013 | 30.9% | 30.9% | land area | 0.0001 | 0.0004 |
| 2260002006 | Construction | 2-Stroke Tampers/Rammers | MOVES | 0.0001 | 0.0055 | 77.2% | 77.2% | population | 0.0001 | 0.0042 |
| 2260002009 | Construction | 2-Stroke Plate Compactors | MOVES | 0.0000 | 0.0002 | 77.2% | 77.2% | population | 0.0000 | 0.0002 |
| 2260002021 | Construction | 2-Stroke Paving Equipment | MOVES | 0.0000 | 0.0002 | 77.2% | 77.2% | population | 0.0000 | 0.0002 |
| 2260002027 | Construction | 2-Stroke Signal Boards | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2260002039 | Construction | 2-Stroke Concrete/Industrial Saws | MOVES | 0.0004 | 0.0138 | 77.2% | 77.2% | population | 0.0003 | 0.0107 |
| 2260002054 | Construction | 2-Stroke Crushing/Proc. Equipment | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2260003030 | Industrial | 2-Stroke Sweepers/Scrubbers | MOVES | 0.0000 | 0.0001 | 77.2% | 77.2% | population | 0.0000 | 0.0001 |
| 2260003040 | Industrial | 2-Stroke Other General Industrial Equipment | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2260004015 | Lawn/Garden | 2-Stroke Rotary Tillers < 6 HP (Residential) | MOVES | 0.0001 | 0.0022 | 77.2% | 77.2% | population | 0.0001 | 0.0017 |
| 2260004016 | Lawn/Garden | 2-Stroke Rotary Tillers < 6 HP (Commercial) | MOVES | 0.0002 | 0.0034 | 77.2% | 77.2% | population | 0.0001 | 0.0026 |
| 2260004020 | Lawn/Garden | 2-Stroke Chain Saws < 6 HP (Residential) | MOVES | 0.0005 | 0.0175 | 77.2% | 77.2% | population | 0.0004 | 0.0135 |
| 2260004021 | Lawn/Garden | 2-Stroke Chain Saws < 6 HP (Commercial) | MOVES | 0.0009 | 0.0382 | 77.2% | 77.2% | population | 0.0007 | 0.0295 |
| 2260004025 | Lawn/Garden | 2-Stroke Trimmers/Edgers/Brush Cutters (Res.) | MOVES | 0.0014 | 0.0419 | 77.2% | 77.2% | population | 0.0011 | 0.0323 |
| 2260004026 | Lawn/Garden | 2-Stroke Trimmers/Edgers/Brush Cutters (Com.) | MOVES | 0.0015 | 0.0386 | 77.2% | 77.2% | population | 0.0012 | 0.0298 |
| 2260004030 | Lawn/Garden | 2-Stroke Leafblowers/Vacuums (Residential) | MOVES | 0.0009 | 0.0276 | 77.2% | 77.2% | population | 0.0007 | 0.0213 |
| 2260004031 | Lawn/Garden | 2-Stroke Leafblowers/Vacuums (Commercial) | MOVES | 0.0014 | 0.0384 | 77.2% | 77.2% | population | 0.0011 | 0.0297 |
| 2260004035 | Lawn/Garden | 2-Stroke Snowblowers (Residential) | MOVES | 0.0000 | 0.0048 | 77.2% | 77.2% | population | 0.0000 | 0.0037 |
| 2260004036 | Lawn/Garden | 2-Stroke Snowblowers (Commercial) | MOVES | 0.0000 | 0.0003 | 77.2% | 77.2% | population | 0.0000 | 0.0002 |
| 2260004071 | Lawn/Garden | 2-Stroke Commercial Turf Equipment | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2260005035 | Agriculture | 2-Stroke Sprayers | MOVES | 0.0000 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0001 |
| 2260006005 | Commercial | 2-Stroke Light Commercial Generator Set | MOVES | 0.0000 | 0.0012 | 77.2% | 77.2% | population | 0.0000 | 0.0009 |
| 2260006010 | Commercial | 2-Stroke Light Commercial Pumps | MOVES | 0.0003 | 0.0083 | 77.2% | 77.2% | population | 0.0002 | 0.0064 |
| 2260006015 | Commercial | 2-Stroke Light Commercial Air Compressors | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2260006035 | Commercial | 2-Stroke Hydro Power Units | MOVES | 0.0000 | 0.0001 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2260007005 | Logging | 2-Stroke Logging Equipment Chain Saws > 6 HP | MOVES | 0.0000 | 0.0004 | 30.9% | 30.9% | land area | 0.0000 | 0.0001 |
| 2265001010 | Recreational | 4-Stroke Motorcycles: Off-Road | MOVES | 0.0007 | 0.0058 | 30.9% | 30.9% | land area | 0.0002 | 0.0018 |
| 2265001030 | Recreational | 4-Stroke All Terrain Vehicles | MOVES | 0.0061 | 0.0647 | 30.9% | 30.9% | land area | 0.0019 | 0.0200 |
| 2265001050 | Recreational | 4-Stroke Golf Carts | MOVES | 0.0046 | 0.0141 | 30.9% | 30.9% | land area | 0.0014 | 0.0043 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2011 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2011 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2265001060 | Recreational | 4-Stroke Specialty Vehicle Carts | MOVES | 0.0003 | 0.0014 | 30.9% | 30.9% | land area | 0.0001 | 0.0004 |
| 2265002003 | Construction | 4-Stroke Asphalt Pavers | MOVES | 0.0002 | 0.0004 | 77.2% | 77.2% | population | 0.0001 | 0.0003 |
| 2265002006 | Construction | 4-Stroke Tampers/Rammers | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2265002009 | Construction | 4-Stroke Plate Compactors | MOVES | 0.0003 | 0.0013 | 77.2% | 77.2% | population | 0.0002 | 0.0010 |
| 2265002015 | Construction | 4-Stroke Rollers | MOVES | 0.0003 | 0.0006 | 77.2% | 77.2% | population | 0.0002 | 0.0005 |
| 2265002021 | Construction | 4-Stroke Paving Equipment | MOVES | 0.0006 | 0.0022 | 77.2% | 77.2% | population | 0.0005 | 0.0017 |
| 2265002024 | Construction | 4-Stroke Surfacing Equipment | MOVES | 0.0002 | 0.0008 | 77.2% | 77.2% | population | 0.0002 | 0.0006 |
| 2265002027 | Construction | 4-Stroke Signal Boards | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2265002030 | Construction | 4-Stroke Trenchers | MOVES | 0.0006 | 0.0014 | 77.2% | 77.2% | population | 0.0004 | 0.0011 |
| 2265002033 | Construction | 4-Stroke Bore/Drill Rigs | MOVES | 0.0002 | 0.0009 | 77.2% | 77.2% | population | 0.0002 | 0.0007 |
| 2265002039 | Construction | 4-Stroke Concrete/Industrial Saws | MOVES | 0.0008 | 0.0021 | 77.2% | 77.2% | population | 0.0006 | 0.0016 |
| 2265002042 | Construction | 4-Stroke Cement & Mortar Mixers | MOVES | 0.0005 | 0.0029 | 77.2% | 77.2% | population | 0.0004 | 0.0022 |
| 2265002045 | Construction | 4-Stroke Cranes | MOVES | 0.0001 | 0.0001 | 77.2% | 77.2% | population | 0.0001 | 0.0001 |
| 2265002054 | Construction | 4-Stroke Crushing/Proc. Equipment | MOVES | 0.0001 | 0.0002 | 77.2% | 77.2% | population | 0.0001 | 0.0002 |
| 2265002057 | Construction | 4-Stroke Rough Terrain Forklifts | MOVES | 0.0001 | 0.0001 | 77.2% | 77.2% | population | 0.0001 | 0.0001 |
| 2265002060 | Construction | 4-Stroke Rubber Tire Loaders | MOVES | 0.0002 | 0.0001 | 77.2% | 77.2% | population | 0.0002 | 0.0001 |
| 2265002066 | Construction | 4-Stroke Tractors/Loaders/Backhoes | MOVES | 0.0003 | 0.0008 | 77.2% | 77.2% | population | 0.0002 | 0.0006 |
| 2265002072 | Construction | 4-Stroke Skid Steer Loaders | MOVES | 0.0004 | 0.0005 | 77.2% | 77.2% | population | 0.0003 | 0.0004 |
| 2265002078 | Construction | 4-Stroke Dumpers/Tenders | MOVES | 0.0001 | 0.0004 | 77.2% | 77.2% | population | 0.0001 | 0.0003 |
| 2265002081 | Construction | 4-Stroke Other Construction Equipment | MOVES | 0.0002 | 0.0001 | 77.2% | 77.2% | population | 0.0001 | 0.0001 |
| 2265003010 | Industrial | 4-Stroke Aerial Lifts | MOVES | 0.0019 | 0.0018 | 77.2% | 77.2% | population | 0.0015 | 0.0014 |
| 2265003020 | Industrial | 4-Stroke Forklifts | MOVES | 0.0042 | 0.0025 | 77.2% | 77.2% | population | 0.0032 | 0.0019 |
| 2265003030 | Industrial | 4-Stroke Sweepers/Scrubbers | MOVES | 0.0006 | 0.0009 | 77.2% | 77.2% | population | 0.0004 | 0.0007 |
| 2265003040 | Industrial | 4-Stroke Other General Industrial Equipment | MOVES | 0.0009 | 0.0040 | 77.2% | 77.2% | population | 0.0007 | 0.0031 |
| 2265003050 | Industrial | 4-Stroke Other Material Handling Equipment | MOVES | 0.0001 | 0.0001 | 77.2% | 77.2% | population | 0.0001 | 0.0001 |
| 2265003060 | Industrial | 4-Stroke Industrial AC/Refrigeration | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2265003070 | Industrial | 4-Stroke Terminal Tractors | MOVES | 0.0001 | 0.0001 | 77.2% | 77.2% | population | 0.0001 | 0.0001 |
| 2265004010 | Lawn/Garden | 4-Stroke Lawn mowers (Residential) | MOVES | 0.0162 | 0.1863 | 77.2% | 77.2% | population | 0.0125 | 0.1438 |
| 2265004011 | Lawn/Garden | 4-Stroke Lawn mowers (Commercial) | MOVES | 0.0051 | 0.0383 | 77.2% | 77.2% | population | 0.0039 | 0.0296 |
| 2265004015 | Lawn/Garden | 4-Stroke Rotary Tillers < 6 HP (Residential) | MOVES | 0.0014 | 0.0157 | 77.2% | 77.2% | population | 0.0011 | 0.0122 |
| 2265004016 | Lawn/Garden | 4-Stroke Rotary Tillers < 6 HP (Commercial) | MOVES | 0.0027 | 0.0229 | 77.2% | 77.2% | population | 0.0021 | 0.0177 |
| 2265004025 | Lawn/Garden | 4-Stroke Trimmers/Edgers/Brush Cutters (Res.) | MOVES | 0.0001 | 0.0010 | 77.2% | 77.2% | population | 0.0001 | 0.0007 |
| 2265004026 | Lawn/Garden | 4-Stroke Trimmers/Edgers/Brush Cutters (Com.) | MOVES | 0.0001 | 0.0008 | 77.2% | 77.2% | population | 0.0001 | 0.0006 |
| 2265004030 | Lawn/Garden | 4-Stroke Leafblowers/Vacuums (Residential) | MOVES | 0.0002 | 0.0018 | 77.2% | 77.2% | population | 0.0001 | 0.0014 |
| 2265004031 | Lawn/Garden | 4-Stroke Leafblowers/Vacuums (Commercial) | MOVES | 0.0066 | 0.0168 | 77.2% | 77.2% | population | 0.0051 | 0.0130 |
| 2265004035 | Lawn/Garden | 4-Stroke Snowblowers (Residential) | MOVES | 0.0000 | 0.0093 | 77.2% | 77.2% | population | 0.0000 | 0.0071 |
| 2265004036 | Lawn/Garden | 4-Stroke Snowblowers (Commercial) | MOVES | 0.0000 | 0.0006 | 77.2% | 77.2% | population | 0.0000 | 0.0005 |
| 2265004040 | Lawn/Garden | 4-Stroke Rear Engine Riding Mowers (Res.) | MOVES | 0.0035 | 0.0183 | 77.2% | 77.2% | population | 0.0027 | 0.0142 |
| 2265004041 | Lawn/Garden | 4-Stroke Rear Engine Riding Mowers (Comm.) | MOVES | 0.0006 | 0.0017 | 77.2% | 77.2% | population | 0.0005 | 0.0013 |
| 2265004046 | Lawn/Garden | 4-Stroke Front Mowers (Commercial) | MOVES | 0.0008 | 0.0027 | 77.2% | 77.2% | population | 0.0006 | 0.0021 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2011 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2011 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2265004051 | Lawn/Garden | 4-Stroke Shredders < 6 HP (Commercial) | MOVES | 0.0003 | 0.0028 | 77.2% | 77.2% | population | 0.0002 | 0.0022 |
| 2265004055 | Lawn/Garden | 4-Stroke Lawn & Garden Tractors (Residential) | MOVES | 0.0469 | 0.1906 | 77.2% | 77.2% | population | 0.0362 | 0.1472 |
| 2265004056 | Lawn/Garden | 4-Stroke Lawn & Garden Tractors (Commercial) | MOVES | 0.0085 | 0.0212 | 77.2% | 77.2% | population | 0.0065 | 0.0164 |
| 2265004066 | Lawn/Garden | 4-Stroke Chippers/Stump Grinders (Comm.) | MOVES | 0.0015 | 0.0024 | 77.2% | 77.2% | population | 0.0012 | 0.0019 |
| 2265004071 | Lawn/Garden | 4-Stroke Commercial Turf Equipment (Comm.) | MOVES | 0.0254 | 0.0734 | 77.2% | 77.2% | population | 0.0196 | 0.0567 |
| 2265004075 | Lawn/Garden | 4-Stroke Other Lawn & Garden Equip. (Res.) | MOVES | 0.0017 | 0.0110 | 77.2% | 77.2% | population | 0.0013 | 0.0085 |
| 2265004076 | Lawn/Garden | 4-Stroke Other Lawn & Garden Equip. (Com.) | MOVES | 0.0009 | 0.0059 | 77.2% | 77.2% | population | 0.0007 | 0.0046 |
| 2265005010 | Agriculture | 4-Stroke 2-Wheel Tractors | MOVES | 0.0000 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005015 | Agriculture | 4-Stroke Agricultural Tractors | MOVES | 0.0003 | 0.0002 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0001 |
| 2265005020 | Agriculture | 4-Stroke Combines | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005025 | Agriculture | 4-Stroke Balers | MOVES | 0.0004 | 0.0004 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0001 |
| 2265005030 | Agriculture | 4-Stroke Agricultural Mowers | MOVES | 0.0000 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005035 | Agriculture | 4-Stroke Sprayers | MOVES | 0.0008 | 0.0019 | 24.2% | 24.2% | land area (1) | 0.0002 | 0.0005 |
| 2265005040 | Agriculture | 4-Stroke Tillers > 5 HP | MOVES | 0.0010 | 0.0048 | 24.2% | 24.2% | land area (1) | 0.0002 | 0.0012 |
| 2265005045 | Agriculture | 4-Stroke Swathers | MOVES | 0.0007 | 0.0005 | 24.2% | 24.2% | land area (1) | 0.0002 | 0.0001 |
| 2265005055 | Agriculture | 4-Stroke Other Agricultural Equipment | MOVES | 0.0008 | 0.0008 | 24.2% | 24.2% | land area (1) | 0.0002 | 0.0002 |
| 2265005060 | Agriculture | 4-Stroke Irrigation Sets | MOVES | 0.0004 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0001 |
| 2265006005 | Commercial | 4-Stroke Light Commercial Generator Set | MOVES | 0.0127 | 0.0579 | 77.2% | 77.2% | population | 0.0098 | 0.0447 |
| 2265006010 | Commercial | 4-Stroke Light Commercial Pumps | MOVES | 0.0033 | 0.0135 | 77.2% | 77.2% | population | 0.0025 | 0.0104 |
| 2265006015 | Commercial | 4-Stroke Light Commercial Air Compressors | MOVES | 0.0019 | 0.0054 | 77.2% | 77.2% | population | 0.0014 | 0.0041 |
| 2265006025 | Commercial | 4-Stroke Light Commercial Welders | MOVES | 0.0036 | 0.0090 | 77.2% | 77.2% | population | 0.0028 | 0.0070 |
| 2265006030 | Commercial | 4-Stroke Light Commercial Pressure Wash | MOVES | 0.0052 | 0.0257 | 77.2% | 77.2% | population | 0.0040 | 0.0199 |
| 2265006035 | Commercial | 4-Stroke Hydro Power Units | MOVES | 0.0002 | 0.0008 | 77.2% | 77.2% | population | 0.0002 | 0.0006 |
| 2265007010 | Logging | 4-Stroke Logging Equipment Shredders > 6 HP | MOVES | 0.0000 | 0.0001 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2265007015 | Logging | 4-Stroke Logging Equipment Skidders | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2265008005 | Airport Support | 4-Stroke Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2265010010 | Oil Field | 4-Stroke Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2267001060 | Recreational | LPG Specialty Vehicle Carts | MOVES | 0.0001 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2267002003 | Construction | LPG Asphalt Pavers | MOVES | 0.0001 | 0.0000 | 77.2% | 77.2% | population | 0.0001 | 0.0000 |
| 2267002015 | Construction | LPG Rollers | MOVES | 0.0001 | 0.0000 | 77.2% | 77.2% | population | 0.0001 | 0.0000 |
| 2267002021 | Construction | LPG Paving Equipment | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2267002024 | Construction | LPG Surfacing Equipment | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2267002030 | Construction | LPG Trenchers | MOVES | 0.0002 | 0.0001 | 77.2% | 77.2% | population | 0.0002 | 0.0000 |
| 2267002033 | Construction | LPG Bore/Drill Rigs | MOVES | 0.0001 | 0.0000 | 77.2% | 77.2% | population | 0.0001 | 0.0000 |
| 2267002039 | Construction | LPG Concrete/Industrial Saws | MOVES | 0.0001 | 0.0000 | 77.2% | 77.2% | population | 0.0001 | 0.0000 |
| 2267002045 | Construction | LPG Cranes | MOVES | 0.0001 | 0.0000 | 77.2% | 77.2% | population | 0.0001 | 0.0000 |
| 2267002054 | Construction | LPG Crushing/Proc. Equipment | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2267002057 | Construction | LPG Rough Terrain Forklifts | MOVES | 0.0002 | 0.0000 | 77.2% | 77.2% | population | 0.0001 | 0.0000 |
| 2267002060 | Construction | LPG Rubber Tire Loaders | MOVES | 0.0003 | 0.0001 | 77.2% | 77.2% | population | 0.0002 | 0.0001 |
| 2267002066 | Construction | LPG Tractors/Loaders/Backhoes | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2011 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2011 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2267002072 | Construction | LPG Skid Steer Loaders | MOVES | 0.0004 | 0.0001 | 77.2% | 77.2% | population | 0.0003 | 0.0001 |
| 2267002081 | Construction | LPG Other Construction Equipment | MOVES | 0.0002 | 0.0000 | 77.2% | 77.2% | population | 0.0002 | 0.0000 |
| 2267003010 | Industrial | LPG Aerial Lifts | MOVES | 0.0042 | 0.0009 | 77.2% | 77.2% | population | 0.0032 | 0.0007 |
| 2267003020 | Industrial | LPG Forklifts | MOVES | 0.2060 | 0.0452 | 77.2% | 77.2% | population | 0.1590 | 0.0349 |
| 2267003030 | Industrial | LPG Sweepers/Scrubbers | MOVES | 0.0010 | 0.0002 | 77.2% | 77.2% | population | 0.0008 | 0.0002 |
| 2267003040 | Industrial | LPG Other General Industrial Equipment | MOVES | 0.0004 | 0.0001 | 77.2% | 77.2% | population | 0.0003 | 0.0001 |
| 2267003050 | Industrial | LPG Other Material Handling Equipment | MOVES | 0.0002 | 0.0000 | 77.2% | 77.2% | population | 0.0002 | 0.0000 |
| 2267003070 | Industrial | LPG Terminal Tractors | MOVES | 0.0004 | 0.0001 | 77.2% | 77.2% | population | 0.0003 | 0.0000 |
| 2267004066 | Lawn/Garden | LPG Chippers/Stump Grinders (Commercial) | MOVES | 0.0009 | 0.0002 | 77.2% | 77.2% | population | 0.0007 | 0.0001 |
| 2267005055 | Agriculture | LPG Other Agricultural Equipment | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2267005060 | Agriculture | LPG Irrigation Sets | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2267006005 | Commercial | LPG Light Commercial Generator Sets | MOVES | 0.0061 | 0.0010 | 77.2% | 77.2% | population | 0.0047 | 0.0008 |
| 2267006010 | Commercial | LPG Light Commercial Pumps | MOVES | 0.0011 | 0.0002 | 77.2% | 77.2% | population | 0.0008 | 0.0001 |
| 2267006015 | Commercial | LPG Light Commercial Air Compressors | MOVES | 0.0010 | 0.0002 | 77.2% | 77.2% | population | 0.0008 | 0.0001 |
| 2267006025 | Commercial | LPG Light Commercial Welders | MOVES | 0.0014 | 0.0003 | 77.2% | 77.2% | population | 0.0011 | 0.0002 |
| 2267006030 | Commercial | LPG Light Commercial Pressure Washers | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2267006035 | Commercial | LPG Hydro Power Units | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2267008005 | Airport Support | LPG Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2268002081 | Construction | CNG Other Construction Equipment | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2268003020 | Industrial | CNG Forklifts | MOVES | 0.0147 | 0.0115 | 77.2% | 77.2% | population | 0.0114 | 0.0089 |
| 2268003030 | Industrial | CNG Sweepers/Scrubbers | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2268003040 | Industrial | CNG Other General Industrial Equipment | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2268003060 | Industrial | CNG AC/Refrigeration | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2268003070 | Industrial | CNG Terminal Tractors | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2268005055 | Agriculture | CNG Other Agricultural Equipment | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2268005060 | Agriculture | CNG Irrigation Sets | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2268006005 | Commercial | CNG Light Commercial Generator Sets | MOVES | 0.0019 | 0.0011 | 77.2% | 77.2% | population | 0.0014 | 0.0009 |
| 2268006010 | Commercial | CNG Light Commercial Pumps | MOVES | 0.0001 | 0.0000 | 77.2% | 77.2% | population | 0.0001 | 0.0000 |
| 2268006015 | Commercial | CNG Light Commercial Air Compressors | MOVES | 0.0001 | 0.0000 | 77.2% | 77.2% | population | 0.0001 | 0.0000 |
| 2268006020 | Commercial | CNG Light Commercial Gas Compressors | MOVES | 0.0006 | 0.0003 | 77.2% | 77.2% | population | 0.0005 | 0.0002 |
| 2268008005 | Airport Support | CNG Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2268010010 | Oil Field | CNG Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2270001060 | Recreational | Diesel Specialty Vehicle Carts | MOVES | 0.0011 | 0.0003 | 30.9% | 30.9% | land area | 0.0003 | 0.0001 |
| 2270002003 | Construction | Diesel Pavers | MOVES | 0.0110 | 0.0009 | 77.2% | 77.2% | population | 0.0085 | 0.0007 |
| 2270002006 | Construction | Diesel Tampers/Rammers (unused) | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2270002009 | Construction | Diesel Plate Compactors | MOVES | 0.0004 | 0.0001 | 77.2% | 77.2% | population | 0.0003 | 0.0000 |
| 2270002015 | Construction | Diesel Rollers | MOVES | 0.0291 | 0.0025 | 77.2% | 77.2% | population | 0.0225 | 0.0020 |
| 2270002018 | Construction | Diesel Scrapers | MOVES | 0.0306 | 0.0019 | 77.2% | 77.2% | population | 0.0236 | 0.0015 |
| 2270002021 | Construction | Diesel Paving Equipment | MOVES | 0.0018 | 0.0002 | 77.2% | 77.2% | population | 0.0014 | 0.0001 |
| 2270002024 | Construction | Diesel Surfacing Equipment | MOVES | 0.0013 | 0.0001 | 77.2% | 77.2% | population | 0.0010 | 0.0001 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2011 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2011 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2270002027 | Construction | Diesel Signal Boards | MOVES | 0.0038 | 0.0005 | 77.2% | 77.2% | population | 0.0030 | 0.0004 |
| 2270002030 | Construction | Diesel Trenchers | MOVES | 0.0151 | 0.0014 | 77.2% | 77.2% | population | 0.0116 | 0.0011 |
| 2270002033 | Construction | Diesel Bore/Drill Rigs | MOVES | 0.0176 | 0.0015 | 77.2% | 77.2% | population | 0.0136 | 0.0011 |
| 2270002036 | Construction | Diesel Excavators | MOVES | 0.1012 | 0.0081 | 77.2% | 77.2% | population | 0.0781 | 0.0063 |
| 2270002039 | Construction | Diesel Concrete/Industrial Saws | MOVES | 0.0011 | 0.0001 | 77.2% | 77.2% | population | 0.0008 | 0.0001 |
| 2270002042 | Construction | Diesel Cement & Mortar Mixers | MOVES | 0.0007 | 0.0001 | 77.2% | 77.2% | population | 0.0005 | 0.0001 |
| 2270002045 | Construction | Diesel Cranes | MOVES | 0.0292 | 0.0021 | 77.2% | 77.2% | population | 0.0225 | 0.0016 |
| 2270002048 | Construction | Diesel Graders | MOVES | 0.0251 | 0.0021 | 77.2% | 77.2% | population | 0.0194 | 0.0016 |
| 2270002051 | Construction | Diesel Off-highway Trucks | MOVES | 0.0999 | 0.0063 | 77.2% | 77.2% | population | 0.0771 | 0.0049 |
| 2270002054 | Construction | Diesel Crushing/Proc. Equipment | MOVES | 0.0055 | 0.0004 | 77.2% | 77.2% | population | 0.0042 | 0.0003 |
| 2270002057 | Construction | Diesel Rough Terrain Forklifts | MOVES | 0.0397 | 0.0038 | 77.2% | 77.2% | population | 0.0306 | 0.0029 |
| 2270002060 | Construction | Diesel Rubber Tire Loaders | MOVES | 0.1370 | 0.0100 | 77.2% | 77.2% | population | 0.1058 | 0.0077 |
| 2270002066 | Construction | Diesel Tractors/Loaders/Backhoes | MOVES | 0.0973 | 0.0202 | 77.2% | 77.2% | population | 0.0751 | 0.0156 |
| 2270002069 | Construction | Diesel Crawler Tractors | MOVES | 0.1148 | 0.0083 | 77.2% | 77.2% | population | 0.0886 | 0.0064 |
| 2270002072 | Construction | Diesel Skid Steer Loaders | MOVES | 0.0673 | 0.0178 | 77.2% | 77.2% | population | 0.0519 | 0.0137 |
| 2270002075 | Construction | Diesel Off-Highway Tractors | MOVES | 0.0151 | 0.0010 | 77.2% | 77.2% | population | 0.0117 | 0.0008 |
| 2270002078 | Construction | Diesel Dumpers/Tenders | MOVES | 0.0002 | 0.0001 | 77.2% | 77.2% | population | 0.0002 | 0.0000 |
| 2270002081 | Construction | Diesel Other Construction Equipment | MOVES | 0.0147 | 0.0011 | 77.2% | 77.2% | population | 0.0114 | 0.0008 |
| 2270003010 | Industrial | Diesel Aerial Lifts | MOVES | 0.0059 | 0.0016 | 77.2% | 77.2% | population | 0.0046 | 0.0012 |
| 2270003020 | Industrial | Diesel Forklifts | MOVES | 0.0507 | 0.0041 | 77.2% | 77.2% | population | 0.0391 | 0.0032 |
| 2270003030 | Industrial | Diesel Sweepers/Scrubbers | MOVES | 0.0267 | 0.0022 | 77.2% | 77.2% | population | 0.0206 | 0.0017 |
| 2270003040 | Industrial | Diesel Other General Industrial Equipment | MOVES | 0.0308 | 0.0026 | 77.2% | 77.2% | population | 0.0238 | 0.0020 |
| 2270003050 | Industrial | Diesel Other Material Handling Equipment | MOVES | 0.0016 | 0.0003 | 77.2% | 77.2% | population | 0.0012 | 0.0002 |
| 2270003060 | Industrial | Diesel AC/Refrigeration | MOVES | 0.0644 | 0.0055 | 77.2% | 77.2% | population | 0.0497 | 0.0043 |
| 2270003070 | Industrial | Diesel Terminal Tractors | MOVES | 0.0312 | 0.0027 | 77.2% | 77.2% | population | 0.0241 | 0.0021 |
| 2270004031 | Lawn/Garden | Diesel Leafblowers/Vacuums (Commercial) | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2270004036 | Lawn/Garden | Diesel Snowblowers (Commercial) | MOVES | 0.0000 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2270004046 | Lawn/Garden | Diesel Front Mowers (Commercial) | MOVES | 0.0147 | 0.0018 | 77.2% | 77.2% | population | 0.0114 | 0.0014 |
| 2270004056 | Lawn/Garden | Diesel Lawn & Garden Tractors (Commercial) | MOVES | 0.0029 | 0.0004 | 77.2% | 77.2% | population | 0.0023 | 0.0003 |
| 2270004066 | Lawn/Garden | Diesel Chippers/Stump Grinders (Commercial) | MOVES | 0.0220 | 0.0021 | 77.2% | 77.2% | population | 0.0170 | 0.0016 |
| 2270004071 | Lawn/Garden | Diesel Commercial Turf Equipment (Comm.) | MOVES | 0.0021 | 0.0002 | 77.2% | 77.2% | population | 0.0016 | 0.0001 |
| 2270004076 | Lawn/Garden | Diesel Other Lawn & Garden Equipment (Comm) | MOVES | 0.0001 | 0.0000 | 77.2% | 77.2% | population | 0.0000 | 0.0000 |
| 2270005010 | Agriculture | Diesel 2-Wheel Tractors | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005015 | Agriculture | Diesel Agricultural Tractors | MOVES | 0.4712 | 0.0446 | 24.2% | 24.2% | land area (1) | 0.1140 | 0.0108 |
| 2270005020 | Agriculture | Diesel Combines | MOVES | 0.0496 | 0.0044 | 24.2% | 24.2% | land area (1) | 0.0120 | 0.0011 |
| 2270005025 | Agriculture | Diesel Balers | MOVES | 0.0002 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0000 |
| 2270005030 | Agriculture | Diesel Agricultural Mowers | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005035 | Agriculture | Diesel Sprayers | MOVES | 0.0039 | 0.0005 | 24.2% | 24.2% | land area (1) | 0.0009 | 0.0001 |
| 2270005040 | Agriculture | Diesel Tillers > 6 HP | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005045 | Agriculture | Diesel Swathers | MOVES | 0.0037 | 0.0004 | 24.2% | 24.2% | land area (1) | 0.0009 | 0.0001 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2011 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2011 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2270005055 | Agriculture | Diesel Other Agricultural Equipment | MOVES | 0.0100 | 0.0010 | 24.2% | 24.2% | land area (1) | 0.0024 | 0.0002 |
| 2270005060 | Agriculture | Diesel Irrigation Sets | MOVES | 0.0063 | 0.0006 | 24.2% | 24.2% | land area (1) | 0.0015 | 0.0001 |
| 2270006005 | Commercial | Diesel Light Commercial Generator Sets | MOVES | 0.0300 | 0.0036 | 77.2% | 77.2% | population | 0.0231 | 0.0028 |
| 2270006010 | Commercial | Diesel Light Commercial Pumps | MOVES | 0.0071 | 0.0008 | 77.2% | 77.2% | population | 0.0055 | 0.0006 |
| 2270006015 | Commercial | Diesel Light Commercial Air Compressors | MOVES | 0.0162 | 0.0015 | 77.2% | 77.2% | population | 0.0125 | 0.0012 |
| 2270006025 | Commercial | Diesel Light Commercial Welders | MOVES | 0.0090 | 0.0026 | 77.2% | 77.2% | population | 0.0070 | 0.0020 |
| 2270006030 | Commercial | Diesel Light Commercial Pressure Washer | MOVES | 0.0010 | 0.0001 | 77.2% | 77.2% | population | 0.0008 | 0.0001 |
| 2270006035 | Commercial | Diesel Hydro Power Units | MOVES | 0.0007 | 0.0001 | 77.2% | 77.2% | population | 0.0005 | 0.0001 |
| 2270007015 | Logging | Diesel Logging Equip Fell/Bunch/Skidders | MOVES | 0.0008 | 0.0001 | 30.9% | 30.9% | land area | 0.0002 | 0.0000 |
| 2270008005 | Airport Support | Diesel Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2270010010 | Oil Field | Diesel Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2275001000 | Aircraft | Military Aircraft | USEPA | 0.0000 | 0.0002 | 100.0% | 100.0% | airport location (2) | 0.0000 | 0.0002 |
| 2275020000 | Aircraft | Commercial Aviation | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2275050000 | Aircraft | General Aviation | USEPA | 0.0071 | 0.0157 | 60.9% | 60.8% | airport location (2) | 0.0043 | 0.0095 |
| 2275060000 | Aircraft | Air Taxi | USEPA | 0.0010 | 0.0013 | 97.5% | 97.5% | airport location (2) | 0.0010 | 0.0012 |
| 2275070000 | Aircraft | Aircraft Auxiliary Power Units | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2280000000 | Comm. Mar. | All Commercial Marine Vessels | USEPA | 0.1186 | 0.0041 | 100.0% | 100.0% | Lake Mich. shoreline | 0.1186 | 0.0041 |
| 2282005010 | Pleasure Craft | 2-Stroke Outboards | MOVES | 0.0341 | 0.4127 | 69.1% | 69.1% | water area (3) | 0.0236 | 0.2851 |
| 2282005015 | Pleasure Craft | 2-Stroke Personal Watercraft | MOVES | 0.0137 | 0.1076 | 69.1% | 69.1% | water area (3) | 0.0095 | 0.0743 |
| 2282010005 | Pleasure Craft | 4-Stroke Inboards | MOVES | 0.0942 | 0.0889 | 69.1% | 69.1% | water area (3) | 0.0651 | 0.0614 |
| 2282020005 | Pleasure Craft | Diesel Inboards | MOVES | 0.0960 | 0.0044 | 69.1% | 69.1% | water area (3) | 0.0663 | 0.0031 |
| 2282020010 | Pleasure Craft | Diesel Outboards | MOVES | 0.0001 | 0.0000 | 69.1% | 69.1% | water area (3) | 0.0001 | 0.0000 |
| 2285002006 | Railroad | Diesel Locomotives | USEPA | 0.6892 | 0.0339 | 60.0% | 60.0% | rail links (2) | 0.4135 | 0.0203 |
| 2285002015 | Railroad | Diesel Railway Maintenance | MOVES | 0.0022 | 0.0004 | 60.0% | 60.0% | rail links (2) | 0.0013 | 0.0002 |
| 2285004015 | Railroad | 4-Stroke Gasoline Railway Maintenance | MOVES | 0.0000 | 0.0001 | 60.0% | 60.0% | rail links (2) | 0.0000 | 0.0001 |
| 2285006015 | Railroad | LPG Railway Maintenance | MOVES | 0.0000 | 0.0000 | 60.0% | 60.0% | rail links (2) | 0.0000 | 0.0000 |
| | | | | | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | | **3.2109** | **2.3076** | | | | **2.0678** | **1.5112** |

(1) City of Kenosha excluded.

(2) Obtained from USEPA 2011 Modeling Platform, ver. 6.2.

(3) Allocation based on surface water area (81 sq. km. for county and 56 sq. km., 69.1%, for nonattainment area, from the NMIM2009 files WI_WIB.ALO and WI_WOB.ALO).

## Table 6.2

## 2017 Nonroad $NO_X$ and VOC Emissions: tons per summer day (tpsd)
## Kenosha County and Eastern Kenosha County Nonattainment Area (NAA)

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2017 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2017 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2260001010 | Recreational | 2-Stroke Motorcycles: Off-Road | MOVES | 0.0013 | 0.1172 | 30.9% | 30.9% | land area | 0.0004 | 0.0362 |
| 2260001020 | Recreational | 2-Stroke Snowmobiles | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2260001030 | Recreational | 2-Stroke All Terrain Vehicles | MOVES | 0.0018 | 0.0862 | 30.9% | 30.9% | land area | 0.0006 | 0.0266 |
| 2260001060 | Recreational | 2-Stroke Specialty Vehicle Carts | MOVES | 0.0002 | 0.0008 | 30.9% | 30.9% | land area | 0.0001 | 0.0003 |
| 2260002006 | Construction | 2-Stroke Tampers/Rammers | MOVES | 0.0001 | 0.0055 | 77.3% | 77.3% | population | 0.0001 | 0.0043 |
| 2260002009 | Construction | 2-Stroke Plate Compactors | MOVES | 0.0000 | 0.0002 | 77.3% | 77.3% | population | 0.0000 | 0.0001 |
| 2260002021 | Construction | 2-Stroke Paving Equipment | MOVES | 0.0000 | 0.0002 | 77.3% | 77.3% | population | 0.0000 | 0.0002 |
| 2260002027 | Construction | 2-Stroke Signal Boards | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260002039 | Construction | 2-Stroke Concrete/Industrial Saws | MOVES | 0.0004 | 0.0140 | 77.3% | 77.3% | population | 0.0003 | 0.0108 |
| 2260002054 | Construction | 2-Stroke Crushing/Proc. Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260003030 | Industrial | 2-Stroke Sweepers/Scrubbers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260003040 | Industrial | 2-Stroke Other General Industrial Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260004015 | Lawn/Garden | 2-Stroke Rotary Tillers < 6 HP (Residential) | MOVES | 0.0001 | 0.0019 | 77.3% | 77.3% | population | 0.0001 | 0.0014 |
| 2260004016 | Lawn/Garden | 2-Stroke Rotary Tillers < 6 HP (Commercial) | MOVES | 0.0002 | 0.0036 | 77.3% | 77.3% | population | 0.0001 | 0.0028 |
| 2260004020 | Lawn/Garden | 2-Stroke Chain Saws < 6 HP (Residential) | MOVES | 0.0005 | 0.0191 | 77.3% | 77.3% | population | 0.0004 | 0.0147 |
| 2260004021 | Lawn/Garden | 2-Stroke Chain Saws < 6 HP (Commercial) | MOVES | 0.0009 | 0.0423 | 77.3% | 77.3% | population | 0.0007 | 0.0327 |
| 2260004025 | Lawn/Garden | 2-Stroke Trimmers/Edgers/Brush Cutters (Res.) | MOVES | 0.0015 | 0.0381 | 77.3% | 77.3% | population | 0.0012 | 0.0294 |
| 2260004026 | Lawn/Garden | 2-Stroke Trimmers/Edgers/Brush Cutters (Com.) | MOVES | 0.0017 | 0.0423 | 77.3% | 77.3% | population | 0.0013 | 0.0327 |
| 2260004030 | Lawn/Garden | 2-Stroke Leafblowers/Vacuums (Residential) | MOVES | 0.0010 | 0.0233 | 77.3% | 77.3% | population | 0.0008 | 0.0180 |
| 2260004031 | Lawn/Garden | 2-Stroke Leafblowers/Vacuums (Commercial) | MOVES | 0.0015 | 0.0423 | 77.3% | 77.3% | population | 0.0012 | 0.0327 |
| 2260004035 | Lawn/Garden | 2-Stroke Snowblowers (Residential) | MOVES | 0.0000 | 0.0015 | 77.3% | 77.3% | population | 0.0000 | 0.0011 |
| 2260004036 | Lawn/Garden | 2-Stroke Snowblowers (Commercial) | MOVES | 0.0000 | 0.0001 | 77.3% | 77.3% | population | 0.0000 | 0.0001 |
| 2260004071 | Lawn/Garden | 2-Stroke Commercial Turf Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260005035 | Agriculture | 2-Stroke Sprayers | MOVES | 0.0000 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0001 |
| 2260006005 | Commercial | 2-Stroke Light Commercial Generator Set | MOVES | 0.0001 | 0.0013 | 77.3% | 77.3% | population | 0.0000 | 0.0010 |
| 2260006010 | Commercial | 2-Stroke Light Commercial Pumps | MOVES | 0.0003 | 0.0094 | 77.3% | 77.3% | population | 0.0003 | 0.0073 |
| 2260006015 | Commercial | 2-Stroke Light Commercial Air Compressors | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260006035 | Commercial | 2-Stroke Hydro Power Units | MOVES | 0.0000 | 0.0001 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260007005 | Logging | 2-Stroke Logging Equipment Chain Saws > 6 HP | MOVES | 0.0000 | 0.0005 | 30.9% | 30.9% | land area | 0.0000 | 0.0001 |
| 2265001010 | Recreational | 4-Stroke Motorcycles: Off-Road | MOVES | 0.0007 | 0.0054 | 30.9% | 30.9% | land area | 0.0002 | 0.0017 |
| 2265001030 | Recreational | 4-Stroke All Terrain Vehicles | MOVES | 0.0058 | 0.0612 | 30.9% | 30.9% | land area | 0.0018 | 0.0189 |
| 2265001050 | Recreational | 4-Stroke Golf Carts | MOVES | 0.0037 | 0.0121 | 30.9% | 30.9% | land area | 0.0011 | 0.0037 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2017 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2017 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2265001060 | Recreational | 4-Stroke Specialty Vehicle Carts | MOVES | 0.0003 | 0.0010 | 30.9% | 30.9% | land area | 0.0001 | 0.0003 |
| 2265002003 | Construction | 4-Stroke Asphalt Pavers | MOVES | 0.0001 | 0.0002 | 77.3% | 77.3% | population | 0.0001 | 0.0002 |
| 2265002006 | Construction | 4-Stroke Tampers/Rammers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265002009 | Construction | 4-Stroke Plate Compactors | MOVES | 0.0002 | 0.0006 | 77.3% | 77.3% | population | 0.0001 | 0.0005 |
| 2265002015 | Construction | 4-Stroke Rollers | MOVES | 0.0002 | 0.0004 | 77.3% | 77.3% | population | 0.0001 | 0.0003 |
| 2265002021 | Construction | 4-Stroke Paving Equipment | MOVES | 0.0003 | 0.0012 | 77.3% | 77.3% | population | 0.0003 | 0.0009 |
| 2265002024 | Construction | 4-Stroke Surfacing Equipment | MOVES | 0.0001 | 0.0005 | 77.3% | 77.3% | population | 0.0001 | 0.0004 |
| 2265002027 | Construction | 4-Stroke Signal Boards | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265002030 | Construction | 4-Stroke Trenchers | MOVES | 0.0003 | 0.0008 | 77.3% | 77.3% | population | 0.0002 | 0.0006 |
| 2265002033 | Construction | 4-Stroke Bore/Drill Rigs | MOVES | 0.0002 | 0.0004 | 77.3% | 77.3% | population | 0.0001 | 0.0003 |
| 2265002039 | Construction | 4-Stroke Concrete/Industrial Saws | MOVES | 0.0006 | 0.0018 | 77.3% | 77.3% | population | 0.0005 | 0.0014 |
| 2265002042 | Construction | 4-Stroke Cement & Mortar Mixers | MOVES | 0.0003 | 0.0016 | 77.3% | 77.3% | population | 0.0003 | 0.0012 |
| 2265002045 | Construction | 4-Stroke Cranes | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265002054 | Construction | 4-Stroke Crushing/Proc.  Equipment | MOVES | 0.0000 | 0.0001 | 77.3% | 77.3% | population | 0.0000 | 0.0001 |
| 2265002057 | Construction | 4-Stroke Rough Terrain Forklifts | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265002060 | Construction | 4-Stroke Rubber Tire Loaders | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2265002066 | Construction | 4-Stroke Tractors/Loaders/Backhoes | MOVES | 0.0002 | 0.0006 | 77.3% | 77.3% | population | 0.0001 | 0.0004 |
| 2265002072 | Construction | 4-Stroke Skid Steer Loaders | MOVES | 0.0002 | 0.0003 | 77.3% | 77.3% | population | 0.0002 | 0.0002 |
| 2265002078 | Construction | 4-Stroke Dumpers/Tenders | MOVES | 0.0001 | 0.0003 | 77.3% | 77.3% | population | 0.0000 | 0.0002 |
| 2265002081 | Construction | 4-Stroke Other Construction Equipment | MOVES | 0.0001 | 0.0001 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2265003010 | Industrial | 4-Stroke Aerial Lifts | MOVES | 0.0008 | 0.0007 | 77.3% | 77.3% | population | 0.0006 | 0.0005 |
| 2265003020 | Industrial | 4-Stroke Forklifts | MOVES | 0.0007 | 0.0004 | 77.3% | 77.3% | population | 0.0005 | 0.0003 |
| 2265003030 | Industrial | 4-Stroke Sweepers/Scrubbers | MOVES | 0.0001 | 0.0002 | 77.3% | 77.3% | population | 0.0001 | 0.0002 |
| 2265003040 | Industrial | 4-Stroke Other General Industrial Equipment | MOVES | 0.0003 | 0.0010 | 77.3% | 77.3% | population | 0.0002 | 0.0007 |
| 2265003050 | Industrial | 4-Stroke Other Material Handling Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265003060 | Industrial | 4-Stroke Industrial AC/Refrigeration | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265003070 | Industrial | 4-Stroke Terminal Tractors | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265004010 | Lawn/Garden | 4-Stroke Lawn mowers (Residential) | MOVES | 0.0105 | 0.0918 | 77.3% | 77.3% | population | 0.0081 | 0.0709 |
| 2265004011 | Lawn/Garden | 4-Stroke Lawn mowers (Commercial) | MOVES | 0.0035 | 0.0220 | 77.3% | 77.3% | population | 0.0027 | 0.0170 |
| 2265004015 | Lawn/Garden | 4-Stroke Rotary Tillers < 6 HP (Residential) | MOVES | 0.0009 | 0.0080 | 77.3% | 77.3% | population | 0.0007 | 0.0062 |
| 2265004016 | Lawn/Garden | 4-Stroke Rotary Tillers < 6 HP (Commercial) | MOVES | 0.0018 | 0.0132 | 77.3% | 77.3% | population | 0.0014 | 0.0102 |
| 2265004025 | Lawn/Garden | 4-Stroke Trimmers/Edgers/Brush Cutters (Res.) | MOVES | 0.0001 | 0.0006 | 77.3% | 77.3% | population | 0.0000 | 0.0005 |
| 2265004026 | Lawn/Garden | 4-Stroke Trimmers/Edgers/Brush Cutters (Com.) | MOVES | 0.0001 | 0.0006 | 77.3% | 77.3% | population | 0.0001 | 0.0005 |
| 2265004030 | Lawn/Garden | 4-Stroke Leafblowers/Vacuums (Residential) | MOVES | 0.0001 | 0.0008 | 77.3% | 77.3% | population | 0.0001 | 0.0006 |
| 2265004031 | Lawn/Garden | 4-Stroke Leafblowers/Vacuums (Commercial) | MOVES | 0.0036 | 0.0139 | 77.3% | 77.3% | population | 0.0028 | 0.0107 |
| 2265004035 | Lawn/Garden | 4-Stroke Snowblowers (Residential) | MOVES | 0.0000 | 0.0034 | 77.3% | 77.3% | population | 0.0000 | 0.0027 |
| 2265004036 | Lawn/Garden | 4-Stroke Snowblowers (Commercial) | MOVES | 0.0000 | 0.0002 | 77.3% | 77.3% | population | 0.0000 | 0.0002 |
| 2265004040 | Lawn/Garden | 4-Stroke Rear Engine Riding Mowers (Res.) | MOVES | 0.0021 | 0.0117 | 77.3% | 77.3% | population | 0.0017 | 0.0091 |
| 2265004041 | Lawn/Garden | 4-Stroke Rear Engine Riding Mowers (Comm.) | MOVES | 0.0004 | 0.0013 | 77.3% | 77.3% | population | 0.0003 | 0.0010 |
| 2265004046 | Lawn/Garden | 4-Stroke Front Mowers (Commercial) | MOVES | 0.0006 | 0.0019 | 77.3% | 77.3% | population | 0.0004 | 0.0015 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2017 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2017 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2265004051 | Lawn/Garden | 4-Stroke Shredders < 6 HP (Commercial) | MOVES | 0.0002 | 0.0015 | 77.3% | 77.3% | population | 0.0002 | 0.0012 |
| 2265004055 | Lawn/Garden | 4-Stroke Lawn & Garden Tractors (Residential) | MOVES | 0.0286 | 0.1261 | 77.3% | 77.3% | population | 0.0221 | 0.0974 |
| 2265004056 | Lawn/Garden | 4-Stroke Lawn & Garden Tractors (Commercial) | MOVES | 0.0051 | 0.0172 | 77.3% | 77.3% | population | 0.0039 | 0.0133 |
| 2265004066 | Lawn/Garden | 4-Stroke Chippers/Stump Grinders (Comm.) | MOVES | 0.0009 | 0.0018 | 77.3% | 77.3% | population | 0.0007 | 0.0014 |
| 2265004071 | Lawn/Garden | 4-Stroke Commercial Turf Equipment (Comm.) | MOVES | 0.0164 | 0.0503 | 77.3% | 77.3% | population | 0.0127 | 0.0389 |
| 2265004075 | Lawn/Garden | 4-Stroke Other Lawn & Garden Equip. (Res.) | MOVES | 0.0012 | 0.0061 | 77.3% | 77.3% | population | 0.0009 | 0.0047 |
| 2265004076 | Lawn/Garden | 4-Stroke Other Lawn & Garden Equip. (Com.) | MOVES | 0.0006 | 0.0032 | 77.3% | 77.3% | population | 0.0005 | 0.0025 |
| 2265005010 | Agriculture | 4-Stroke 2-Wheel Tractors | MOVES | 0.0000 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005015 | Agriculture | 4-Stroke Agricultural Tractors | MOVES | 0.0001 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005020 | Agriculture | 4-Stroke Combines | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005025 | Agriculture | 4-Stroke Balers | MOVES | 0.0003 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0001 |
| 2265005030 | Agriculture | 4-Stroke Agricultural Mowers | MOVES | 0.0000 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005035 | Agriculture | 4-Stroke Sprayers | MOVES | 0.0006 | 0.0011 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0003 |
| 2265005040 | Agriculture | 4-Stroke Tillers > 5 HP | MOVES | 0.0010 | 0.0041 | 24.2% | 24.2% | land area (1) | 0.0002 | 0.0010 |
| 2265005045 | Agriculture | 4-Stroke Swathers | MOVES | 0.0005 | 0.0004 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0001 |
| 2265005055 | Agriculture | 4-Stroke Other Agricultural Equipment | MOVES | 0.0006 | 0.0006 | 24.2% | 24.2% | land area (1) | 0.0002 | 0.0001 |
| 2265005060 | Agriculture | 4-Stroke Irrigation Sets | MOVES | 0.0002 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265006005 | Commercial | 4-Stroke Light Commercial Generator Set | MOVES | 0.0085 | 0.0373 | 77.3% | 77.3% | population | 0.0065 | 0.0288 |
| 2265006010 | Commercial | 4-Stroke Light Commercial Pumps | MOVES | 0.0021 | 0.0077 | 77.3% | 77.3% | population | 0.0017 | 0.0059 |
| 2265006015 | Commercial | 4-Stroke Light Commercial Air Compressors | MOVES | 0.0011 | 0.0031 | 77.3% | 77.3% | population | 0.0008 | 0.0024 |
| 2265006025 | Commercial | 4-Stroke Light Commercial Welders | MOVES | 0.0022 | 0.0071 | 77.3% | 77.3% | population | 0.0017 | 0.0055 |
| 2265006030 | Commercial | 4-Stroke Light Commercial Pressure Wash | MOVES | 0.0034 | 0.0151 | 77.3% | 77.3% | population | 0.0026 | 0.0117 |
| 2265006035 | Commercial | 4-Stroke Hydro Power Units | MOVES | 0.0002 | 0.0005 | 77.3% | 77.3% | population | 0.0001 | 0.0004 |
| 2265007010 | Logging | 4-Stroke Logging Equipment Shredders > 6 HP | MOVES | 0.0000 | 0.0001 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2265007015 | Logging | 4-Stroke Logging Equipment Skidders | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2265008005 | Airport Support | 4-Stroke Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2265010010 | Oil Field | 4-Stroke Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2267001060 | Recreational | LPG Specialty Vehicle Carts | MOVES | 0.0001 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2267002003 | Construction | LPG Asphalt Pavers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002015 | Construction | LPG Rollers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002021 | Construction | LPG Paving Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002024 | Construction | LPG Surfacing Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002030 | Construction | LPG Trenchers | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267002033 | Construction | LPG Bore/Drill Rigs | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267002039 | Construction | LPG Concrete/Industrial Saws | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002045 | Construction | LPG Cranes | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267002054 | Construction | LPG Crushing/Proc. Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002057 | Construction | LPG Rough Terrain Forklifts | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267002060 | Construction | LPG Rubber Tire Loaders | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267002066 | Construction | LPG Tractors/Loaders/Backhoes | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2017 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2017 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2267002072 | Construction | LPG Skid Steer Loaders | MOVES | 0.0002 | 0.0000 | 77.3% | 77.3% | population | 0.0002 | 0.0000 |
| 2267002081 | Construction | LPG Other Construction Equipment | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267003010 | Industrial | LPG Aerial Lifts | MOVES | 0.0026 | 0.0005 | 77.3% | 77.3% | population | 0.0020 | 0.0004 |
| 2267003020 | Industrial | LPG Forklifts | MOVES | 0.0770 | 0.0113 | 77.3% | 77.3% | population | 0.0595 | 0.0087 |
| 2267003030 | Industrial | LPG Sweepers/Scrubbers | MOVES | 0.0005 | 0.0001 | 77.3% | 77.3% | population | 0.0004 | 0.0001 |
| 2267003040 | Industrial | LPG Other General Industrial Equipment | MOVES | 0.0002 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267003050 | Industrial | LPG Other Material Handling Equipment | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267003070 | Industrial | LPG Terminal Tractors | MOVES | 0.0003 | 0.0000 | 77.3% | 77.3% | population | 0.0002 | 0.0000 |
| 2267004066 | Lawn/Garden | LPG Chippers/Stump Grinders (Commercial) | MOVES | 0.0003 | 0.0000 | 77.3% | 77.3% | population | 0.0003 | 0.0000 |
| 2267005055 | Agriculture | LPG Other Agricultural Equipment | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2267005060 | Agriculture | LPG Irrigation Sets | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2267006005 | Commercial | LPG Light Commercial Generator Sets | MOVES | 0.0049 | 0.0008 | 77.3% | 77.3% | population | 0.0038 | 0.0006 |
| 2267006010 | Commercial | LPG Light Commercial Pumps | MOVES | 0.0007 | 0.0001 | 77.3% | 77.3% | population | 0.0005 | 0.0001 |
| 2267006015 | Commercial | LPG Light Commercial Air Compressors | MOVES | 0.0004 | 0.0001 | 77.3% | 77.3% | population | 0.0003 | 0.0000 |
| 2267006025 | Commercial | LPG Light Commercial Welders | MOVES | 0.0006 | 0.0001 | 77.3% | 77.3% | population | 0.0004 | 0.0001 |
| 2267006030 | Commercial | LPG Light Commercial Pressure Washers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267006035 | Commercial | LPG Hydro Power Units | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267008005 | Airport Support | LPG Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2268002081 | Construction | CNG Other Construction Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268003020 | Industrial | CNG Forklifts | MOVES | 0.0055 | 0.0029 | 77.3% | 77.3% | population | 0.0043 | 0.0023 |
| 2268003030 | Industrial | CNG Sweepers/Scrubbers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268003040 | Industrial | CNG Other General Industrial Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268003060 | Industrial | CNG AC/Refrigeration | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268003070 | Industrial | CNG Terminal Tractors | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268005055 | Agriculture | CNG Other Agricultural Equipment | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2268005060 | Agriculture | CNG Irrigation Sets | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2268006005 | Commercial | CNG Light Commercial Generator Sets | MOVES | 0.0015 | 0.0009 | 77.3% | 77.3% | population | 0.0011 | 0.0007 |
| 2268006010 | Commercial | CNG Light Commercial Pumps | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268006015 | Commercial | CNG Light Commercial Air Compressors | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268006020 | Commercial | CNG Light Commercial Gas Compressors | MOVES | 0.0007 | 0.0004 | 77.3% | 77.3% | population | 0.0006 | 0.0003 |
| 2268008005 | Airport Support | CNG Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2268010010 | Oil Field | CNG Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2270001060 | Recreational | Diesel Specialty Vehicle Carts | MOVES | 0.0010 | 0.0002 | 30.9% | 30.9% | land area | 0.0003 | 0.0001 |
| 2270002003 | Construction | Diesel Pavers | MOVES | 0.0062 | 0.0006 | 77.3% | 77.3% | population | 0.0048 | 0.0005 |
| 2270002006 | Construction | Diesel Tampers/Rammers (unused) | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2270002009 | Construction | Diesel Plate Compactors | MOVES | 0.0004 | 0.0001 | 77.3% | 77.3% | population | 0.0003 | 0.0000 |
| 2270002015 | Construction | Diesel Rollers | MOVES | 0.0175 | 0.0018 | 77.3% | 77.3% | population | 0.0135 | 0.0014 |
| 2270002018 | Construction | Diesel Scrapers | MOVES | 0.0170 | 0.0017 | 77.3% | 77.3% | population | 0.0132 | 0.0013 |
| 2270002021 | Construction | Diesel Paving Equipment | MOVES | 0.0012 | 0.0001 | 77.3% | 77.3% | population | 0.0009 | 0.0001 |
| 2270002024 | Construction | Diesel Surfacing Equipment | MOVES | 0.0010 | 0.0001 | 77.3% | 77.3% | population | 0.0008 | 0.0001 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2017 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2017 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2270002027 | Construction | Diesel Signal Boards | MOVES | 0.0037 | 0.0004 | 77.3% | 77.3% | population | 0.0029 | 0.0003 |
| 2270002030 | Construction | Diesel Trenchers | MOVES | 0.0115 | 0.0010 | 77.3% | 77.3% | population | 0.0089 | 0.0007 |
| 2270002033 | Construction | Diesel Bore/Drill Rigs | MOVES | 0.0138 | 0.0012 | 77.3% | 77.3% | population | 0.0106 | 0.0009 |
| 2270002036 | Construction | Diesel Excavators | MOVES | 0.0464 | 0.0060 | 77.3% | 77.3% | population | 0.0359 | 0.0047 |
| 2270002039 | Construction | Diesel Concrete/Industrial Saws | MOVES | 0.0008 | 0.0001 | 77.3% | 77.3% | population | 0.0006 | 0.0001 |
| 2270002042 | Construction | Diesel Cement & Mortar Mixers | MOVES | 0.0006 | 0.0001 | 77.3% | 77.3% | population | 0.0004 | 0.0000 |
| 2270002045 | Construction | Diesel Cranes | MOVES | 0.0167 | 0.0016 | 77.3% | 77.3% | population | 0.0129 | 0.0012 |
| 2270002048 | Construction | Diesel Graders | MOVES | 0.0116 | 0.0015 | 77.3% | 77.3% | population | 0.0090 | 0.0012 |
| 2270002051 | Construction | Diesel Off-highway Trucks | MOVES | 0.0597 | 0.0062 | 77.3% | 77.3% | population | 0.0462 | 0.0048 |
| 2270002054 | Construction | Diesel Crushing/Proc. Equipment | MOVES | 0.0036 | 0.0003 | 77.3% | 77.3% | population | 0.0028 | 0.0002 |
| 2270002057 | Construction | Diesel Rough Terrain Forklifts | MOVES | 0.0243 | 0.0025 | 77.3% | 77.3% | population | 0.0188 | 0.0019 |
| 2270002060 | Construction | Diesel Rubber Tire Loaders | MOVES | 0.0836 | 0.0078 | 77.3% | 77.3% | population | 0.0646 | 0.0060 |
| 2270002066 | Construction | Diesel Tractors/Loaders/Backhoes | MOVES | 0.0712 | 0.0136 | 77.3% | 77.3% | population | 0.0551 | 0.0105 |
| 2270002069 | Construction | Diesel Crawler Tractors | MOVES | 0.0636 | 0.0066 | 77.3% | 77.3% | population | 0.0492 | 0.0051 |
| 2270002072 | Construction | Diesel Skid Steer Loaders | MOVES | 0.0580 | 0.0124 | 77.3% | 77.3% | population | 0.0449 | 0.0096 |
| 2270002075 | Construction | Diesel Off-Highway Tractors | MOVES | 0.0104 | 0.0008 | 77.3% | 77.3% | population | 0.0080 | 0.0006 |
| 2270002078 | Construction | Diesel Dumpers/Tenders | MOVES | 0.0002 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2270002081 | Construction | Diesel Other Construction Equipment | MOVES | 0.0100 | 0.0008 | 77.3% | 77.3% | population | 0.0077 | 0.0006 |
| 2270003010 | Industrial | Diesel Aerial Lifts | MOVES | 0.0052 | 0.0012 | 77.3% | 77.3% | population | 0.0040 | 0.0009 |
| 2270003020 | Industrial | Diesel Forklifts | MOVES | 0.0235 | 0.0028 | 77.3% | 77.3% | population | 0.0182 | 0.0021 |
| 2270003030 | Industrial | Diesel Sweepers/Scrubbers | MOVES | 0.0140 | 0.0015 | 77.3% | 77.3% | population | 0.0108 | 0.0012 |
| 2270003040 | Industrial | Diesel Other General Industrial Equipment | MOVES | 0.0185 | 0.0019 | 77.3% | 77.3% | population | 0.0143 | 0.0014 |
| 2270003050 | Industrial | Diesel Other Material Handling Equipment | MOVES | 0.0012 | 0.0002 | 77.3% | 77.3% | population | 0.0010 | 0.0002 |
| 2270003060 | Industrial | Diesel AC/Refrigeration | MOVES | 0.0555 | 0.0036 | 77.3% | 77.3% | population | 0.0429 | 0.0027 |
| 2270003070 | Industrial | Diesel Terminal Tractors | MOVES | 0.0121 | 0.0019 | 77.3% | 77.3% | population | 0.0093 | 0.0015 |
| 2270004031 | Lawn/Garden | Diesel Leafblowers/Vacuums (Commercial) | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2270004036 | Lawn/Garden | Diesel Snowblowers (Commercial) | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2270004046 | Lawn/Garden | Diesel Front Mowers (Commercial) | MOVES | 0.0148 | 0.0014 | 77.3% | 77.3% | population | 0.0115 | 0.0011 |
| 2270004056 | Lawn/Garden | Diesel Lawn & Garden Tractors (Commercial) | MOVES | 0.0032 | 0.0004 | 77.3% | 77.3% | population | 0.0024 | 0.0003 |
| 2270004066 | Lawn/Garden | Diesel Chippers/Stump Grinders (Commercial) | MOVES | 0.0182 | 0.0017 | 77.3% | 77.3% | population | 0.0141 | 0.0013 |
| 2270004071 | Lawn/Garden | Diesel Commercial Turf Equipment (Comm.) | MOVES | 0.0015 | 0.0001 | 77.3% | 77.3% | population | 0.0012 | 0.0001 |
| 2270004076 | Lawn/Garden | Diesel Other Lawn & Garden Equipment (Comm) | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2270005010 | Agriculture | Diesel 2-Wheel Tractors | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005015 | Agriculture | Diesel Agricultural Tractors | MOVES | 0.3413 | 0.0320 | 24.2% | 24.2% | land area (1) | 0.0826 | 0.0077 |
| 2270005020 | Agriculture | Diesel Combines | MOVES | 0.0378 | 0.0035 | 24.2% | 24.2% | land area (1) | 0.0091 | 0.0009 |
| 2270005025 | Agriculture | Diesel Balers | MOVES | 0.0002 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0000 |
| 2270005030 | Agriculture | Diesel Agricultural Mowers | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005035 | Agriculture | Diesel Sprayers | MOVES | 0.0031 | 0.0004 | 24.2% | 24.2% | land area (1) | 0.0007 | 0.0001 |
| 2270005040 | Agriculture | Diesel Tillers > 6 HP | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005045 | Agriculture | Diesel Swathers | MOVES | 0.0029 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0007 | 0.0001 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2017 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2017 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2270005055 | Agriculture | Diesel Other Agricultural Equipment | MOVES | 0.0074 | 0.0007 | 24.2% | 24.2% | land area (1) | 0.0018 | 0.0002 |
| 2270005060 | Agriculture | Diesel Irrigation Sets | MOVES | 0.0041 | 0.0004 | 24.2% | 24.2% | land area (1) | 0.0010 | 0.0001 |
| 2270006005 | Commercial | Diesel Light Commercial Generator Sets | MOVES | 0.0261 | 0.0028 | 77.3% | 77.3% | population | 0.0202 | 0.0021 |
| 2270006010 | Commercial | Diesel Light Commercial Pumps | MOVES | 0.0061 | 0.0007 | 77.3% | 77.3% | population | 0.0047 | 0.0005 |
| 2270006015 | Commercial | Diesel Light Commercial Air Compressors | MOVES | 0.0116 | 0.0011 | 77.3% | 77.3% | population | 0.0090 | 0.0008 |
| 2270006025 | Commercial | Diesel Light Commercial Welders | MOVES | 0.0083 | 0.0017 | 77.3% | 77.3% | population | 0.0064 | 0.0013 |
| 2270006030 | Commercial | Diesel Light Commercial Pressure Washer | MOVES | 0.0009 | 0.0001 | 77.3% | 77.3% | population | 0.0007 | 0.0001 |
| 2270006035 | Commercial | Diesel Hydro Power Units | MOVES | 0.0005 | 0.0000 | 77.3% | 77.3% | population | 0.0004 | 0.0000 |
| 2270007015 | Logging | Diesel Logging Equip Fell/Bunch/Skidders | MOVES | 0.0003 | 0.0000 | 30.9% | 30.9% | land area | 0.0001 | 0.0000 |
| 2270008005 | Airport Support | Diesel Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2270010010 | Oil Field | Diesel Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2275001000 | Aircraft | Military Aircraft | USEPA | 0.0000 | 0.0002 | 100.0% | 100.0% | airport location (2) | 0.0000 | 0.0002 |
| 2275020000 | Aircraft | Commercial Aviation | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2275050000 | Aircraft | General Aviation | USEPA | 0.0072 | 0.0160 | 61.8% | 61.8% | airport location (2) | 0.0045 | 0.0099 |
| 2275060000 | Aircraft | Air Taxi | USEPA | 0.0015 | 0.0019 | 98.7% | 98.7% | airport location (2) | 0.0015 | 0.0019 |
| 2275070000 | Aircraft | Aircraft Auxiliary Power Units | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2280000000 | Comm. Mar. | All Commercial Marine Vessels | USEPA | 0.1152 | 0.0045 | 100.0% | 100.0% | Lake Mich. shoreline | 0.1152 | 0.0045 |
| 2282005010 | Pleasure Craft | 2-Stroke Outboards | MOVES | 0.0391 | 0.2358 | 69.1% | 69.1% | water area (3) | 0.0270 | 0.1629 |
| 2282005015 | Pleasure Craft | 2-Stroke Personal Watercraft | MOVES | 0.0173 | 0.0435 | 69.1% | 69.1% | water area (3) | 0.0120 | 0.0300 |
| 2282010005 | Pleasure Craft | 4-Stroke Inboards | MOVES | 0.0765 | 0.0707 | 69.1% | 69.1% | water area (3) | 0.0528 | 0.0488 |
| 2282020005 | Pleasure Craft | Diesel Inboards | MOVES | 0.0945 | 0.0052 | 69.1% | 69.1% | water area (3) | 0.0653 | 0.0036 |
| 2282020010 | Pleasure Craft | Diesel Outboards | MOVES | 0.0001 | 0.0000 | 69.1% | 69.1% | water area (3) | 0.0001 | 0.0000 |
| 2285002006 | Railroad | Diesel Locomotives | USEPA | 0.5790 | 0.0222 | 60.0% | 60.0% | rail links (2) | 0.3474 | 0.0133 |
| 2285002015 | Railroad | Diesel Railway Maintenance | MOVES | 0.0017 | 0.0003 | 60.0% | 60.0% | rail links (2) | 0.0010 | 0.0002 |
| 2285004015 | Railroad | 4-Stroke Gasoline Railway Maintenance | MOVES | 0.0000 | 0.0001 | 60.0% | 60.0% | rail links (2) | 0.0000 | 0.0000 |
| 2285006015 | Railroad | LPG Railway Maintenance | MOVES | 0.0000 | 0.0000 | 60.0% | 60.0% | rail links (2) | 0.0000 | 0.0000 |
| | | | | | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | | **2.3060** | **1.5403** | | | | **1.4692** | **1.0009** |

(1) City of Kenosha excluded.
(2) Obtained from USEPA 2011 Modeling Platform, ver. 6.2.
(3) Allocation based on surface water area (81 sq. km. for county and 56 sq. km., 69.1%, for nonattainment area, from the NMIM2009 files WI_WIB.ALO and WI_WOB.ALO).

## Table 6.3

## 2018 Nonroad $NO_X$ and VOC Emissions: tons per summer day (tpsd) Kenosha County and Eastern Kenosha County Nonattainment Area (NAA)

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2018 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2018 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2260001010 | Recreational | 2-Stroke Motorcycles: Off-Road | MOVES | 0.0013 | 0.1134 | 30.9% | 30.9% | land area | 0.0004 | 0.0350 |
| 2260001020 | Recreational | 2-Stroke Snowmobiles | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2260001030 | Recreational | 2-Stroke All Terrain Vehicles | MOVES | 0.0019 | 0.0705 | 30.9% | 30.9% | land area | 0.0006 | 0.0218 |
| 2260001060 | Recreational | 2-Stroke Specialty Vehicle Carts | MOVES | 0.0002 | 0.0008 | 30.9% | 30.9% | land area | 0.0001 | 0.0002 |
| 2260002006 | Construction | 2-Stroke Tampers/Rammers | MOVES | 0.0001 | 0.0055 | 77.3% | 77.3% | population | 0.0001 | 0.0043 |
| 2260002009 | Construction | 2-Stroke Plate Compactors | MOVES | 0.0000 | 0.0002 | 77.3% | 77.3% | population | 0.0000 | 0.0002 |
| 2260002021 | Construction | 2-Stroke Paving Equipment | MOVES | 0.0000 | 0.0002 | 77.3% | 77.3% | population | 0.0000 | 0.0002 |
| 2260002027 | Construction | 2-Stroke Signal Boards | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260002039 | Construction | 2-Stroke Concrete/Industrial Saws | MOVES | 0.0004 | 0.0140 | 77.3% | 77.3% | population | 0.0003 | 0.0109 |
| 2260002054 | Construction | 2-Stroke Crushing/Proc. Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260003030 | Industrial | 2-Stroke Sweepers/Scrubbers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260003040 | Industrial | 2-Stroke Other General Industrial Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260004015 | Lawn/Garden | 2-Stroke Rotary Tillers < 6 HP (Residential) | MOVES | 0.0001 | 0.0019 | 77.3% | 77.3% | population | 0.0001 | 0.0015 |
| 2260004016 | Lawn/Garden | 2-Stroke Rotary Tillers < 6 HP (Commercial) | MOVES | 0.0002 | 0.0037 | 77.3% | 77.3% | population | 0.0001 | 0.0028 |
| 2260004020 | Lawn/Garden | 2-Stroke Chain Saws < 6 HP (Residential) | MOVES | 0.0006 | 0.0194 | 77.3% | 77.3% | population | 0.0004 | 0.0150 |
| 2260004021 | Lawn/Garden | 2-Stroke Chain Saws < 6 HP (Commercial) | MOVES | 0.0010 | 0.0429 | 77.3% | 77.3% | population | 0.0007 | 0.0332 |
| 2260004025 | Lawn/Garden | 2-Stroke Trimmers/Edgers/Brush Cutters (Res.) | MOVES | 0.0016 | 0.0385 | 77.3% | 77.3% | population | 0.0012 | 0.0298 |
| 2260004026 | Lawn/Garden | 2-Stroke Trimmers/Edgers/Brush Cutters (Com.) | MOVES | 0.0017 | 0.0430 | 77.3% | 77.3% | population | 0.0013 | 0.0332 |
| 2260004030 | Lawn/Garden | 2-Stroke Leafblowers/Vacuums (Residential) | MOVES | 0.0010 | 0.0236 | 77.3% | 77.3% | population | 0.0008 | 0.0183 |
| 2260004031 | Lawn/Garden | 2-Stroke Leafblowers/Vacuums (Commercial) | MOVES | 0.0016 | 0.0430 | 77.3% | 77.3% | population | 0.0012 | 0.0332 |
| 2260004035 | Lawn/Garden | 2-Stroke Snowblowers (Residential) | MOVES | 0.0000 | 0.0014 | 77.3% | 77.3% | population | 0.0000 | 0.0011 |
| 2260004036 | Lawn/Garden | 2-Stroke Snowblowers (Commercial) | MOVES | 0.0000 | 0.0001 | 77.3% | 77.3% | population | 0.0000 | 0.0001 |
| 2260004071 | Lawn/Garden | 2-Stroke Commercial Turf Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260005035 | Agriculture | 2-Stroke Sprayers | MOVES | 0.0000 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0001 |
| 2260006005 | Commercial | 2-Stroke Light Commercial Generator Set | MOVES | 0.0001 | 0.0014 | 77.3% | 77.3% | population | 0.0000 | 0.0011 |
| 2260006010 | Commercial | 2-Stroke Light Commercial Pumps | MOVES | 0.0004 | 0.0096 | 77.3% | 77.3% | population | 0.0003 | 0.0074 |
| 2260006015 | Commercial | 2-Stroke Light Commercial Air Compressors | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260006035 | Commercial | 2-Stroke Hydro Power Units | MOVES | 0.0000 | 0.0001 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2260007005 | Logging | 2-Stroke Logging Equipment Chain Saws > 6 HP | MOVES | 0.0000 | 0.0005 | 30.9% | 30.9% | land area | 0.0000 | 0.0001 |
| 2265001010 | Recreational | 4-Stroke Motorcycles: Off-Road | MOVES | 0.0007 | 0.0053 | 30.9% | 30.9% | land area | 0.0002 | 0.0016 |
| 2265001030 | Recreational | 4-Stroke All Terrain Vehicles | MOVES | 0.0057 | 0.0600 | 30.9% | 30.9% | land area | 0.0018 | 0.0185 |
| 2265001050 | Recreational | 4-Stroke Golf Carts | MOVES | 0.0037 | 0.0121 | 30.9% | 30.9% | land area | 0.0011 | 0.0038 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2018 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2018 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2265001060 | Recreational | 4-Stroke Specialty Vehicle Carts | MOVES | 0.0003 | 0.0010 | 30.9% | 30.9% | land area | 0.0001 | 0.0003 |
| 2265002003 | Construction | 4-Stroke Asphalt Pavers | MOVES | 0.0001 | 0.0002 | 77.3% | 77.3% | population | 0.0001 | 0.0002 |
| 2265002006 | Construction | 4-Stroke Tampers/Rammers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265002009 | Construction | 4-Stroke Plate Compactors | MOVES | 0.0002 | 0.0006 | 77.3% | 77.3% | population | 0.0001 | 0.0005 |
| 2265002015 | Construction | 4-Stroke Rollers | MOVES | 0.0002 | 0.0004 | 77.3% | 77.3% | population | 0.0001 | 0.0003 |
| 2265002021 | Construction | 4-Stroke Paving Equipment | MOVES | 0.0003 | 0.0012 | 77.3% | 77.3% | population | 0.0003 | 0.0009 |
| 2265002024 | Construction | 4-Stroke Surfacing Equipment | MOVES | 0.0001 | 0.0005 | 77.3% | 77.3% | population | 0.0001 | 0.0004 |
| 2265002027 | Construction | 4-Stroke Signal Boards | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265002030 | Construction | 4-Stroke Trenchers | MOVES | 0.0003 | 0.0008 | 77.3% | 77.3% | population | 0.0002 | 0.0006 |
| 2265002033 | Construction | 4-Stroke Bore/Drill Rigs | MOVES | 0.0002 | 0.0004 | 77.3% | 77.3% | population | 0.0001 | 0.0003 |
| 2265002039 | Construction | 4-Stroke Concrete/Industrial Saws | MOVES | 0.0006 | 0.0018 | 77.3% | 77.3% | population | 0.0005 | 0.0014 |
| 2265002042 | Construction | 4-Stroke Cement & Mortar Mixers | MOVES | 0.0003 | 0.0015 | 77.3% | 77.3% | population | 0.0002 | 0.0012 |
| 2265002045 | Construction | 4-Stroke Cranes | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265002054 | Construction | 4-Stroke Crushing/Proc. Equipment | MOVES | 0.0000 | 0.0001 | 77.3% | 77.3% | population | 0.0000 | 0.0001 |
| 2265002057 | Construction | 4-Stroke Rough Terrain Forklifts | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265002060 | Construction | 4-Stroke Rubber Tire Loaders | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2265002066 | Construction | 4-Stroke Tractors/Loaders/Backhoes | MOVES | 0.0002 | 0.0006 | 77.3% | 77.3% | population | 0.0001 | 0.0004 |
| 2265002072 | Construction | 4-Stroke Skid Steer Loaders | MOVES | 0.0002 | 0.0003 | 77.3% | 77.3% | population | 0.0002 | 0.0002 |
| 2265002078 | Construction | 4-Stroke Dumpers/Tenders | MOVES | 0.0001 | 0.0002 | 77.3% | 77.3% | population | 0.0000 | 0.0002 |
| 2265002081 | Construction | 4-Stroke Other Construction Equipment | MOVES | 0.0001 | 0.0001 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2265003010 | Industrial | 4-Stroke Aerial Lifts | MOVES | 0.0007 | 0.0006 | 77.3% | 77.3% | population | 0.0005 | 0.0005 |
| 2265003020 | Industrial | 4-Stroke Forklifts | MOVES | 0.0005 | 0.0003 | 77.3% | 77.3% | population | 0.0004 | 0.0002 |
| 2265003030 | Industrial | 4-Stroke Sweepers/Scrubbers | MOVES | 0.0001 | 0.0002 | 77.3% | 77.3% | population | 0.0001 | 0.0002 |
| 2265003040 | Industrial | 4-Stroke Other General Industrial Equipment | MOVES | 0.0002 | 0.0008 | 77.3% | 77.3% | population | 0.0002 | 0.0006 |
| 2265003050 | Industrial | 4-Stroke Other Material Handling Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265003060 | Industrial | 4-Stroke Industrial AC/Refrigeration | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265003070 | Industrial | 4-Stroke Terminal Tractors | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2265004010 | Lawn/Garden | 4-Stroke Lawn mowers (Residential) | MOVES | 0.0103 | 0.0873 | 77.3% | 77.3% | population | 0.0080 | 0.0675 |
| 2265004011 | Lawn/Garden | 4-Stroke Lawn mowers (Commercial) | MOVES | 0.0035 | 0.0223 | 77.3% | 77.3% | population | 0.0027 | 0.0172 |
| 2265004015 | Lawn/Garden | 4-Stroke Rotary Tillers < 6 HP (Residential) | MOVES | 0.0009 | 0.0076 | 77.3% | 77.3% | population | 0.0007 | 0.0059 |
| 2265004016 | Lawn/Garden | 4-Stroke Rotary Tillers < 6 HP (Commercial) | MOVES | 0.0018 | 0.0131 | 77.3% | 77.3% | population | 0.0014 | 0.0101 |
| 2265004025 | Lawn/Garden | 4-Stroke Trimmers/Edgers/Brush Cutters (Res.) | MOVES | 0.0001 | 0.0006 | 77.3% | 77.3% | population | 0.0000 | 0.0005 |
| 2265004026 | Lawn/Garden | 4-Stroke Trimmers/Edgers/Brush Cutters (Com.) | MOVES | 0.0001 | 0.0006 | 77.3% | 77.3% | population | 0.0001 | 0.0005 |
| 2265004030 | Lawn/Garden | 4-Stroke Leafblowers/Vacuums (Residential) | MOVES | 0.0001 | 0.0007 | 77.3% | 77.3% | population | 0.0001 | 0.0006 |
| 2265004031 | Lawn/Garden | 4-Stroke Leafblowers/Vacuums (Commercial) | MOVES | 0.0035 | 0.0140 | 77.3% | 77.3% | population | 0.0027 | 0.0108 |
| 2265004035 | Lawn/Garden | 4-Stroke Snowblowers (Residential) | MOVES | 0.0000 | 0.0033 | 77.3% | 77.3% | population | 0.0000 | 0.0025 |
| 2265004036 | Lawn/Garden | 4-Stroke Snowblowers (Commercial) | MOVES | 0.0000 | 0.0002 | 77.3% | 77.3% | population | 0.0000 | 0.0002 |
| 2265004040 | Lawn/Garden | 4-Stroke Rear Engine Riding Mowers (Res.) | MOVES | 0.0021 | 0.0114 | 77.3% | 77.3% | population | 0.0016 | 0.0088 |
| 2265004041 | Lawn/Garden | 4-Stroke Rear Engine Riding Mowers (Comm.) | MOVES | 0.0004 | 0.0013 | 77.3% | 77.3% | population | 0.0003 | 0.0010 |
| 2265004046 | Lawn/Garden | 4-Stroke Front Mowers (Commercial) | MOVES | 0.0005 | 0.0019 | 77.3% | 77.3% | population | 0.0004 | 0.0014 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2018 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2018 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2265004051 | Lawn/Garden | 4-Stroke Shredders < 6 HP (Commercial) | MOVES | 0.0002 | 0.0015 | 77.3% | 77.3% | population | 0.0002 | 0.0012 |
| 2265004055 | Lawn/Garden | 4-Stroke Lawn & Garden Tractors (Residential) | MOVES | 0.0277 | 0.1235 | 77.3% | 77.3% | population | 0.0214 | 0.0955 |
| 2265004056 | Lawn/Garden | 4-Stroke Lawn & Garden Tractors (Commercial) | MOVES | 0.0051 | 0.0174 | 77.3% | 77.3% | population | 0.0040 | 0.0135 |
| 2265004066 | Lawn/Garden | 4-Stroke Chippers/Stump Grinders (Comm.) | MOVES | 0.0008 | 0.0018 | 77.3% | 77.3% | population | 0.0007 | 0.0014 |
| 2265004071 | Lawn/Garden | 4-Stroke Commercial Turf Equipment (Comm.) | MOVES | 0.0166 | 0.0510 | 77.3% | 77.3% | population | 0.0128 | 0.0394 |
| 2265004075 | Lawn/Garden | 4-Stroke Other Lawn & Garden Equip. (Res.) | MOVES | 0.0011 | 0.0058 | 77.3% | 77.3% | population | 0.0009 | 0.0045 |
| 2265004076 | Lawn/Garden | 4-Stroke Other Lawn & Garden Equip. (Com.) | MOVES | 0.0006 | 0.0031 | 77.3% | 77.3% | population | 0.0005 | 0.0024 |
| 2265005010 | Agriculture | 4-Stroke 2-Wheel Tractors | MOVES | 0.0000 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005015 | Agriculture | 4-Stroke Agricultural Tractors | MOVES | 0.0001 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005020 | Agriculture | 4-Stroke Combines | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005025 | Agriculture | 4-Stroke Balers | MOVES | 0.0003 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0001 |
| 2265005030 | Agriculture | 4-Stroke Agricultural Mowers | MOVES | 0.0000 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265005035 | Agriculture | 4-Stroke Sprayers | MOVES | 0.0005 | 0.0011 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0003 |
| 2265005040 | Agriculture | 4-Stroke Tillers > 5 HP | MOVES | 0.0010 | 0.0039 | 24.2% | 24.2% | land area (1) | 0.0002 | 0.0010 |
| 2265005045 | Agriculture | 4-Stroke Swathers | MOVES | 0.0005 | 0.0004 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0001 |
| 2265005055 | Agriculture | 4-Stroke Other Agricultural Equipment | MOVES | 0.0006 | 0.0005 | 24.2% | 24.2% | land area (1) | 0.0001 | 0.0001 |
| 2265005060 | Agriculture | 4-Stroke Irrigation Sets | MOVES | 0.0002 | 0.0001 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2265006005 | Commercial | 4-Stroke Light Commercial Generator Set | MOVES | 0.0082 | 0.0365 | 77.3% | 77.3% | population | 0.0064 | 0.0282 |
| 2265006010 | Commercial | 4-Stroke Light Commercial Pumps | MOVES | 0.0021 | 0.0078 | 77.3% | 77.3% | population | 0.0017 | 0.0060 |
| 2265006015 | Commercial | 4-Stroke Light Commercial Air Compressors | MOVES | 0.0011 | 0.0032 | 77.3% | 77.3% | population | 0.0008 | 0.0025 |
| 2265006025 | Commercial | 4-Stroke Light Commercial Welders | MOVES | 0.0022 | 0.0072 | 77.3% | 77.3% | population | 0.0017 | 0.0056 |
| 2265006030 | Commercial | 4-Stroke Light Commercial Pressure Wash | MOVES | 0.0034 | 0.0152 | 77.3% | 77.3% | population | 0.0026 | 0.0118 |
| 2265006035 | Commercial | 4-Stroke Hydro Power Units | MOVES | 0.0002 | 0.0005 | 77.3% | 77.3% | population | 0.0001 | 0.0004 |
| 2265007010 | Logging | 4-Stroke Logging Equipment Shredders > 6 HP | MOVES | 0.0000 | 0.0001 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2265007015 | Logging | 4-Stroke Logging Equipment Skidders | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2265008005 | Airport Support | 4-Stroke Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2265010010 | Oil Field | 4-Stroke Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2267001060 | Recreational | LPG Specialty Vehicle Carts | MOVES | 0.0001 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2267002003 | Construction | LPG Asphalt Pavers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002015 | Construction | LPG Rollers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002021 | Construction | LPG Paving Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002024 | Construction | LPG Surfacing Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002030 | Construction | LPG Trenchers | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267002033 | Construction | LPG Bore/Drill Rigs | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267002039 | Construction | LPG Concrete/Industrial Saws | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002045 | Construction | LPG Cranes | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002054 | Construction | LPG Crushing/Proc. Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002057 | Construction | LPG Rough Terrain Forklifts | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267002060 | Construction | LPG Rubber Tire Loaders | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267002066 | Construction | LPG Tractors/Loaders/Backhoes | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2018 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2018 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2267002072 | Construction | LPG Skid Steer Loaders | MOVES | 0.0002 | 0.0000 | 77.3% | 77.3% | population | 0.0002 | 0.0000 |
| 2267002081 | Construction | LPG Other Construction Equipment | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267003010 | Industrial | LPG Aerial Lifts | MOVES | 0.0023 | 0.0005 | 77.3% | 77.3% | population | 0.0018 | 0.0004 |
| 2267003020 | Industrial | LPG Forklifts | MOVES | 0.0722 | 0.0098 | 77.3% | 77.3% | population | 0.0558 | 0.0076 |
| 2267003030 | Industrial | LPG Sweepers/Scrubbers | MOVES | 0.0005 | 0.0001 | 77.3% | 77.3% | population | 0.0004 | 0.0001 |
| 2267003040 | Industrial | LPG Other General Industrial Equipment | MOVES | 0.0002 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267003050 | Industrial | LPG Other Material Handling Equipment | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2267003070 | Industrial | LPG Terminal Tractors | MOVES | 0.0003 | 0.0000 | 77.3% | 77.3% | population | 0.0002 | 0.0000 |
| 2267004066 | Lawn/Garden | LPG Chippers/Stump Grinders (Commercial) | MOVES | 0.0003 | 0.0000 | 77.3% | 77.3% | population | 0.0003 | 0.0000 |
| 2267005055 | Agriculture | LPG Other Agricultural Equipment | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2267005060 | Agriculture | LPG Irrigation Sets | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2267006005 | Commercial | LPG Light Commercial Generator Sets | MOVES | 0.0047 | 0.0008 | 77.3% | 77.3% | population | 0.0036 | 0.0006 |
| 2267006010 | Commercial | LPG Light Commercial Pumps | MOVES | 0.0006 | 0.0001 | 77.3% | 77.3% | population | 0.0005 | 0.0001 |
| 2267006015 | Commercial | LPG Light Commercial Air Compressors | MOVES | 0.0004 | 0.0001 | 77.3% | 77.3% | population | 0.0003 | 0.0000 |
| 2267006025 | Commercial | LPG Light Commercial Welders | MOVES | 0.0005 | 0.0001 | 77.3% | 77.3% | population | 0.0004 | 0.0001 |
| 2267006030 | Commercial | LPG Light Commercial Pressure Washers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267006035 | Commercial | LPG Hydro Power Units | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2267008005 | Airport Support | LPG Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2268002081 | Construction | CNG Other Construction Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268003020 | Industrial | CNG Forklifts | MOVES | 0.0052 | 0.0026 | 77.3% | 77.3% | population | 0.0040 | 0.0020 |
| 2268003030 | Industrial | CNG Sweepers/Scrubbers | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268003040 | Industrial | CNG Other General Industrial Equipment | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268003060 | Industrial | CNG AC/Refrigeration | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268003070 | Industrial | CNG Terminal Tractors | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268005055 | Agriculture | CNG Other Agricultural Equipment | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2268005060 | Agriculture | CNG Irrigation Sets | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2268006005 | Commercial | CNG Light Commercial Generator Sets | MOVES | 0.0014 | 0.0008 | 77.3% | 77.3% | population | 0.0011 | 0.0006 |
| 2268006010 | Commercial | CNG Light Commercial Pumps | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268006015 | Commercial | CNG Light Commercial Air Compressors | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2268006020 | Commercial | CNG Light Commercial Gas Compressors | MOVES | 0.0007 | 0.0004 | 77.3% | 77.3% | population | 0.0006 | 0.0003 |
| 2268008005 | Airport Support | CNG Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2268010010 | Oil Field | CNG Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2270001060 | Recreational | Diesel Specialty Vehicle Carts | MOVES | 0.0009 | 0.0002 | 30.9% | 30.9% | land area | 0.0003 | 0.0001 |
| 2270002003 | Construction | Diesel Pavers | MOVES | 0.0055 | 0.0006 | 77.3% | 77.3% | population | 0.0043 | 0.0005 |
| 2270002006 | Construction | Diesel Tampers/Rammers (unused) | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2270002009 | Construction | Diesel Plate Compactors | MOVES | 0.0004 | 0.0001 | 77.3% | 77.3% | population | 0.0003 | 0.0000 |
| 2270002015 | Construction | Diesel Rollers | MOVES | 0.0157 | 0.0017 | 77.3% | 77.3% | population | 0.0122 | 0.0013 |
| 2270002018 | Construction | Diesel Scrapers | MOVES | 0.0149 | 0.0016 | 77.3% | 77.3% | population | 0.0115 | 0.0013 |
| 2270002021 | Construction | Diesel Paving Equipment | MOVES | 0.0011 | 0.0001 | 77.3% | 77.3% | population | 0.0009 | 0.0001 |
| 2270002024 | Construction | Diesel Surfacing Equipment | MOVES | 0.0010 | 0.0001 | 77.3% | 77.3% | population | 0.0007 | 0.0001 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2018 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2018 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2270002027 | Construction | Diesel Signal Boards | MOVES | 0.0037 | 0.0004 | 77.3% | 77.3% | population | 0.0029 | 0.0003 |
| 2270002030 | Construction | Diesel Trenchers | MOVES | 0.0110 | 0.0009 | 77.3% | 77.3% | population | 0.0085 | 0.0007 |
| 2270002033 | Construction | Diesel Bore/Drill Rigs | MOVES | 0.0131 | 0.0011 | 77.3% | 77.3% | population | 0.0101 | 0.0009 |
| 2270002036 | Construction | Diesel Excavators | MOVES | 0.0389 | 0.0059 | 77.3% | 77.3% | population | 0.0301 | 0.0046 |
| 2270002039 | Construction | Diesel Concrete/Industrial Saws | MOVES | 0.0008 | 0.0001 | 77.3% | 77.3% | population | 0.0006 | 0.0001 |
| 2270002042 | Construction | Diesel Cement & Mortar Mixers | MOVES | 0.0006 | 0.0001 | 77.3% | 77.3% | population | 0.0004 | 0.0000 |
| 2270002045 | Construction | Diesel Cranes | MOVES | 0.0150 | 0.0015 | 77.3% | 77.3% | population | 0.0116 | 0.0012 |
| 2270002048 | Construction | Diesel Graders | MOVES | 0.0097 | 0.0015 | 77.3% | 77.3% | population | 0.0075 | 0.0012 |
| 2270002051 | Construction | Diesel Off-highway Trucks | MOVES | 0.0556 | 0.0061 | 77.3% | 77.3% | population | 0.0430 | 0.0047 |
| 2270002054 | Construction | Diesel Crushing/Proc. Equipment | MOVES | 0.0033 | 0.0003 | 77.3% | 77.3% | population | 0.0026 | 0.0002 |
| 2270002057 | Construction | Diesel Rough Terrain Forklifts | MOVES | 0.0218 | 0.0024 | 77.3% | 77.3% | population | 0.0168 | 0.0018 |
| 2270002060 | Construction | Diesel Rubber Tire Loaders | MOVES | 0.0757 | 0.0076 | 77.3% | 77.3% | population | 0.0585 | 0.0059 |
| 2270002066 | Construction | Diesel Tractors/Loaders/Backhoes | MOVES | 0.0670 | 0.0127 | 77.3% | 77.3% | population | 0.0518 | 0.0098 |
| 2270002069 | Construction | Diesel Crawler Tractors | MOVES | 0.0560 | 0.0064 | 77.3% | 77.3% | population | 0.0433 | 0.0050 |
| 2270002072 | Construction | Diesel Skid Steer Loaders | MOVES | 0.0565 | 0.0116 | 77.3% | 77.3% | population | 0.0437 | 0.0090 |
| 2270002075 | Construction | Diesel Off-Highway Tractors | MOVES | 0.0097 | 0.0008 | 77.3% | 77.3% | population | 0.0075 | 0.0006 |
| 2270002078 | Construction | Diesel Dumpers/Tenders | MOVES | 0.0002 | 0.0000 | 77.3% | 77.3% | population | 0.0001 | 0.0000 |
| 2270002081 | Construction | Diesel Other Construction Equipment | MOVES | 0.0093 | 0.0008 | 77.3% | 77.3% | population | 0.0072 | 0.0006 |
| 2270003010 | Industrial | Diesel Aerial Lifts | MOVES | 0.0051 | 0.0011 | 77.3% | 77.3% | population | 0.0040 | 0.0009 |
| 2270003020 | Industrial | Diesel Forklifts | MOVES | 0.0211 | 0.0028 | 77.3% | 77.3% | population | 0.0163 | 0.0022 |
| 2270003030 | Industrial | Diesel Sweepers/Scrubbers | MOVES | 0.0123 | 0.0015 | 77.3% | 77.3% | population | 0.0095 | 0.0011 |
| 2270003040 | Industrial | Diesel Other General Industrial Equipment | MOVES | 0.0165 | 0.0018 | 77.3% | 77.3% | population | 0.0128 | 0.0014 |
| 2270003050 | Industrial | Diesel Other Material Handling Equipment | MOVES | 0.0012 | 0.0002 | 77.3% | 77.3% | population | 0.0009 | 0.0002 |
| 2270003060 | Industrial | Diesel AC/Refrigeration | MOVES | 0.0557 | 0.0034 | 77.3% | 77.3% | population | 0.0431 | 0.0027 |
| 2270003070 | Industrial | Diesel Terminal Tractors | MOVES | 0.0098 | 0.0019 | 77.3% | 77.3% | population | 0.0076 | 0.0015 |
| 2270004031 | Lawn/Garden | Diesel Leafblowers/Vacuums (Commercial) | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2270004036 | Lawn/Garden | Diesel Snowblowers (Commercial) | MOVES | 0.0000 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2270004046 | Lawn/Garden | Diesel Front Mowers (Commercial) | MOVES | 0.0149 | 0.0014 | 77.3% | 77.3% | population | 0.0115 | 0.0011 |
| 2270004056 | Lawn/Garden | Diesel Lawn & Garden Tractors (Commercial) | MOVES | 0.0032 | 0.0004 | 77.3% | 77.3% | population | 0.0025 | 0.0003 |
| 2270004066 | Lawn/Garden | Diesel Chippers/Stump Grinders (Commercial) | MOVES | 0.0174 | 0.0017 | 77.3% | 77.3% | population | 0.0135 | 0.0013 |
| 2270004071 | Lawn/Garden | Diesel Commercial Turf Equipment (Comm.) | MOVES | 0.0014 | 0.0001 | 77.3% | 77.3% | population | 0.0011 | 0.0001 |
| 2270004076 | Lawn/Garden | Diesel Other Lawn & Garden Equipment (Comm) | MOVES | 0.0001 | 0.0000 | 77.3% | 77.3% | population | 0.0000 | 0.0000 |
| 2270005010 | Agriculture | Diesel 2-Wheel Tractors | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005015 | Agriculture | Diesel Agricultural Tractors | MOVES | 0.3192 | 0.0304 | 24.2% | 24.2% | land area (1) | 0.0773 | 0.0074 |
| 2270005020 | Agriculture | Diesel Combines | MOVES | 0.0357 | 0.0034 | 24.2% | 24.2% | land area (1) | 0.0086 | 0.0008 |
| 2270005025 | Agriculture | Diesel Balers | MOVES | 0.0002 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005030 | Agriculture | Diesel Agricultural Mowers | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005035 | Agriculture | Diesel Sprayers | MOVES | 0.0029 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0007 | 0.0001 |
| 2270005040 | Agriculture | Diesel Tillers > 6 HP | MOVES | 0.0000 | 0.0000 | 24.2% | 24.2% | land area (1) | 0.0000 | 0.0000 |
| 2270005045 | Agriculture | Diesel Swathers | MOVES | 0.0028 | 0.0003 | 24.2% | 24.2% | land area (1) | 0.0007 | 0.0001 |

| SCC | Segment Description | SCC Description | Emis. from | Kenosha County 2018 Emissions | | % in NAA | | Allocate by | Kenosha NAA 2018 Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NOx | VOC | NOx | VOC | | NOx | VOC |
| 2270005055 | Agriculture | Diesel Other Agricultural Equipment | MOVES | 0.0069 | 0.0007 | 24.2% | 24.2% | land area (1) | 0.0017 | 0.0002 |
| 2270005060 | Agriculture | Diesel Irrigation Sets | MOVES | 0.0038 | 0.0004 | 24.2% | 24.2% | land area (1) | 0.0009 | 0.0001 |
| 2270006005 | Commercial | Diesel Light Commercial Generator Sets | MOVES | 0.0254 | 0.0027 | 77.3% | 77.3% | population | 0.0196 | 0.0021 |
| 2270006010 | Commercial | Diesel Light Commercial Pumps | MOVES | 0.0059 | 0.0006 | 77.3% | 77.3% | population | 0.0046 | 0.0005 |
| 2270006015 | Commercial | Diesel Light Commercial Air Compressors | MOVES | 0.0108 | 0.0010 | 77.3% | 77.3% | population | 0.0084 | 0.0008 |
| 2270006025 | Commercial | Diesel Light Commercial Welders | MOVES | 0.0081 | 0.0016 | 77.3% | 77.3% | population | 0.0063 | 0.0012 |
| 2270006030 | Commercial | Diesel Light Commercial Pressure Washer | MOVES | 0.0009 | 0.0001 | 77.3% | 77.3% | population | 0.0007 | 0.0001 |
| 2270006035 | Commercial | Diesel Hydro Power Units | MOVES | 0.0005 | 0.0000 | 77.3% | 77.3% | population | 0.0004 | 0.0000 |
| 2270007015 | Logging | Diesel Logging Equip Fell/Bunch/Skidders | MOVES | 0.0002 | 0.0000 | 30.9% | 30.9% | land area | 0.0001 | 0.0000 |
| 2270008005 | Airport Support | Diesel Airport Support Equipment | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2270010010 | Oil Field | Diesel Other Oil Field Equipment | MOVES | 0.0000 | 0.0000 | 30.9% | 30.9% | land area | 0.0000 | 0.0000 |
| 2275001000 | Aircraft | Military Aircraft | USEPA | 0.0000 | 0.0002 | 100.0% | 100.0% | airport location (2) | 0.0000 | 0.0002 |
| 2275020000 | Aircraft | Commercial Aviation | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2275050000 | Aircraft | General Aviation | USEPA | 0.0072 | 0.0161 | 62.0% | 62.0% | airport location (2) | 0.0045 | 0.0099 |
| 2275060000 | Aircraft | Air Taxi | USEPA | 0.0016 | 0.0021 | 98.9% | 98.9% | airport location (2) | 0.0016 | 0.0020 |
| 2275070000 | Aircraft | Aircraft Auxiliary Power Units | USEPA | 0.0000 | 0.0000 | - | - | airport location (2) | 0.0000 | 0.0000 |
| 2280000000 | Comm. Mar. | All Commercial Marine Vessels | USEPA | 0.1146 | 0.0046 | 100.0% | 100.0% | Lake Mich. shoreline | 0.1146 | 0.0046 |
| 2282005010 | Pleasure Craft | 2-Stroke Outboards | MOVES | 0.0395 | 0.2144 | 69.1% | 69.1% | water area (3) | 0.0273 | 0.1482 |
| 2282005015 | Pleasure Craft | 2-Stroke Personal Watercraft | MOVES | 0.0178 | 0.0369 | 69.1% | 69.1% | water area (3) | 0.0123 | 0.0255 |
| 2282010005 | Pleasure Craft | 4-Stroke Inboards | MOVES | 0.0733 | 0.0680 | 69.1% | 69.1% | water area (3) | 0.0507 | 0.0470 |
| 2282020005 | Pleasure Craft | Diesel Inboards | MOVES | 0.0941 | 0.0053 | 69.1% | 69.1% | water area (3) | 0.0650 | 0.0037 |
| 2282020010 | Pleasure Craft | Diesel Outboards | MOVES | 0.0001 | 0.0000 | 69.1% | 69.1% | water area (3) | 0.0001 | 0.0000 |
| 2285002006 | Railroad | Diesel Locomotives | USEPA | 0.5606 | 0.0203 | 60.0% | 60.0% | rail links (2) | 0.3364 | 0.0122 |
| 2285002015 | Railroad | Diesel Railway Maintenance | MOVES | 0.0016 | 0.0003 | 60.0% | 60.0% | rail links (2) | 0.0010 | 0.0002 |
| 2285004015 | Railroad | 4-Stroke Gasoline Railway Maintenance | MOVES | 0.0000 | 0.0001 | 60.0% | 60.0% | rail links (2) | 0.0000 | 0.0000 |
| 2285006015 | Railroad | LPG Railway Maintenance | MOVES | 0.0000 | 0.0000 | 60.0% | 60.0% | rail links (2) | 0.0000 | 0.0000 |
| | | | | | | | | | | |
| **ALL (Total)** | **ALL (Total)** | **ALL (Total)** | | **2.1935** | **1.4752** | | | | **1.3991** | **0.9641** |

(1) City of Kenosha excluded.

(2) Obtained from USEPA 2011 Modeling Platform, ver. 6.2.

(3) Allocation based on surface water area (81 sq. km. for county and 56 sq. km., 69.1%, for nonattainment area, from the NMIM2009 files WI_WIB.ALO and WI_WOB.ALO).

# APPENDIX 7

# 2017 and 2018 Wisconsin Emissions Projections Documentation - Methodology

This appendix provides additional information for the sector-specific NOx and VOC tons per summer day (tpsd) emission estimates in section 3.3 (2017 & 2018 Projected Year Inventories for RFP) of the Wisconsin Department of Natural Resources (WDNR) eastern Kenosha County ozone attainment plan. For the U.S. Environmental Protection Agency (EPA) to approve an attainment plan for ozone, a state must show that improvement in air quality is due to permanent and enforceable reductions in emissions. This is accomplished in part by developing and comparing a nonattainment year (2011) emissions inventory and attainment year (2017) emissions inventory. Emissions were also projected for 2018 in order to meet the required contingency.

This appendix includes:

7.1 EGU Inventory Methodology for 2017 and 2018……………………………………3

7.2 Point Non-EGU Inventory Methodology for 2017 and 2018…………………..4

7.3 Area Source Inventory Methodology for 2017 and 2018………………………7

7.4 Onroad Inventory Methodology for 2017 and 2018……………………………8

7.5 Nonroad Inventory Methodology for 2017 and 2018………………………….9

# Appendix 7.1 – EGU Inventory Methodology for 2017 and 2018

See Appendix 2 for the projection methodology related to EGUs.

# Appendix 7.2 – Point Non-EGU Inventory Methodology for 2017 and 2018

## 7.2.1 – Growth Factors from AEO 2014/2016 for Existing Sources

Non-EGU point source projected 2017 and 2018 emissions were derived by first applying growth factors to the 2011 base year inventory. These growth factors were developed from Annual Energy Outlook (AEO) 2014 and AEO 2016 industry-specific energy consumption data, summarized in Table 7.2.1. Growth in energy consumption was assumed to correspond linearly with growth in emissions. A second step in projecting emissions – accounting for potential emissions increases resulting from the modification of existing sources or the installation of new sources – is described in section 7.2.2 below.

**Table 7.2.1. Growth Factors from AEO 2014/2016 Used for Projecting Wisconsin Non-EGU Point Source Emissions in Eastern Kenosha County.**

| NAICS | NAICS Description | AEO 2014/2016 Industrial or Commercial Sub-sector [1] | AEO 2014/2016 Energy Consumption (trillion Btu) [1,2] | | | Growth Factor (from 2011) [3] | |
|---|---|---|---|---|---|---|---|
| | | | 2011 | 2017 | 2018 | 2017 GF | 2018 GF |
| 331513 | Foundries - Steel | Iron and Steel Industry | 1,362 | 1,507 | 1,492 | 1.11 | 1.10 |
| 311421 | Food Manufacturing | Food Industry | 1,114 | 1,238 | 1,294 | 1.11 | 1.16 |
| 322222 | Paper Bag and Coated and Treated Paper Manufacturing | Paper Industry | 2,018 | 2,136 | 2,216 | 1.06 | 1.10 |
| 611310 | Colleges, Universities, and Professional Schools | Commercial sector energy consumption (natural gas) for East North Central U.S. | 0.72 | 0.70 | 0.69 | 0.97 | 0.97 |
| 6221 | General Medical and Surgical Hospitals | Commercial sector energy consumption (natural gas and distillate fuel oil) for East North Central U.S. | 0.75 | 0.73 | 0.73 | 0.97 | 0.97 |
| 325510 | Paint, Coating and Adhesive Manufacturing | Bulk Chemical Industry | 2,441 | 2,619 | 2,741 | 1.07 | 1.12 |
| 622110 | General Medical and Surgical Hospitals | Commercial sector energy consumption (natural gas and distillate fuel oil) for East North Central U.S. | 0.75 | 0.73 | 0.73 | 0.97 | 0.97 |
| 611310 | Colleges, Universities, and Professional Schools | Commercial sector energy consumption (natural gas and distillate fuel oil) for East North Central U.S. | 0.75 | 0.73 | 0.73 | 0.97 | 0.97 |
| 331523 | Foundries - Aluminum | Aluminum Industry | 351 | 411 | 419 | 1.17 | 1.19 |

| NAICS | NAICS Description | AEO 2014/2016 Industrial or Commercial Sub-sector [1] | AEO 2014/2016 Energy Consumption (trillion Btu) [1,2] | | | Growth Factor (from 2011) [3] | |
|---|---|---|---|---|---|---|---|
| | | | 2011 | 2017 | 2018 | 2017 GF | 2018 GF |
| 335921 | Electrical Equipment, Appliance, and Component Manufacturing | Metal Based Durables Industry - Electrical Equipment | 69 | 77 | 79 | 1.13 | 1.15 |
| 323111 | Printing and Related Support Activities | Paper Industry | 2,018 | 2,136 | 2,216 | 1.06 | 1.10 |
| 31121 | Flour Milling and Malt Manufacturing | Food Industry | 1,114 | 1,238 | 1,294 | 1.11 | 1.16 |
| 332322 | Fabricated Metal Product Manufacturing | Metal Based Durables Industry - Fabricated Metal Products | 331 | 384 | 390 | 1.16 | 1.18 |

[1] Source: http://www.eia.gov/forecasts/aeo/index.cfm
[2] 2011 energy consumption values are from AEO 2014; 2017 and 2018 projected energy consumption values are from AEO 2016.
[3] Growth factors for the entire 2011-2017 and 2011-2018 periods were calculated by dividing the 2017 or 2018 energy consumption values by the 2011 energy consumption value.

## 7.2.2 – Modified and New Source Emissions

Section 172(c)(4) of the Clean Air Act (CAA) requires identification and quantification of potential emissions from new or modified sources when developing emission inventories for attainment and maintenance purposes. The point source emissions inventory described in section 7.2.1 above includes projections of emissions growth determined by applying general regional growth factors. However, this methodology alone does not distinguish emissions associated with modified and new sources. Therefore, as a second step the WDNR reviewed permitting actions for sources in eastern Kenosha County from 2010 to 2015 (five years). A summary of the permitting activity and associated potential emissions is shown in Table 7.2.2. The resulting emissions from this exercise are added to the projected emissions for *existing* point source non-EGU, to yield the *total* projected point source non-EGU emissions for 2017 and 2018 found in section 3.3 of the eastern Kenosha County ozone attainment demonstration (see also Appendix 3, Table 3.2 for the addition of new/modified sources to existing sources). This approach may add emissions which overlap with existing source grown emissions, but it provides a more conservative estimate of future emissions. It should be noted that this future projection of emissions does not limit the amount of future emissions allowed from modified and new sources. This is consistent with the CAA which allows for the installation of new or modification of sources subject to requirements of the New Source Review (NSR) or Prevention of Significant Deterioration (PSD) programs as discussed in section 3.6 of the eastern Kenosha County ozone attainment demonstration.

The review summarized in Table 7.2.2 identified the construction of one new facility with process lines for mixing commercial paint products. The potential VOC emissions (based on enforceable operating constraints) for this new facility were below 100 tons per year and therefore constituted a minor source permitting action. A new facility is unlikely to operate at full capacity, at least through the attainment and contingency period. Therefore, the WDNR believes that applying 50 tons per year is a better approximation of actual emissions for purposes of counting emissions from this new facility in projecting future emissions. Based on this information, an emission estimate of 0.137 tons per day of VOC is added to the projection of future year point source emissions.

**Table 7.2.2. Permitting Actions for Existing Source and New Emission Sources – 2010 to 2015.**

| Construction Permit Class | Year | Potential Emissions Increase (TPY) | | Estimated Daily Average (TPD) [1] | | Project Description |
|---|---|---|---|---|---|---|
| | | NOx | VOC | NOx | VOC | |
| Minor action | 2010 | 0.00 | 50.00 | - | 0.137 | Construction of a new paint product mixing facility. |

[1] The tons per day (TPD) daily emissions are calculated by dividing annual potential emissions by 365 days. These are also assumed to be equivalent to tons per summer day (tpsd) emissions.

[2] A minor action is a permitting action that falls below the major source threshold of 100 tons per year (TPY) or significant emissions increase threshold of 40 TPY.

## Appendix 7.3 – Area Source Inventory Methodology for 2017 and 2018

As mentioned in section 3.3 of the attainment demonstration main document, EPA's 2011 Emissions Modeling Platform, Version 6.2 includes projections for the years 2017 and 2025. Wisconsin's 2017 area source emissions estimates were based primarily on EPA's 2017 modeling inventory, while the 2018 area source emissions were estimated primarily by interpolating between EPA's 2017 and 2025 modeling inventories. The exception is that WDNR staff projected emissions from vehicle refueling at gasoline stations (Stage II refueling) using the EPA's MOVES2014a model with the same activity inputs used for the onroad modeling. (The geographical coverage of the MOVES2014a modeling was limited to the eastern nonattainment portion of Kenosha County.) Unlike 2011, no Stage II vapor recovery program was modeled for 2017 and 2018. Owing to most vehicles now having their own vapor recovery system, called onboard refueling vapor recovery or ORVR, Stage II controls at the pump are largely redundant or even counter-productive. Wisconsin submitted a SIP revision removing Stage II requirements, and EPA approved the revision in November 2013. Even without a Stage II program in the projection years, emissions from Stage II refueling are less in 2018 than in 2011, owing to the larger percentage of vehicles having ORVR.

The projected area source emissions can be found in Appendix 4.

## Appendix 7.4 – Onroad Inventory Methodology for 2017 and 2018

The 2017 and 2018 projected onroad emissions were developed using the MOVES2014a model, as was the case for the 2011 emissions.

Vehicle age distributions were projected from a base 2014 distribution using the Age Distribution Projection Tool developed by the EPA (see: https://www3.epa.gov/otaq/models/moves/tools.htm). This macro-based excel file projects a base year age distribution by source type to a future distribution using a similar algorithm to what EPA used to generate the national projected age distributions in MOVES2014.

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) provided projected transportation data assuming their high economic growth scenario for the years 2017, 2020 and 2030. The annual VMT growth rate for the eastern Kenosha County nonattainment area under this scenario is about 2.00% from 2011 to 2017, about 0.86% from 2017 to 2020 and about 0.95% from 2020 to 2030. WDNR calculated 2018 VMT by linearly interpolating between 2017 and 2020. Table 4.4.1 shows the annual VMT values provided by SEWRPC (or interpolated by WDNR) and the summer weekday VMT values outputted by MOVES2014a. The factors to convert annual VMT to summer weekday VMT were those previously agreed to and used by WDNR and SEWRPC.

**Table 4.4.1. Vehicle-Miles of Travel for the Eastern Kenosha County Nonattainment Area**

| Year | Vehicle-Miles of Travel | |
|---|---|---|
| | Annual | Summer Weekday |
| 2011 | 969,754,558 | 3,074,892 |
| 2017 | 1,092,411,717 | 3,463,833 |
| 2018 | 1,101,833,795 | 3,493,710 |
| 2020 | 1,120,677,953 | 3,553,459 |
| 2030 | 1,231,360,240 | 3,904,398 |

The speed distributions provided by SEWRPC reflected the 5 mph speed limit increase (65 mph to 70 mph) which took effect in 2015 on certain restricted access roadways throughout Wisconsin, including Interstate Highway 94 in Kenosha County. MOVES2014a predicts an increase in NOx and VOC emissions from this increase in speed.

Emissions were increased by a 7.5% safety margin, as agreed through the transportation conformity consultative process.

The motor vehicle I/M program and reformulated gasoline were both assumed to remain in effect for 2017 and 2018.

Detailed listing of the projected onroad emissions and activity data are provided in Appendix 5.

## Appendix 7.5 – Nonroad Inventory Methodology for 2017 and 2018

The methodology for the 2017 and 2018 projected nonroad emissions is parallel to the methodology used for the 2011 estimates.

For all source categories except commercial marine, aircraft and rail locomotive (MAR), the MOVES2014a model was run for Kenosha County at hot summer day temperatures, assuming the model's default growth projections.

For the MAR categories, the countywide 2017 emissions were directly obtained from EPA's Version 6.3 Modeling Platform. The countywide 2018 emissions were linearly extrapolated from the 2011 and 2017 Modeling Platform emissions.

The countywide nonroad emissions were then allocated to the eastern Kenosha County nonattainment area using the allocation factors described in section 2.4.3 of Appendix 1.

Detailed listings of the projected nonroad emissions for over 200 subcategories are provided in Appendix 6.

# APPENDIX 8

# Wisconsin VOC RACT Regulations:
# Enforceable Control Measures
# and Negative Declaration related to EPA Control Technology Guidelines

Table 1. Volatile Organic Compounds (VOC) Control Technique Guidelines Incorporated into Wisconsin Administrative Code.

| Source | Title (Description) | EPA CTG Report No. | Wis. Adm. Code Incorporation | Emissions Inventory Classification[1] |
|---|---|---|---|---|
| **Petroleum and Gasoline Sources** | | | | |
| Bulk Gasoline Plants | Control of Volatile Organic Emissions from Bulk Gasoline Plants [bulk gasoline plant unloading, loading and storage] | EPA-450/2-77-035 | NR 420.04(2) | Stationary Point Source |
| Refinery Equipment - Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds | Control of Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds | EPA-450/2-77-025 | NR 420.05(1), (2) and (3) | Stationary Point Source |
| Refinery Equipment - Control of VOC Leaks | Control of Volatile Organic Compound Leaks from Petroleum Refinery Equipment | EPA-450/2-78-036 | NR 420.05(4) | Stationary Point Source |
| Refinery Equipment - Control of VOC Leaks | Control of Volatile Organic Compound Equipment Leaks from Natural Gas/Gasoline Processing Plants | EPA-450/3-83-007 | NR 420.05(4) | Stationary Point Source |
| Tanks - Fixed Roof | Control of Volatile Organic Emissions from Storage of Petroleum Liquids in Fixed-Roof Tanks | EPA-450/2-77-036 | NR 420.03(5) | Stationary Point Source |
| Tanks - External Floating Roofs | Control of Volatile Organic Emissions from Petroleum Liquid Storage in External Floating Roof Tanks | EPA-450/2-78-047 | NR 420.03(6) and (7) | Stationary Point Source |
| Gasoline Loading Terminals | Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals | EPA-450/2-77-026 | NR 420.04(1) | Stationary Point Source |
| Tank Trucks | Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems | EPA-450/2-78-051 | NR 420.04(4) | Stationary Area Source |
| Gasoline Delivery - Stage I Vapor Control Systems | Design Criteria for Stage I Vapor Control Systems – Gasoline Service Stations | EPA-450/R-75-102 | NR 420.04(3) | Stationary Area Source |
| **Surface Coating** | | | | |
| Automobile & Light-duty Truck | Control Techniques Guidelines for Automobile and Light-Duty Truck Assembly | EPA 453/R-08-006 | NR 422.09 | Stationary Point Source |

| Source | Title (Description) | EPA CTG Report No. | Wis. Adm. Code Incorporation | Emissions Inventory Classification[1] |
|---|---|---|---|---|
| | Coatings | | | |
| Cans | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks | EPA-450/2-77-008 | NR 422.05 | Stationary Point Source |
| Coils | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks | EPA-450/2-77-008 | NR 422.06 | Stationary Point Source |
| Fabric & Vinyl | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks | EPA-450/2-77-008 | NR 422.08 | Stationary Point Source |
| Flat Wood Paneling | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume VII: Factory Surface Coating of Flat Wood Paneling | EPA-450/2-78-032 | NR 422.13 | Stationary Point Source |
| | Control Techniques Guidelines for Flat Wood Paneling Coatings | EPA-453/R-06-004 | NR 422.131 | Stationary Point Source |
| Large Appliances | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume V: Surface Coating of Large Appliances | EPA-450/2-77-034 | NR 422.11 | Stationary Point Source |
| | Control Techniques Guidelines for Large Appliance Coatings | EPA 453/R-07-004 | NR 422.115 | Stationary Point Source |
| Magnet Wire | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume IV: Surface Coating of Insulation of Magnet Wire | EPA-450/2-77-033 | NR 422.12 | Stationary Point Source |
| Metal Furniture | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume III: Surface Coating of Metal Furniture | EPA-450/2-77-032 | NR 422.1 | Stationary Point Source |
| | Control Techniques Guidelines for Metal | EPA 453/R-07- | NR 422.105 | Stationary Point |

| Source | Title (Description) | EPA CTG Report No. | Wis. Adm. Code Incorporation | Emissions Inventory Classification[1] |
|---|---|---|---|---|
| | Furniture Coatings | 005 | | Source |
| Metal Parts, miscellaneous | Control Techniques Guidelines for Miscellaneous Metal and Plastic Parts Coatings | EPA 453/R-08-003 | NR 422.15 | Stationary Point Source |
| | Fire Truck and Emergency Response Vehicle Manufacturing - surface coating | (covered under Misc. Metal Parts CTG) | NR 422.151 | Stationary Point Source |
| Paper, Film and Foil | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks | EPA-450/2-77-008 | NR 422.07 | Stationary Point Source |
| | Control Techniques Guidelines for Paper, Film, and Foil Coatings | EPA 453/R-07-003 | NR 422.075 | Stationary Point Source |
| Plastic Parts - Coatings | Control Techniques Guidelines for Miscellaneous Metal and Plastic Parts Coatings | EPA 453/R-08-003 | NR 422.083 | Stationary Point Source |
| Traffic Markings | Reduction of Volatile Organic Compound Emissions from the Application of Traffic Markings | EPA-450/3-88-007 | NR 422.17 | Stationary Area Source |
| Wood Furniture | Control of Volatile Organic Compound Emissions from Wood Furniture Manufacturing Operations | EPA-453/R-96-007 | NR 422.125 | Stationary Point Source |
| **Graphic Arts** | | | | |
| Rotogravure & Flexography | Control of Volatile Organic Emissions from Existing Stationary Sources – Volume VIII: Graphic Arts-Rotogravure and Flexography | EPA-450/2-78-033 | NR 422.14 | Stationary Point Source |
| Flexible Packaging | Control Techniques Guidelines for Flexible Package Printing | EPA-453/R-06-003 | NR 422.141 | Stationary Point Source |
| Letterpress | Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing | EPA-453/R-06-002 | NR 422.144 | Stationary Point Source |
| Lithographic | Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing | EPA-453/R-06-002 | NR 422.142 and 422.143 | Stationary Point Source |

| Source | Title (Description) | EPA CTG Report No. | Wis. Adm. Code Incorporation | Emissions Inventory Classification[1] |
|---|---|---|---|---|
| **Solvents** | | | | |
| Dry Cleaning | Control of Volatile Organic Emissions from Perchloroethylene Dry Cleaning Systems | EPA-450/2-78-050 | NR 423.05 | Stationary Area Source |
| Dry Cleaning | Control of Volatile Organic Compound Emissions from Large Petroleum Dry Cleaners | EPA-450/3-82-009 | NR 423.05 | Stationary Area Source |
| Industrial Cleaning | Control Techniques Guidelines for Industrial Cleaning Solvents | EPA-453/R-06-001 | NR 423.035 and 423.037 | Stationary Area Source |
| Metal Cleaning | Control of Volatile Organic Emissions from Solvent Metal Cleaning | EPA-450/2-77-022 | NR 423.03 | Stationary Area Source |
| **Chemical** | | | | |
| Pharmaceutical | Control of Volatile Organic Emissions from Manufacture of Synthesized Pharmaceutical Products | EPA-450/2-78-029 | NR 421.03 | Stationary Point Source |
| Polystyrene | Control of Volatile Organic Compound Emissions from Manufacture of High-Density Polyethylene, Polypropylene, and Polystyrene Resins | EPA-450/3-83-008 | NR 421.05 | Stationary Point Source |
| Rubber | Control of Volatile Organic Emissions from Manufacture of Pneumatic Rubber Tires | EPA-450/2-78-030 | NR 421.04 | Stationary Point Source |
| Synthetic Organic | Control of Volatile Organic Compound Emissions from Air Oxidation Processes in Synthetic Organic Chemical Manufacturing Industry | EPA-450/3-84-015 | NR 421.07 | Stationary Point Source |
| Synthetic Organic | Control of Volatile Organic Compound Emissions from Reactor Processes and Distillation Operations in Synthetic Organic Chemical Manufacturing Industry | EPA-450/4-91-031 | NR 421.07 | Stationary Point Source |
| Synthetic Resin | Control of Volatile Organic Compound Leaks from Synthetic Organic Chemical Polymer and Resin Manufacturing Equipment | EPA-450/3-83-006 | NR 421.05 | Stationary Point Source |
| **Manufacturing** | | | | |

| **Source** | **Title (Description)** | **EPA CTG Report No.** | **Wis. Adm. Code Incorporation** | **Emissions Inventory Classification[1]** |
|---|---|---|---|---|
| Asphalt | Control of Volatile Organic Emissions from Use of Cutback Asphalt | EPA-450/2-77-037 | NR 422.16 | Stationary Area Source |

[1]For purposes of this table, an "Area" source is defined as a nonpoint or fugitive emission source.

***Wisconsin is making a negative declaration*** for the following CTG source categories where Wisconsin has determined that there are no identified sources in the 2008 ozone NAAQS nonattainment areas meeting the applicability criteria recommended in the specified CTG documents.

Table 2. Volatile Organic Compounds (VOC) Control Technique Guidelines ***Not*** Incorporated into Wisconsin Administrative Code for which Wisconsin is making a ***Negative Declaration.***

| **Source** | **Title (Description)** | **EPA CTG Report No.** |
|---|---|---|
| Shipbuilding and Repair | Control Techniques Guidelines for Shipbuilding and Ship Repair Operations (Surface Coating) | 61 FR 44050 (08-27-1996) |
| Aerospace | Control of Volatile Organic Compound Emissions for Coating Operations at Aerospace Manufacturing and Rework Operations | EPA-453/R-97-004 |
| Fiberglass Boat Manufacturing | Control Techniques Guidelines for Fiberglass Boat Manufacturing Materials | EPA 453/R-08-004 |
| Miscellaneous Industrial Adhesives | Control Techniques Guidelines for Miscellaneous Industrial Adhesives | EPA 453/R-08-005 |

# Appendix 9

# Modeling Demonstration for the 2008 Ozone National Ambient Air Quality Standard for the Lake Michigan Region

# Technical Support Document

Lake Michigan Air Directors Consortium

February 3, 2017

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# EXECUTIVE SUMMARY

On May 21, 2012 and June 11, 2012, the U.S. Environmental Protection Agency (U.S. EPA) established final air quality designations for the 2008 Ozone National Ambient Air Quality Standard (NAAQS), identifying as ‘‘nonattainment’’ those areas that were violating the NAAQS based on air quality monitoring data from 2008-2010 and 2009-2011, or those areas that were considered to be contributing to a violation of the NAAQS in a nearby area. In these actions, U.S. EPA designated Sheboygan County in eastern Wisconsin, and the Chicago metropolitan area, including all or portions of eight counties in Illinois, two counties in northwest Indiana (Lake and Porter), and one county in southeast Wisconsin (Kenosha) as “marginal” ozone nonattainment areas with an attainment deadline of July 20, 2015. On April 11, 2016, U.S. EPA determined that the Chicago metropolitan area failed to attain the 2008 ozone NAAQS by the applicable attainment date and thus reclassified the area as a “moderate” ozone nonattainment area. On September 28, 2016, U.S. EPA made a similar determination for Sheboygan County.

As a result of these actions, the States of Illinois, Indiana, and Wisconsin must submit SIPs that meet the requirements that apply to “moderate” ozone nonattainment areas by January 1, 2017, including the requirement to submit an attainment demonstration which identifies emissions reduction strategies sufficient to achieve the NAAQS by the attainment date, July 20, 2018. Because the attainment deadline occurs during the 2018 ozone season, attainment must be demonstrated by the end of the 2017 ozone season.

The Lake Michigan Air Directors Consortium (LADCO), in cooperation with the Illinois EPA, the Indiana DEM, and the Wisconsin DNR developed updated air quality analyses to support the development of attainment SIPs for ozone. The analyses include preparation of regional emissions inventories and meteorological data, evaluation and application of regional chemical transport models, and collection and analysis of ambient monitoring data. The technical analyses described in this report are conducted in a manner that is consistent with U.S. EPA’s attainment demonstration guidance (U.S. EPA, 2014B).

Monitoring data, including ozone and precursor concentrations and meteorological parameters, are analyzed to produce a conceptual understanding of the air quality problems. Key findings of the analyses include:

- Ozone monitoring data following the 2008 revision of the ozone NAAQS showed some sites in and downwind of the Chicago metropolitan area to be in violation of the revised standard of 75 parts per billion (ppb). Historical ozone data generally show a downward trend in the region, and most sites are currently meeting the 2008 NAAQS.

- Ozone concentrations are strongly influenced by meteorological conditions, with more high ozone days and higher ozone levels during summers with above normal temperatures. Ozone concentrations in the Lake Michigan region are also influenced by local-scale wind circulations (lake breezes) which cause elevated concentrations at shoreline sites and decreasing ozone concentrations at sites further from the shoreline.

- Inter- and intra-regional transport of ozone and ozone precursors affects air quality in the Lake Michigan region, and is the principal cause of nonattainment in some areas far from population or industrial centers.

An air quality modeling platform was developed to evaluate the adequacy of current and potential emissions reduction strategies needed to attain the 2008 ozone NAAQS by the 2017 attainment deadline established by U.S. EPA. LADCO conducted “base year” modeling for 2011 for the purpose of evaluating the model’s performance against measured air quality data. Model performance for the region was found to be improved over previous modeling efforts, although performance at shoreline locations shows more variability. LADCO considers the  performance of the air quality model to be adequate to support the states’ attainment SIPs.

Future year strategy modeling was conducted to determine whether existing (“on the books”) controls would be sufficient to provide for attainment of the ozone standard and if not, to determine what additional emission reductions would be necessary for attainment. Based on the modeling and other supplemental analyses, the following general conclusions can be made:

- Existing emission reduction control measures are expected to improve ozone air quality in the region between 2011 and 2017.

- Modeling indicates that all monitoring sites in the Chicago nonattainment area, including sites in northwest Indiana, northeast Illinois,  and southeast Wisconsin, are expected to meet the 2008 ozone air quality standard by the 2017 ozone season.

- Modeling indicates that one site in eastern Wisconsin, in Sheboygan County, may not meet the 2008 8-hour ozone standard by the 2017 ozone season. This finding of limited residual nonattainment for ozone is consistent with current (2014-2016) monitoring data which continues to show ozone concentrations above the NAAQS in this area (e.g., ozone design values on the order of 76-79 ppb). It is noted that the modeling analysis is, by design, conservative and that air quality in future years may be better than the modeling indicates.

# 1.0 Introduction

On March 12, 2008, the U.S. EPA revised the primary and secondary NAAQS for ozone, strengthening the standards to a level of 0.075 parts per million (ppm) for a maximum daily 8-hour average. The form of the 8-hour ozone NAAQS remained the same as the previous standard, the annual fourth-highest daily maximum averaged over three consecutive years. When U.S. EPA adopts a new or revises an existing NAAQS, it is required by Section 107(d)(1) of the Clean Air Act (CAA) to designate areas as nonattainment, attainment, or unclassifiable. Accordingly, on May 21, 2012, U.S. EPA designated Sheboygan County in eastern Wisconsin as a "marginal" ozone nonattainment area based on 2008-2010 ambient air quality data. On June 11, 2012, U.S. EPA designated the Chicago metropolitan area, including all or portions of eight counties in Illinois, two counties in northwest Indiana (Lake and Porter), and one partial county in southeast Wisconsin (Kenosha) as a "marginal" ozone nonattainment area based on monitoring data from 2009-2011. The attainment deadline for marginal nonattainment areas to meet the 2008 ozone NAAQS was July 20, 2015.

On April 11, 2016, U.S. EPA determined that the Chicago metropolitan area failed to attain the 2008 ozone NAAQS by the applicable attainment date and thus reclassified the area as a "moderate" ozone nonattainment area. On September 28, 2016, U.S. EPA made a similar determination for Sheboygan County. The Chicago and Sheboygan nonattainment areas are shown in Figure 1.1. As a result of these actions, the States of Illinois, Indiana, and Wisconsin must submit State Implementation Plans (SIPs) that meet the requirements applicable to "moderate" ozone nonattainment areas. The states' attainment SIPs must include a demonstration which identifies emissions reduction strategies sufficient to achieve the NAAQS by the attainment date, July 20, 2018. Because the attainment deadline occurs during the 2018 ozone season, the effective attainment deadline is the end of the 2017 ozone season.

This Technical Support Document summarizes the air quality analyses conducted by LADCO to support the ozone attainment SIPs for the States of Illinois, Indiana, and Wisconsin. LADCO was established in 1989 by these states and Michigan, to provide technical assessments for and assistance to its member states, and to provide a forum for its member states to discuss regional air quality issues. Ohio and Minnesota have since joined LADCO. The analyses prepared by LADCO include preparation of emissions inventories for the base year (2011) and the projected year of attainment (2017), evaluation and application of the meteorological and photochemical grid models, and analysis of ambient monitoring data.

This Introduction provides an overview of regulatory requirements and background information. Section 2 reviews the ambient monitoring data and presents a conceptual model of ozone in the Lake Michigan region and the Midwest. Section 3 discusses the development of the emissions inventory used for modeling the base year (2011) and the projected year of attainment (2017), and provides emissions summaries for the major emissions sectors for both years. The 2011 base case model performance evaluation

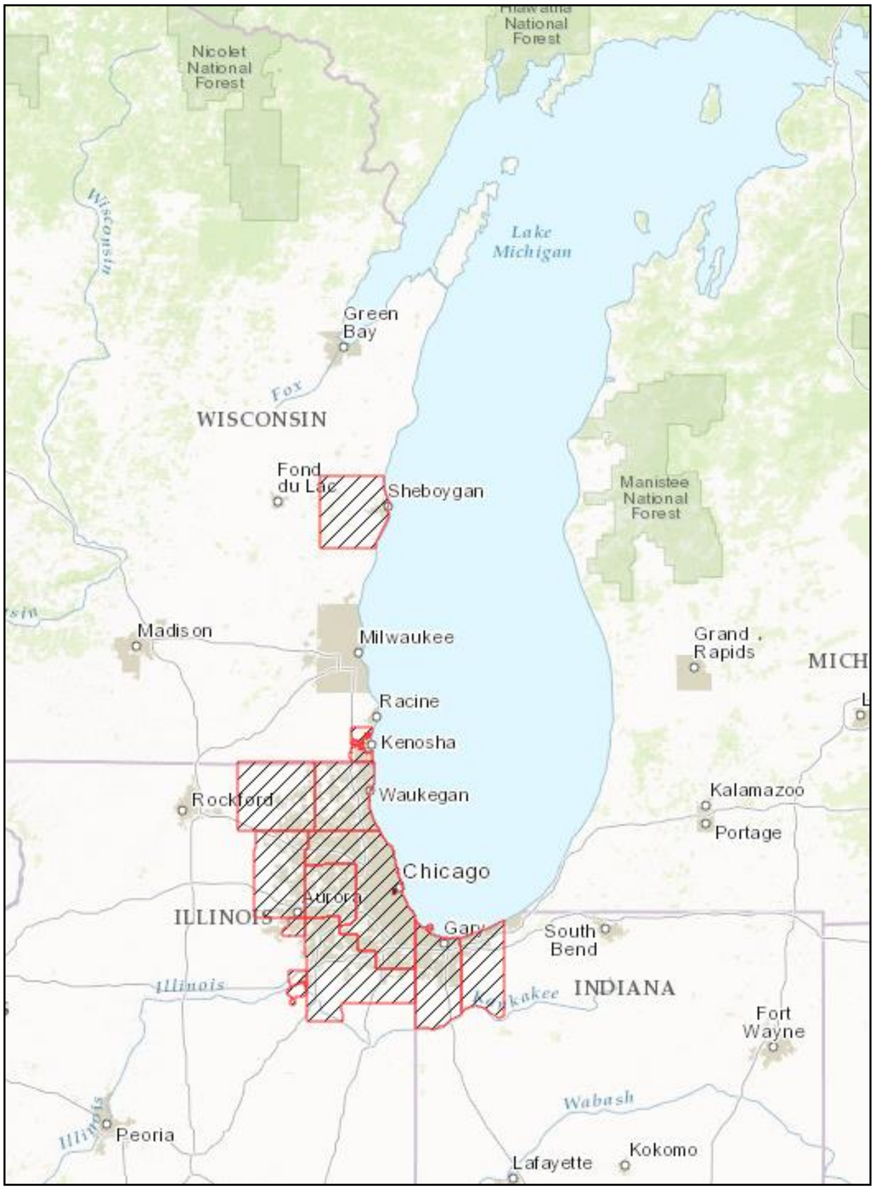


**Figure 1.1. Nonattainment Areas in the Lake Michigan Region for the 2008 Ozone National Ambient Air Quality Standard**

and the modeling assessment for 2017 are presented in Section 4, along with relevant analyses considered as part of the weight-of-evidence determination. Finally, key study findings are reviewed and summarized in Section 5.

## SIP Requirements

As mentioned previously, U.S. EPA designated Sheboygan County in eastern Wisconsin, and the Chicago metropolitan area, including portions of northeast Illinois, northwest Indiana, and southeast Wisconsin, as "marginal" ozone nonattainment areas for the 2008 8-hour ozone NAAQS. Based on a finding of failure to attain by the applicable attainment date, U.S. EPA subsequently reclassified the Chicago and Sheboygan nonattainment areas as "moderate" ozone nonattainment areas. The states must therefore meet the requirements that apply to "moderate" ozone nonattainment areas, including the following:

- Nonattainment New Source Review, with emissions offsets for new or modified sources at a ratio of 1.15 to 1 tons of emissions;
- Reasonably Available Control Technology (RACT) for existing VOC and NOx emissions sources in the nonattainment areas;
- Additional reductions of VOCs or NOx necessary for the state to demonstrate 15% reduction from baseline emissions within six years;
- Emission reduction measures needed to attain, as demonstrated by a formal modeled attainment demonstration.

This Technical Support Document identifies emissions reduction strategies and includes a modeling assessment of the effectiveness of the strategies in achieving the NAAQS. The states must submit attainment SIPs to U.S. EPA by January 1, 2017. The deadline for meeting the 8-hour ozone NAAQS is July 20, 2018. Because the attainment deadline occurs during the 2018 ozone season, the effective attainment deadline is the end of the 2017 ozone season.

**Technical Work: Overview**

LADCO worked closely with the States of Illinois, Indiana, and Wisconsin and U.S. EPA Region 5 to develop the technical analyses described in this report.
A "conceptual model" is presented which provides a qualitative description of the region's ozone air quality, based on an analysis of ambient air quality data. These analyses also provide information for evaluating the performance of the air quality model. The data analyses are an integral part of the overall technical support given uncertainties in emissions inventories and modeling.

Base year (2011) and future year (2017) emissions inventories are based on U.S. EPA's modeling platforms, as described in U.S. EPA's "Notice of Availability of the Environmental Protection Agency's Updated Ozone Transport Modeling Data for the 2008 Ozone National Ambient Air Quality Standard (NAAQS)" (U.S. EPA, 2015A). States provided point source and area source emissions data, and MOVES input files and mobile source activity data to U.S. EPA's 2011 National Emissions Inventory (NEI) database. U.S. EPA prepared emissions data for other categories not provided by the states, including nonroad sources, ammonia, fires, and biogenics. LADCO and its contractors developed improved emissions data for its member states for on-road sources and electrical generating units.

The air quality modeling described here can act as the core of states' attainment demonstrations. The modeling methodology described in this Technical Support

Document adheres to U.S. EPA's guidance document: "Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze" (U.S. EPA, 2014B). LADCO used a combination of models and specified methods to model air quality for an attainment assessment.  These included the Weather Research and Forecasting (WRF) model, the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system, the Eastern Regional Technical Advisory Committee (ERTAC) EGU Forecast Tool, and the Comprehensive Air quality Model with extensions (CAMx). These models and tools are described in greater detail in Sections 3 and 4.

The models used in this technical analysis meet all of the prerequisites stated in U.S. EPA's draft modeling guidance.

## 2.0 Ambient Data Analyses

On March 12, 2008, U.S. EPA tightened the 8-hour ozone standard to increase public health protection and prevent environmental damage from ground-level ozone. U.S. EPA set the primary (health) standard and secondary (welfare) standard at the same level: 0.075 ppm (75 ppb). The standard is attained if the three-year average of the 4th-highest daily maximum 8-hour average ozone concentrations (i.e., the design value) measured at each monitor within an area is less than or equal to 0.075 ppm.

### Current Conditions

Table 2.1 provides 8-hour ozone design values for the period 2010-2016 for monitoring sites with valid design values in the nonattainment areas. A map of the 8-hour ozone design values at each monitoring site in the region for the three-year period 2013-2015 is shown in Figure 2.1. The “hotter” colors represent higher concentrations, where red dots represent sites with design values above the standard. Based on 2013-2015 data, there was one site in violation of the 2008 8-hour ozone NAAQS in the Lake Michigan area. This monitor is located in Sheboygan, Wisconsin. Based on preliminary 2016 data (Figure 2.2), two additional sites within the LADCO region exceed the NAAQS for the three-year period, 2014-2016. These include monitors in each of the nonattainment areas for the 2008 ozone NAAQS: Sheboygan County and the Chicago area.

### Meteorology and Transport

Ozone concentrations are significantly influenced by meteorological factors. Ozone production is driven by high temperatures and sunlight, as well as precursor concentrations. Ozone concentrations at a given location are also dependent on wind direction, which governs which sources or source regions are upwind. Figure 2.3 shows the general relationship between hot days (number of days each summer over 90°F, as determined from the nearest airport measurements) and ozone exceedance days (the number of days each summer for which one or more monitors recorded an ozone concentration over 75 ppb).

Qualitatively, ozone episodes in the region are associated with hot weather, clear skies (sometimes hazy), low wind speeds, high solar radiation, and winds with a southerly component. These conditions are often a result of a slow-moving high pressure system to the east of the region. The relative importance of various meteorological factors is discussed later in this section.

Transport of ozone and its precursors is a significant factor and occurs on several spatial scales. Regionally, over a multi-day period, somewhat stagnant summertime conditions can lead to the build-up in ozone and ozone precursor concentrations over a large spatial area. This polluted air mass can be transported long distances, resulting in elevated ozone levels in locations far downwind. An example of such an episode is shown in Figure 2.4 for June 9-11, 2016.

## Table 2.1. Design Values for Ozone Monitors in the Chicago and Sheboygan Nonattainment Areas, 2010-2016.*

| AQS ID | Site Name | Address | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|
| **Illinois** | | | | | | | | | |
| 170310001 | ALSIP | 4500 W. 123RD ST. | 69 | 71 | 74 | 71 | 69 | 65 | 69 |
| 170310032 | CHICAGO--SWFP | 3300 E. CHELTENHAM PL. | 68 | 72 | 81 | 80 | 76 | 68 | 70 |
| 170310076 | CHICAGO--COM ED | 7801 LAWNDALE | 67 | 69 | 74 | 72 | 70 | 64 | 68 |
| 170311003 | CHICAGO--TAFT | 6545 W. HURLBUT ST. | 66 | 67 | 72 | 70 | NA | 66 | 68 |
| 170311601 | LEMONT | 729 HOUSTON | 70 | 69 | 74 | 71 | 71 | 66 | 69 |
| 170313103 | SCHILLER PARK | 4743 MANNHEIM RD. | NA | NA | NA | NA | NA | 61 | 62 |
| 170314002 | CICERO | 1820 S. 51ST AVE. | 65 | 69 | 74 | 72 | 69 | 62 | 66 |
| 170314007 | DES PLAINES | 9511 W. HARRISON ST | 59 | 62 | 67 | 68 | 69 | 68 | 71 |
| 170314201 | NORTHBROOK | 750 DUNDEE ROAD | NA | NA | 78 | 77 | 73 | 67 | 70 |
| 170317002 | EVANSTON | 531 E. LINCOLN | 63 | 69 | 79 | 80 | 78 | 70 | 72 |
| 170436001 | LISLE | RT. 53 | 60 | 63 | 68 | 68 | 67 | 64 | 68 |
| 170890005 | ELGIN | 665 DUNDEE RD. | 66 | 69 | 71 | 69 | 68 | 65 | 68 |
| 170971007 | ZION | ILLINOIS BEACH STATE PARK | 74 | 76 | 82 | 80 | 79 | 71 | 73 |
| 171110001 | CARY | FIRST ST. & THREE OAKS RD. | 65 | 67 | 71 | 71 | 69 | 65 | 68 |
| 171971011 | BRAIDWOOD | 36400 S. ESSEX RD. | 62 | 63 | 65 | 64 | 65 | 63 | 64 |
| **Indiana** | | | | | | | | | |
| 180890022 | GARY--IITRI | 201 MISSISSIPPI ST., IITRI BUNKER | 61 | 62 | 69 | 69 | 69 | 65 | 67 |
| 180890030 | WHITING | 1751 OLIVER ST/ WHITING HIGH SCHOOL | 64 | 66 | 73 | 70 | 69 | 65 | NA |
| 180892008 | HAMMOND | 1300 141 ST STREET | 67 | 68 | NA | NA | NA | 63 | 65 |
| 181270024 | OGDEN DUNES | 84 DIANA RD/ WATER TREATMENT PLANT | 67 | 67 | 72 | 72 | 73 | 68 | 69 |
| 181270026 | VALPARAISO | 1000 WESLEY ST./ VALPARAISO WATER DEPT. | 62 | 62 | 63 | 64 | 65 | 63 | 66 |
| **Wisconsin** | | | | | | | | | |
| 550590019 | CHIWAUKEE PRAIRIE | CHIWAUKEE PRAIRIE, 11838 FIRST COURT | 74 | 77 | 84 | 82 | 81 | 75 | 77 |
| 551170006 | SHEBOYGAN—KOHLER ANDRAE | KOHLER ANDRE PARK, 1520 Beach Park Rd. | 78 | 81 | 87 | 85 | 81 | 77 | 79 |

*2016 data are preliminary based on AirNow data and may change.

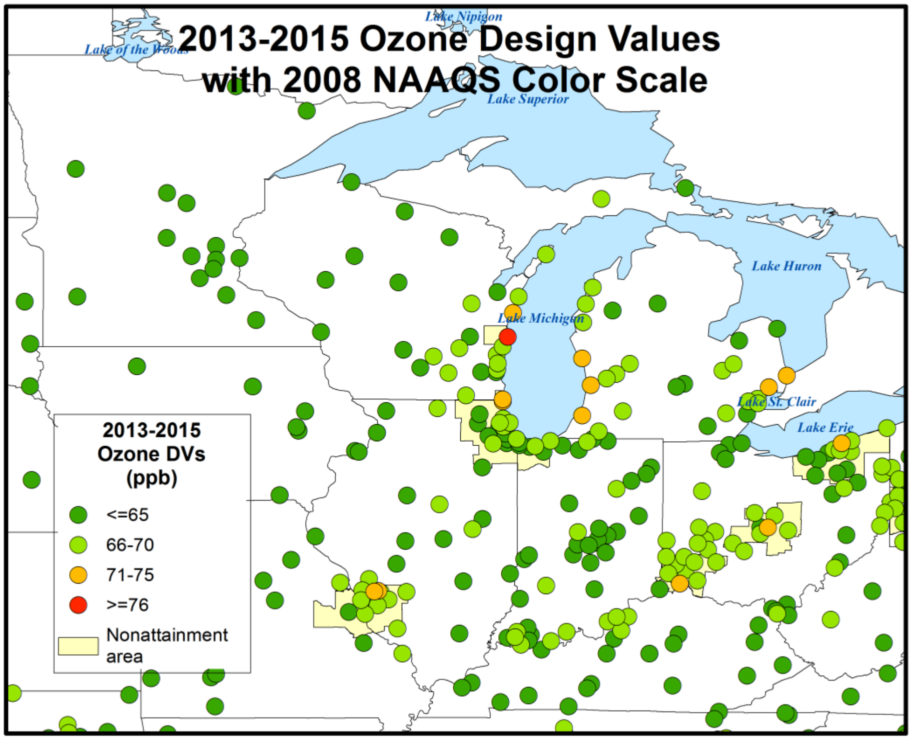


**Figure 2.1. 8-hour Ozone Design Values (2013-2015) in the LADCO Region**

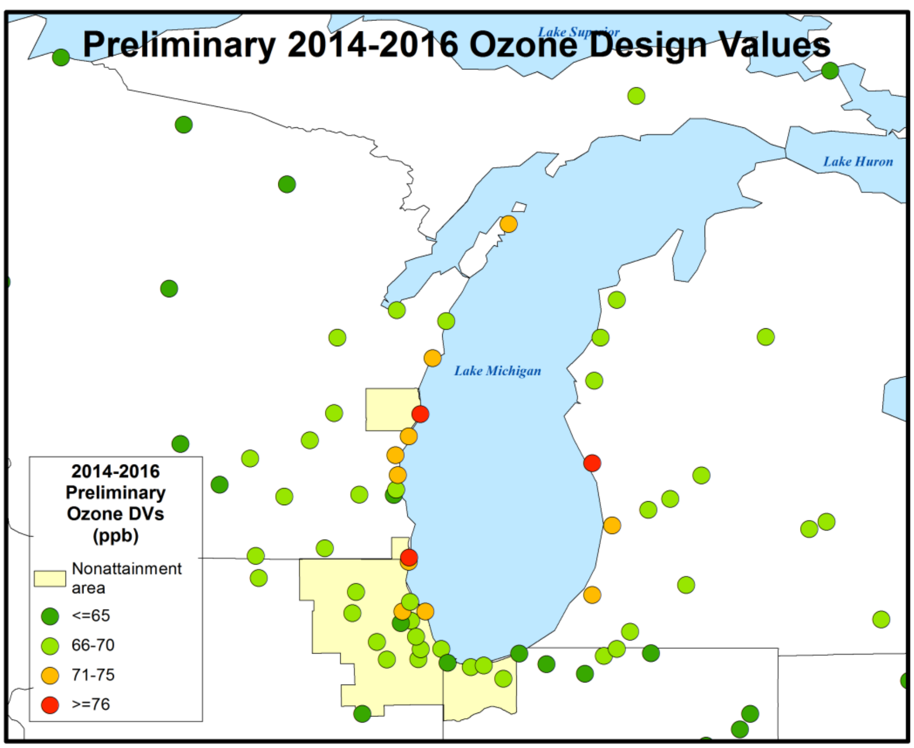


**Figure 2.2. 8-hour Ozone Design Values in the Lake Michigan Region (2014-2016) (based on preliminary 2016 data)**

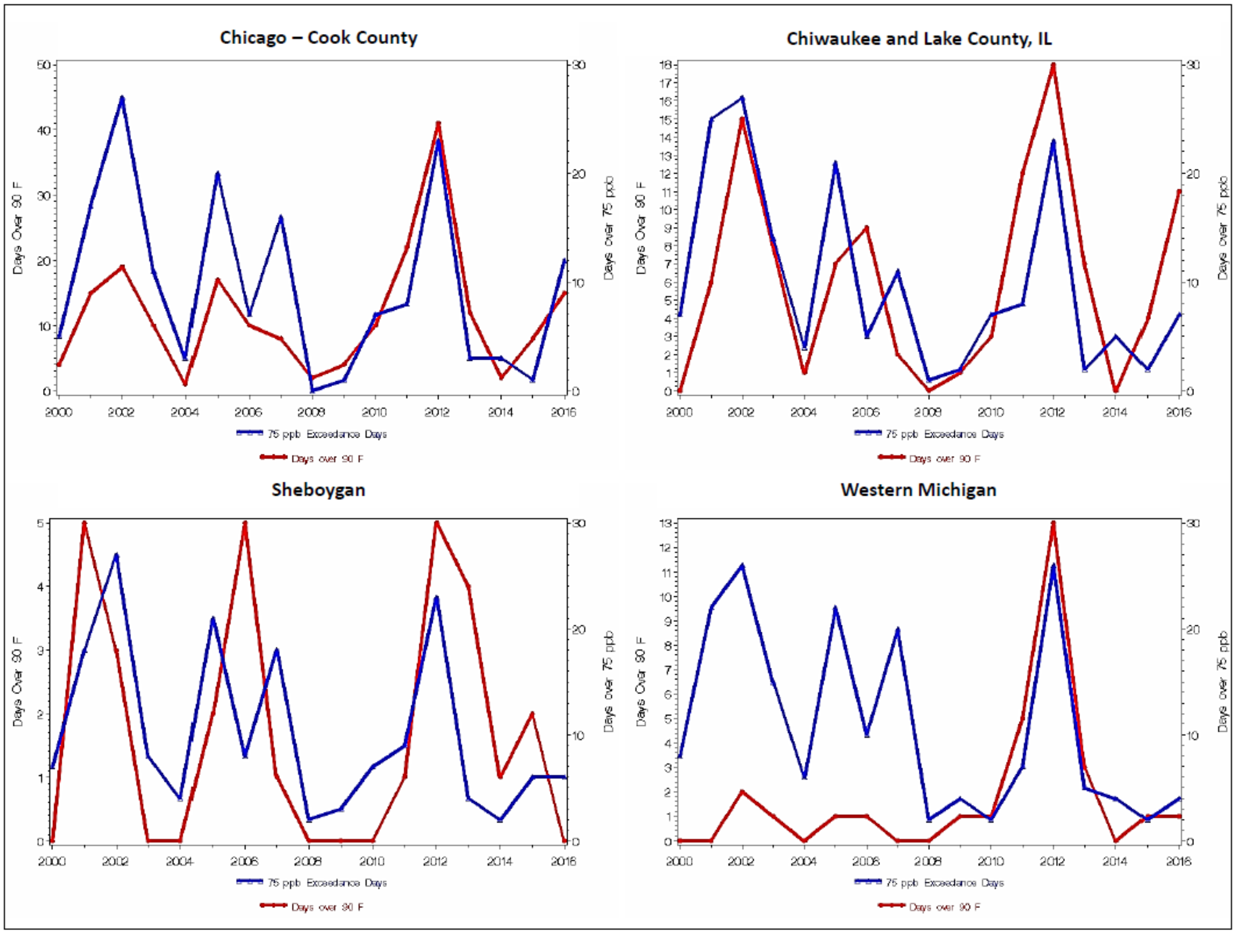


**Figure 2.3. Trends in 90-degree Days and 8-hour "Exceedance" Days Around Lake Michigan**

Locally, emissions from urban areas add to the regional background leading to ozone concentration hot spots downwind. Depending on the synoptic wind patterns (and local land-lake breezes), different downwind areas are affected. Figure 2.5, for example, shows build-up of ozone on the western shore of Lake Michigan on June 15, 2012, and on the southeastern shore of the lake on June 28, 2012.

Aircraft measurements conducted in prior years in the Lake Michigan area provide evidence of elevated regional background concentrations and "plumes" from urban areas. For one example summer day (August 20, 2003 – see Figure 2.6), the incoming background ozone levels were on the order of 80-100 ppb and the downwind ozone levels over Lake Michigan were on the order of 100-150 ppb (STI, 2004). Although these data are older (aircraft measurements ceased in 2003) and ozone concentrations now are significantly lower, the transport mechanisms remain the same, and the issue of high background ozone affecting nonurban areas and contributing to elevated ozone at locations along the lakeshore is a persistent problem in the region.

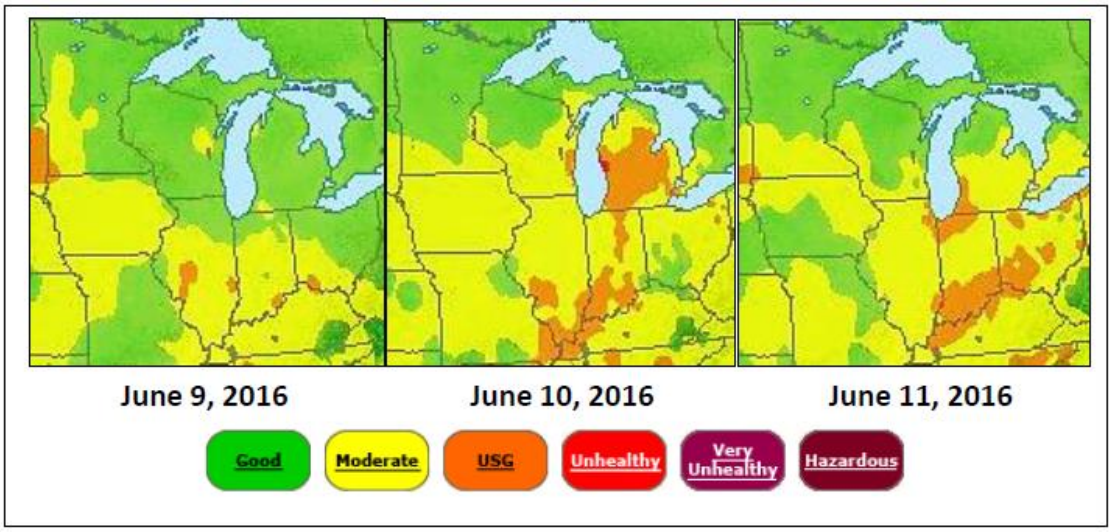


**Figure 2.4. Example of Elevated Regional Ozone Concentrations (June 9-11, 2016). (Note: data come from AirNow, showing maximum daily ozone Air Quality Index; hotter colors represent higher concentrations, with orange and red representing concentrations above the 8-hour standard.)**

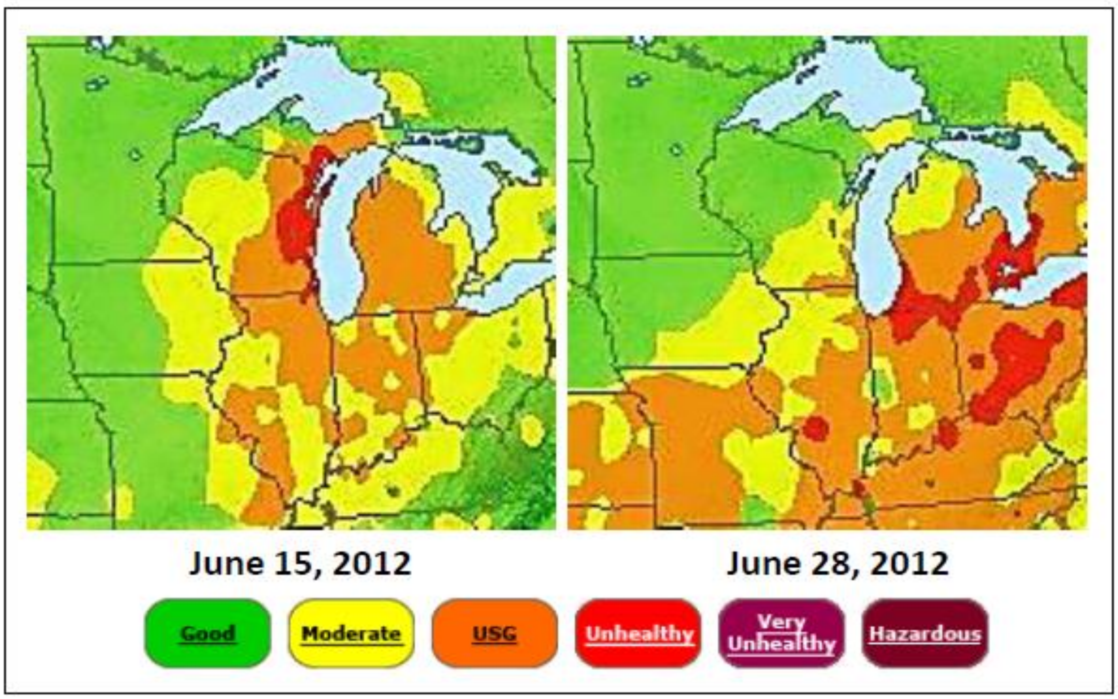


**Figure 2.5. Examples of High Ozone Days in the Lake Michigan Area. (Note: data come from AirNow, showing maximum daily ozone Air Quality Index; hotter colors represent higher concentrations, with orange and red representing concentrations above the 8-hour standard.)**

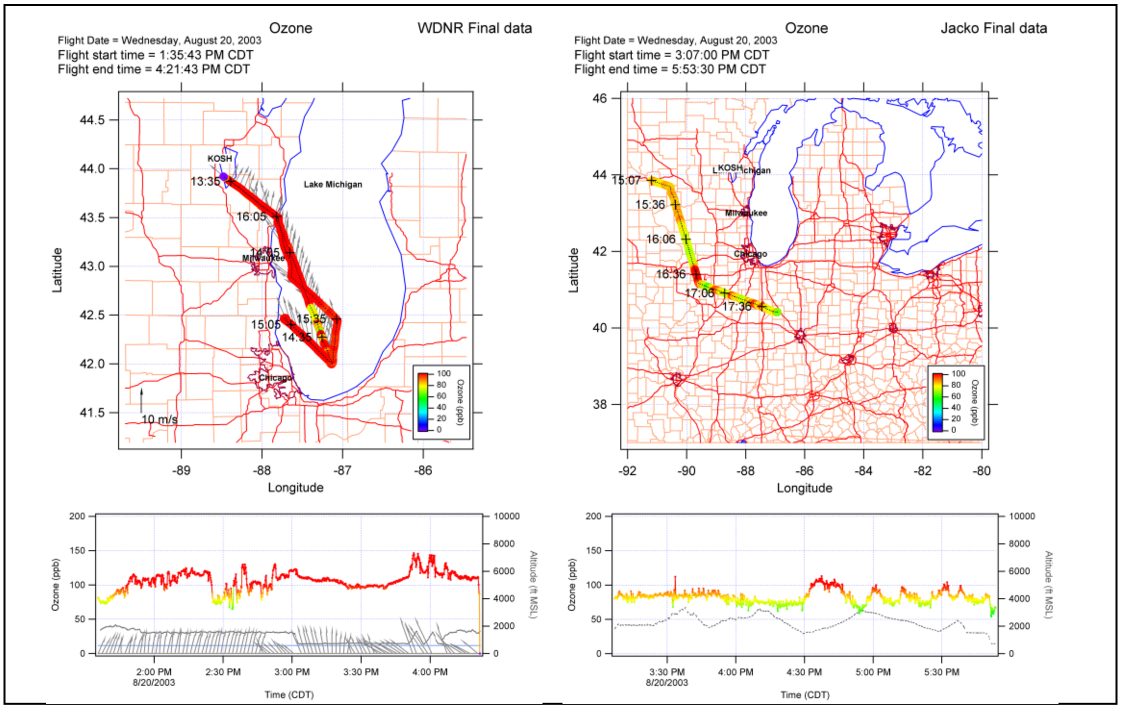


**Figure 2.6. Aircraft Ozone Measurements over Lake Michigan (left) and Along Upwind Boundary (right) – August 20, 2003. (Note: aircraft measurements reflect instantaneous values. Flight paths are shown as thick lines, with the color of the lines reflecting ozone concentrations. The wind barbs show southwest to southeast winds)**

To understand the source regions likely impacting areas along the Lake Michigan shoreline with high ozone concentrations, LADCO constructed back trajectories using the HYSPLIT model. High ozone days (8-hour peak > 65 ppb) during the period 2012-2015 at Wisconsin shoreline monitors (Manitowoc, Sheboygan, SE Region WDNR Headquarters, and Chiwaukee Prairie) were used to characterize general transport patterns. For each day from May through September, four 72-hour back trajectories were calculated for the maximum 8-hour ozone period, starting at hours 1, 3, 5, and 7. Each trajectory calculation (performed with HYSPLIT) results in 72 latitude/longitude coordinates (endpoints) that mark the position of the air mass in the 72 hours preceding its arrival at the monitor. Because all trajectories start at the monitoring site and disperse from there, the density of endpoints is highest at the site and decreases with distance from the monitor. To remove this central tendency to more clearly show the differences between areas upwind on high and low ozone days, an incremental probability plot is calculated by subtracting endpoints for all-days from the endpoints on high ozone days. The resulting endpoints are plotted in ArcGIS, as shown in Figure 2.7 for all four shoreline monitors combined (left) and for Sheboygan only (right). This analysis shows the areas that are most likely to be upwind on high ozone days in red and the areas that are least likely to be upwind on high ozone days in blue. The results indicate that air masses on high ozone days at these monitors are most likely to travel through northeast Illinois and northwest Indiana in the hours before high ozone is recorded.

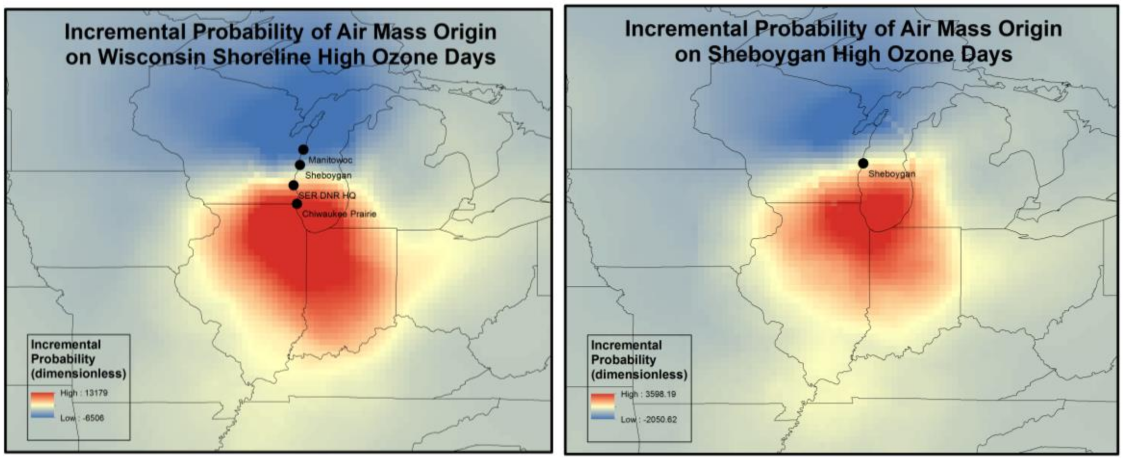


**Figure 2.7. Incremental Probability of Air Mass Location in 72 Hours Prior to High Ozone Concentrations at Wisconsin Shoreline Monitors**

The following key findings related to transport can be made:

- Ozone transport is a problem affecting many portions of the eastern U.S. The Lake Michigan area (and other areas in the LADCO region) both receives high levels of incoming (transported) ozone and ozone precursors from upwind source areas on many hot summer days, and contributes to the high levels of ozone and ozone precursors affecting downwind receptor areas.

- The presence of a large body of water (i.e., Lake Michigan) influences the formation and transport of ozone in the Lake Michigan area. Depending on large-scale synoptic winds and local-scale lake breezes, different parts of the area experience high ozone concentrations. For example, under southerly flow, high ozone can occur in eastern Wisconsin, and under southwesterly flow, high ozone can occur in western Michigan.

- Downwind shoreline areas around Lake Michigan are affected by transport of ozone from major cities in the Lake Michigan area and from areas further upwind.

### Ozone Air Quality Trends

In the last 15 years, considerable progress has been made to meet the 8-hour ozone standard in the Lake Michigan area and regionally. Figure 2.8 shows the decline in 8-hour design values for the Chicago and Sheboygan nonattainment areas since 2002, and Figure 2.9 shows the decline in fourth-high yearly values for the same area and

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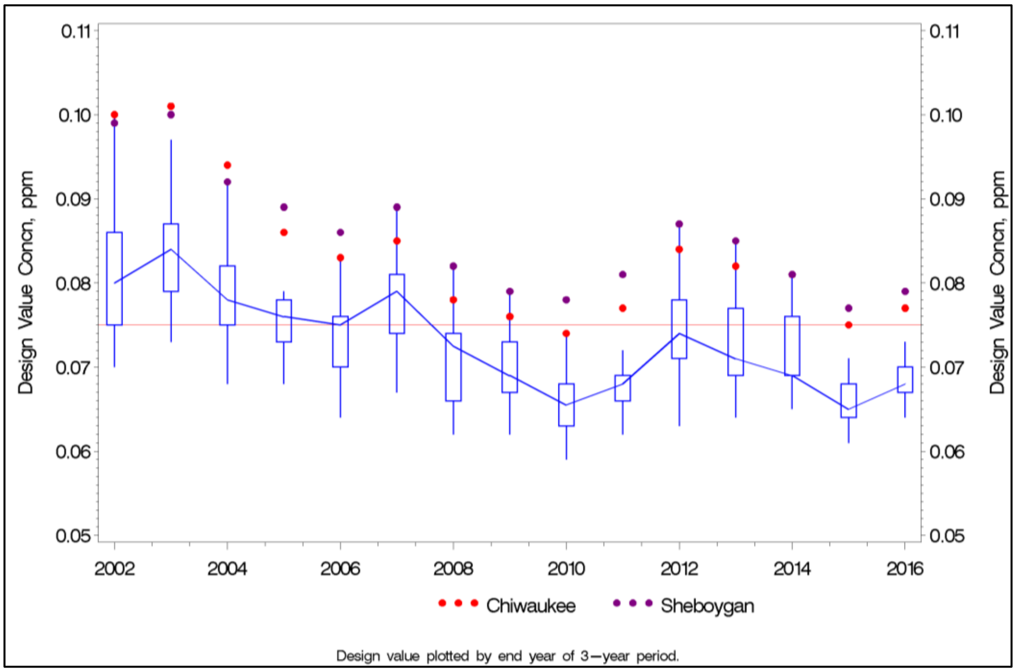


**Figure 2.8. Ozone Design Value Trends in the Chicago and Sheboygan Nonattainment Areas**

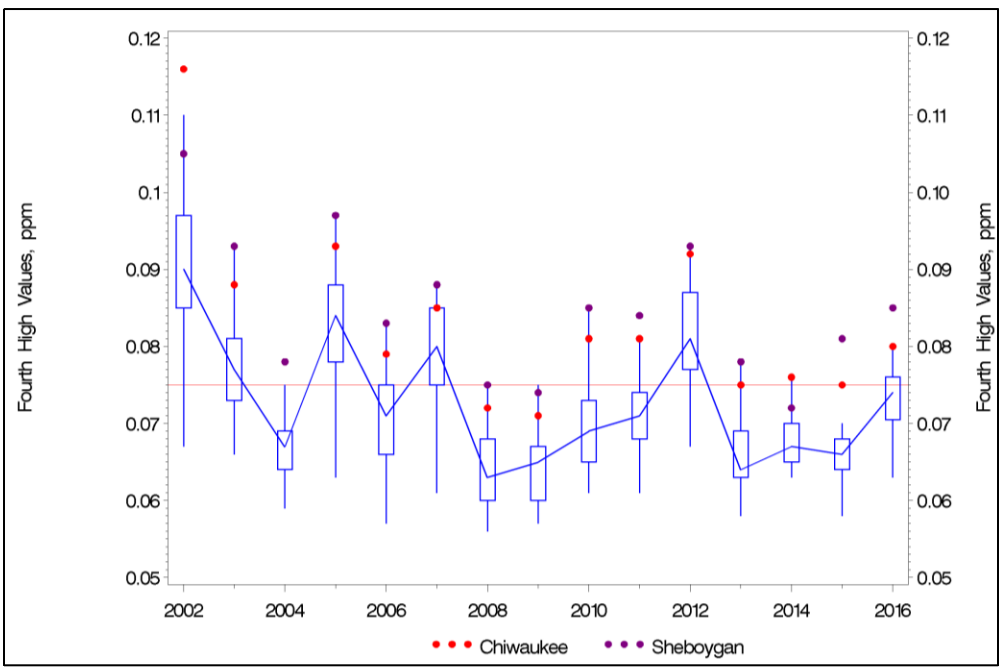


**Figure 2.9. Trend in Fourth-High Values in the Chicago and Sheboygan Nonattainment Areas**

period.  The trend in fourth high values is less pronounced due to year-to-year meteorological variability, which is averaged out in the design value calculation.  Both plots show Chiwaukee Prairie and Sheboygan values individually as red and purpledots. The blue boxes indicate the 25th-75th percentiles of the design values and fourth high concentrations for all the nonattainment area monitors, and the whiskers (lines extending from the boxes) show the most extreme point within 1.5 times the interquartile range.

The improvement in ozone concentrations is also seen in the decrease in the number of sites measuring exceedance levels from the 2009-2011 designation period to the most current design value period of 2014-2016 (see Figure 2.10).

Given the effect of meteorology on ambient ozone levels, year-to-year variations in meteorology can make it difficult to assess short term (e.g. – less than 10 years) trends in ozone air quality. Figure 2.11 shows the variability in summer average temperatures for the period from 2005 to 2016, expressed as deviation from long term average temperatures for June-August. This plot shows that 2012 had the hottest summer in that period, and 2009 had the coolest. This pattern is also apparent in the number of 90-degree days each summer, as shown previously in Figure 2.3.

One approach to adjust ozone trends for meteorological influences is through the use of Classification and Regression Trees (CART). CART is a statistical technique which partitions data sets into similar groups (Breiman et al., 1984).  A CART analysis was performed using data for the period 2000-2015 for urban and ozone transport areas in the LADCO region. The CART model searches through 60 meteorological variables to determine which are most efficient in predicting ozone. Although the exact selection of predictive variables changes from site to site, the most common predictors were temperature, wind direction, and relative humidity. Only occasionally were upper air variables, transport time or distance, lake breeze, or other variables significant as predictors.

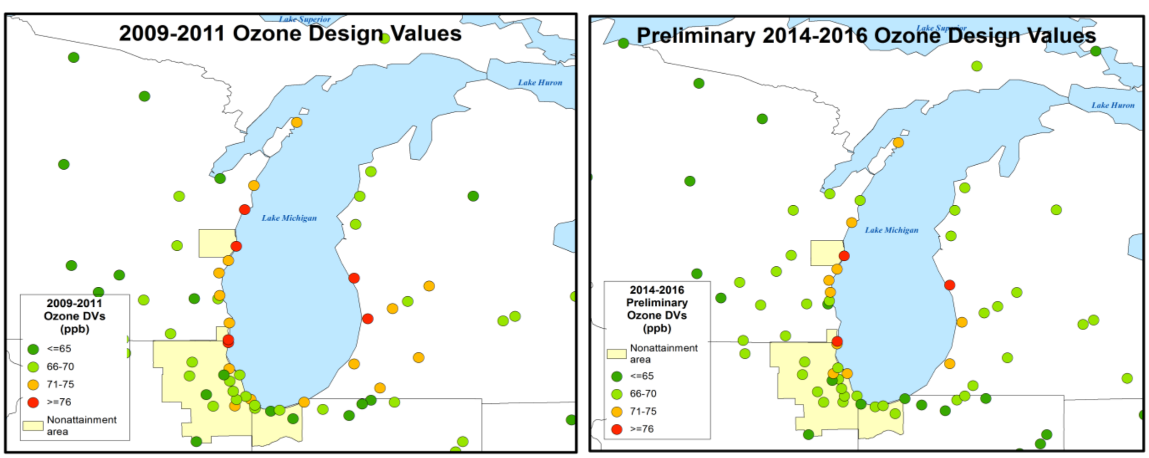


**Figure 2.10.  Change in Ozone Design Values from 2009-2011 to 2014-2016**

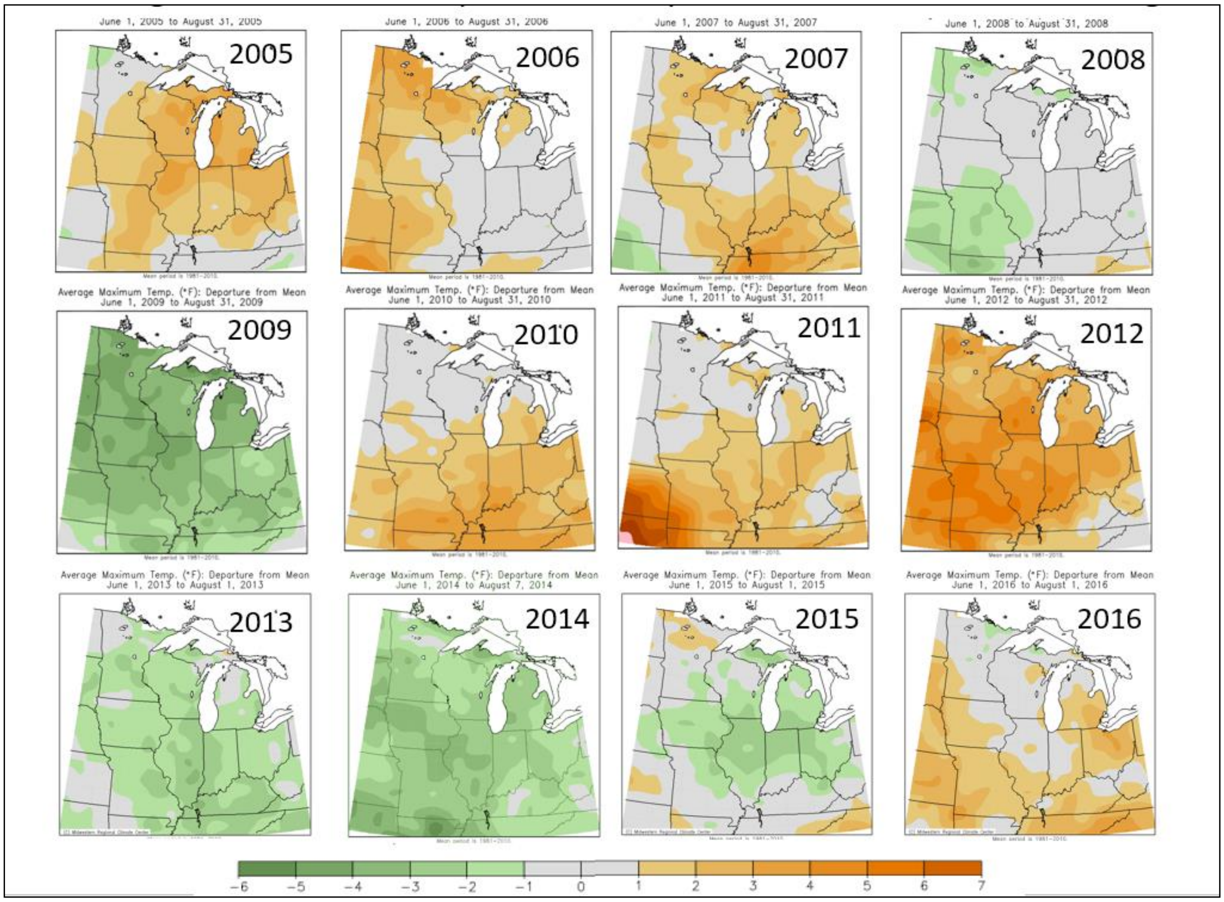


**Figure 2.11. Deviation from Long Term Average Temperature, June-August, for 2005-2016**

For each monitor, regression trees were developed that classify each summer day (May-September) by its meteorological conditions. Similar days are assigned to nodes, which are equivalent to branches of the regression tree. Ozone time series for the higher concentration nodes are plotted for select areas in Figure 2.12. By grouping days with similar meteorology, the influence of meteorological variability on the trend in ozone concentrations is partially removed; the remaining trend is presumed to be due to trends in precursor emissions or other non-meteorological influences. Trends over the 16-year period ending in 2015 were found to be declining for each monitor or composite area noted. These plots reflect long term trends and are not meant to depict trends over shorter time periods.

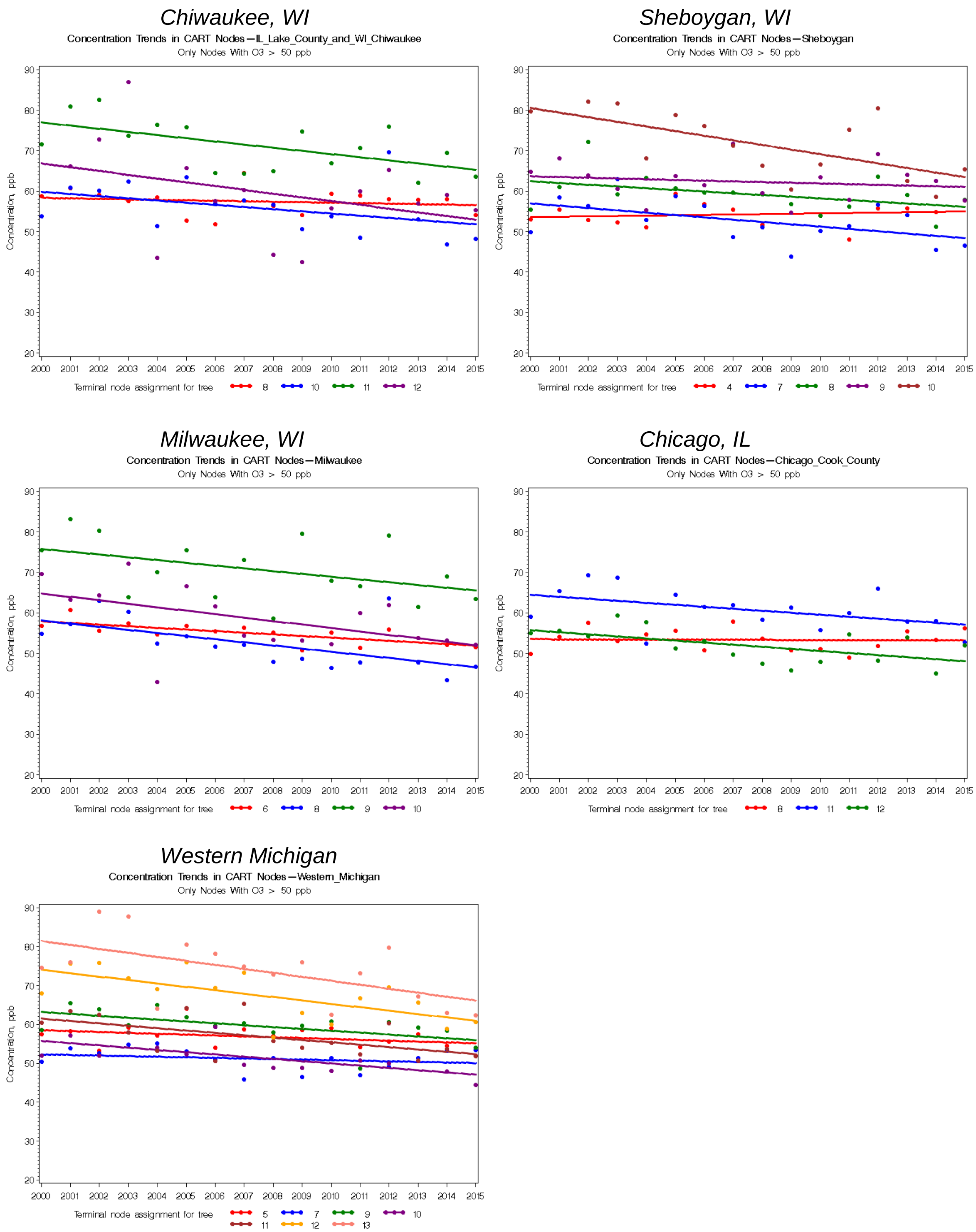


**Figure 2.12. Meteorologically Adjusted Ozone Trends Around Lake Michigan**

## Conceptual Model for Ozone in the Lake Michigan Region

A conceptual model is a qualitative summary of the physical, chemical, and meteorological processes that control the formation and distribution of pollutants in a given region. Based on the data and analyses presented above, and of previous conceptual models and technical support documents developed for the Lake Michigan region, a conceptual model of the behavior, meteorological influences, and causes of high ozone in the Chicago and Sheboygan nonattainment areas is summarized below:

- Current monitoring data show that most sites in the Lake Michigan region are meeting the 2008 8-hour ozone NAAQS. However, three sites in the region exceeded the 8-hour ozone standard of 75 ppb in 2014-16: Chiwaukee Prairie, WI, Sheboygan, WI, and Muskegon, MI. Historical ozone data show a downward trend over the past 15 years, due likely to federal and state emission control programs. Concentrations declined sharply from 2002 through 2010. The rate of decrease appears to have tapered in recent years, although the high year-to-year variability of ozone makes it imprudent to make assumptions about short-term trends.

- Ozone concentrations are strongly influenced by meteorological conditions, with more high ozone days and higher ozone levels during summers with above normal temperatures. Nevertheless, meteorologically adjusted trends show that concentrations have declined even on hot days, providing strong evidence that emission reductions of ozone precursors have been effective.

- Inter- and intra-regional transport of ozone and ozone precursors affects many portions of the LADCO states, and is the principal cause of nonattainment in some areas far from population or industrial centers.

- The presence of Lake Michigan influences the formation, transport, and duration of elevated ozone concentrations along its shoreline. Depending on large-scale synoptic winds and local-scale lake breezes, different parts of the area experience high ozone concentrations. For example, under southerly flow, high ozone can occur in eastern Wisconsin, and under southwesterly flow, high ozone can occur in western Michigan.

- Areas in closer proximity to the Lake shoreline display the most frequent and most elevated ozone concentrations.

- Ozone concentrations have declined since 2000-2002 both inland and along the Lake Michigan shoreline.

# 3.0 Emissions Inventory Development

This technical analysis relies heavily on emissions and other model inputs prepared by U.S. EPA. U.S. EPA and LADCO rigorously quality assure their emission inventories (U.S. EPA, 2015A). LADCO's emissions modeling quality assurance procedures include reviewing emissions model output files for errors and warnings, comparing emissions between processing steps, checking that speciation, temporal, and spatial allocation factors are applied correctly, and reviewing the air quality model emissions inputs and stack parameters.

### U.S. EPA's Modeling Platform

LADCO utilized emissions inventories compiled by U.S. EPA for the years 2011 and 2017 as the starting point for the modeling inventories used in this analysis. U.S. EPA's 2011 emission inventory (Version 2011EH) is based on the 2011 National Emissions Inventory, version 2 (2011NEIv2), which was speciated, temporalized and gridded to provide hourly emissions inputs to support photochemical modeling.

The major sectors of the anthropogenic emissions inventory are:

- Electric generating units (EGUs) include fossil fuel electricity generation. Coal-fired utilities dominate this sector. These sources are defined by discrete stack locations.
- Point sources (point non-EGU) include other industrial sources that do not generate power. This category includes refineries, steel mills, foundries, cement plants and other large industrial facilities.
- Onroad mobile sources (Onroad) includes all onroad transportation related vehicles. Passenger automobiles and medium and heavy freight trucks are the primary vehicles included in this category.
- Nonroad mobile sources (Nonroad) include small and medium engines that are not used on roadways. Examples include lawn and garden equipment, recreational marine, ATVs, and construction equipment. It also includes industrial freight handling equipment such as forklifts and cranes.
- Area sources (Area) are those sources that do not fit into other groups and are spatially diverse in nature. Examples include small industrial activities, consumer solvents, home heating, and commercial and institutional fuel use.
- Marine, aircraft and rail (MAR) includes commercial marine vessels, commercial and private aircraft, and railroad locomotives including those operated at switching yards.

Non-anthropogenic sources such as biogenic emissions and wildfires are also represented in the emissions inventory. For the biggest inventory sectors, the Version 2011 EH inventory relies on hourly 2011 continuous emissions monitoring system (CEMS) data for EGU emissions, hourly on-road mobile emissions, and 2011 day-specific wildfire and prescribed fire data. Emissions include all criteria pollutants and ozone precursors. See U.S. EPA's Technical Support Document (U.S. EPA, 2015A) for a thorough description of the methodology used to develop the 2011EH emissions inventory. LADCO further updated the inventories for regional on-road mobile sources and EGUs as described in more detail later in this section.

U.S. EPA's projected future emission inventory for the year 2017 is based on the 2011 baseline inventory and incorporates current "on-the-books" emission control measures. See U.S. EPA (2015A) for a thorough description of the methodology used to project future emissions. LADCO developed updated EGU and regional on-road emissions for 2017. The next two sections describe these updates in more detail.

### On-Road Motor Vehicles

For the on-road category, LADCO worked with its member states plus Iowa, Missouri, and Kentucky to derive improved inputs for running the MOVES emissions model for the base year 2011 and the projection year 2017. In March 2014, LADCO contracted with Ramboll-Environ to evaluate and develop base year and future year on-road mobile emissions inventories using U.S. EPA's MOVES emissions model. As part of this contractual effort, Ramboll-Environ quality assured the MOVES inputs used by U.S. EPA in developing the NEIv2 inventory. This quality assurance effort identified several problems in the MOVES inputs in NEIv2 (Ramboll-Environ, 2014). For example, Ramboll-Environ reviewed vehicle population data used in the NEIv2 and discovered that the vehicle population data in Ohio differed markedly from that for other Midwestern states, which warranted further review from the State of Ohio (see Figure 3.1). This is just one example of issues identified by Ramboll-Environ in U.S. EPA's NEIv2 on-road inventory.

Based on the findings of the quality assurance effort, LADCO worked with the states noted above to review and update key MOVES inputs, including vehicle type profiles, vehicle miles travelled data (VMT), vehicle speeds, and vehicle inspection and maintenance program characteristics. After extensive review, Ramboll-Environ completed the final MOVES (Version MOVES2014) and provided model-ready inputs to LADCO for 2011 and 2017.

Figure 3.2 illustrates the changes in emissions between the base and future year for the onroad mobile source sector for Illinois, Indiana and Wisconsin. Significant reductions in both VOC and NOx emissions are projected between 2011 and 2017 in all three states.

Figure 3.3 shows the relative contribution of the different components of the onroad mobile source category for VOC emissions. The three emissions components represented in the figure are:

- Rate Per Vehicle (RPV) are emissions related to vehicle counts including start and soak activity

- Rate Per Profile (RPP) are emissions related to evaporative activity from resting vehicles
- Rate Per Distance (RPD) are emissions related to tailpipe emissions that are related to VOC

This figure illustrates that a significant portion of motor vehicle emissions do not come from traditional tailpipe emissions, but instead come from evaporative emissions from fuel tanks, and engine crankcase leaks.

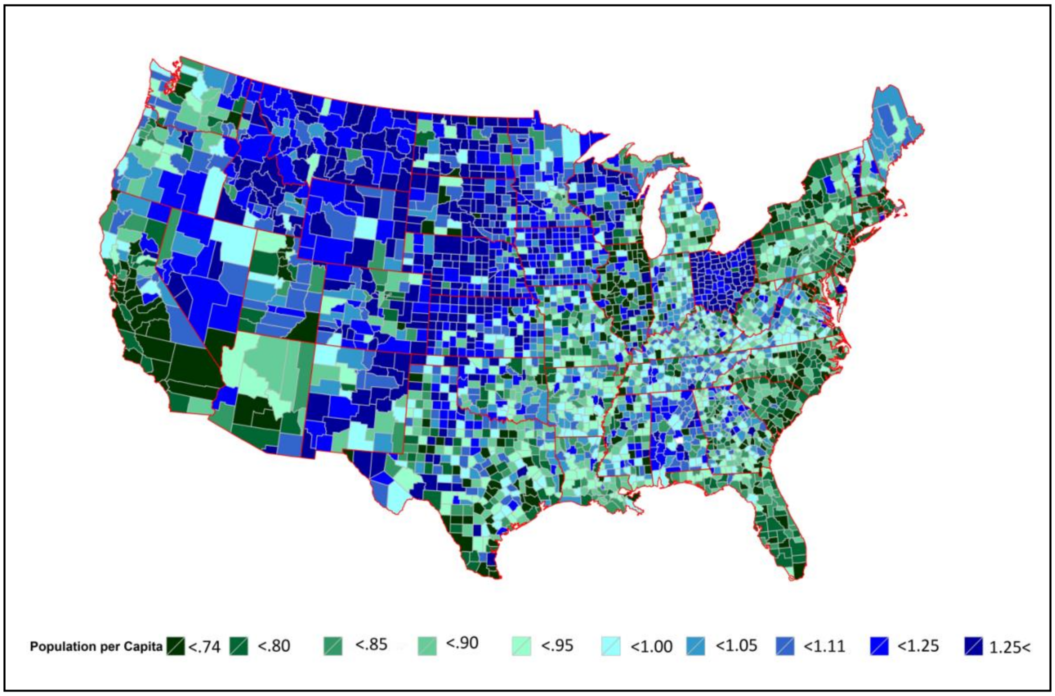


**Figure 3.1. Vehicle Population Per Capita Used in the 2011 NEIv2. (Ramboll-Environ, 2014)**

Figure 3.4 illustrates the VOC and NOx emissions contribution from different types of vehicles. As shown in the figure, most VOC emissions from onroad sources, and much of the improvement from 2011 to 2017, are from gasoline powered vehicles. In contrast, NOx emissions are dominated by heavy duty diesel trucks. Gasoline powered vehicles are also significant NOx sources but represent a smaller fraction of the total in future years.

**Electric Generating Units**

LADCO used the ERTAC EGU projection tool (version 2.5L2) to develop future year estimates for 2017. EGU emissions were used in place of U.S. EPA's estimates from

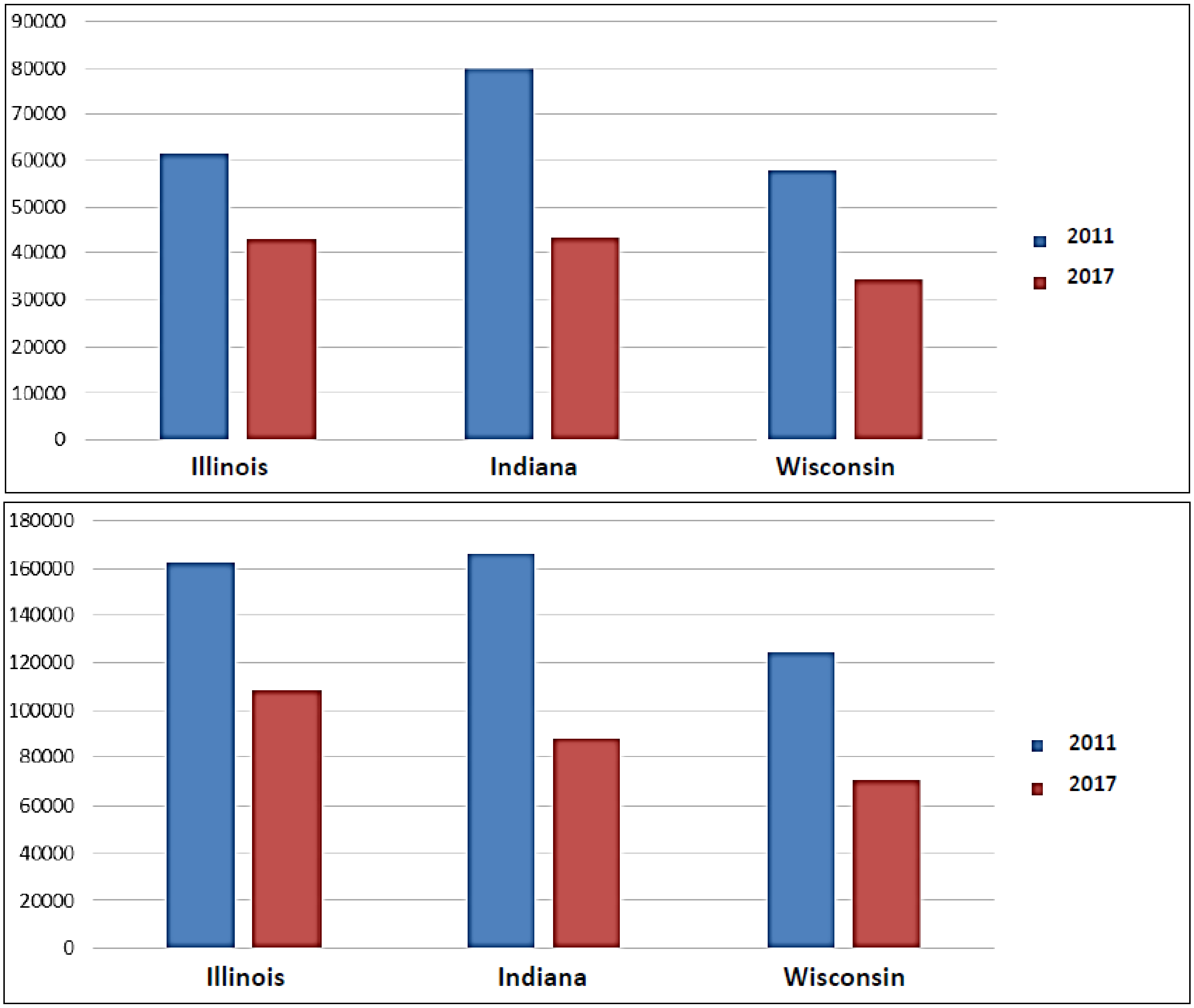


**Figure 3.2. Base Year (2011) and Future Year (2017)**
**VOC (top) and $NO_X$ (bottom) Emissions (tons per year) for On-Road Mobile Sources**

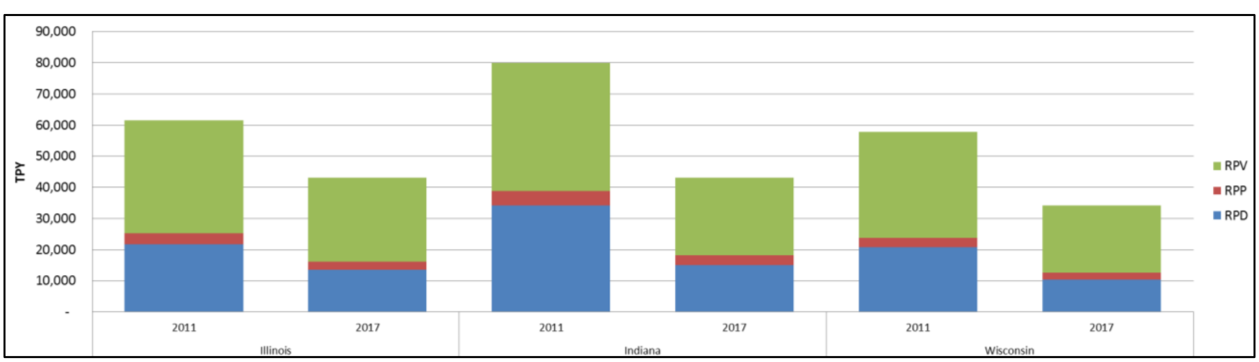


**Figure 3.3. VOC Emissions by MOVES Rate Source**

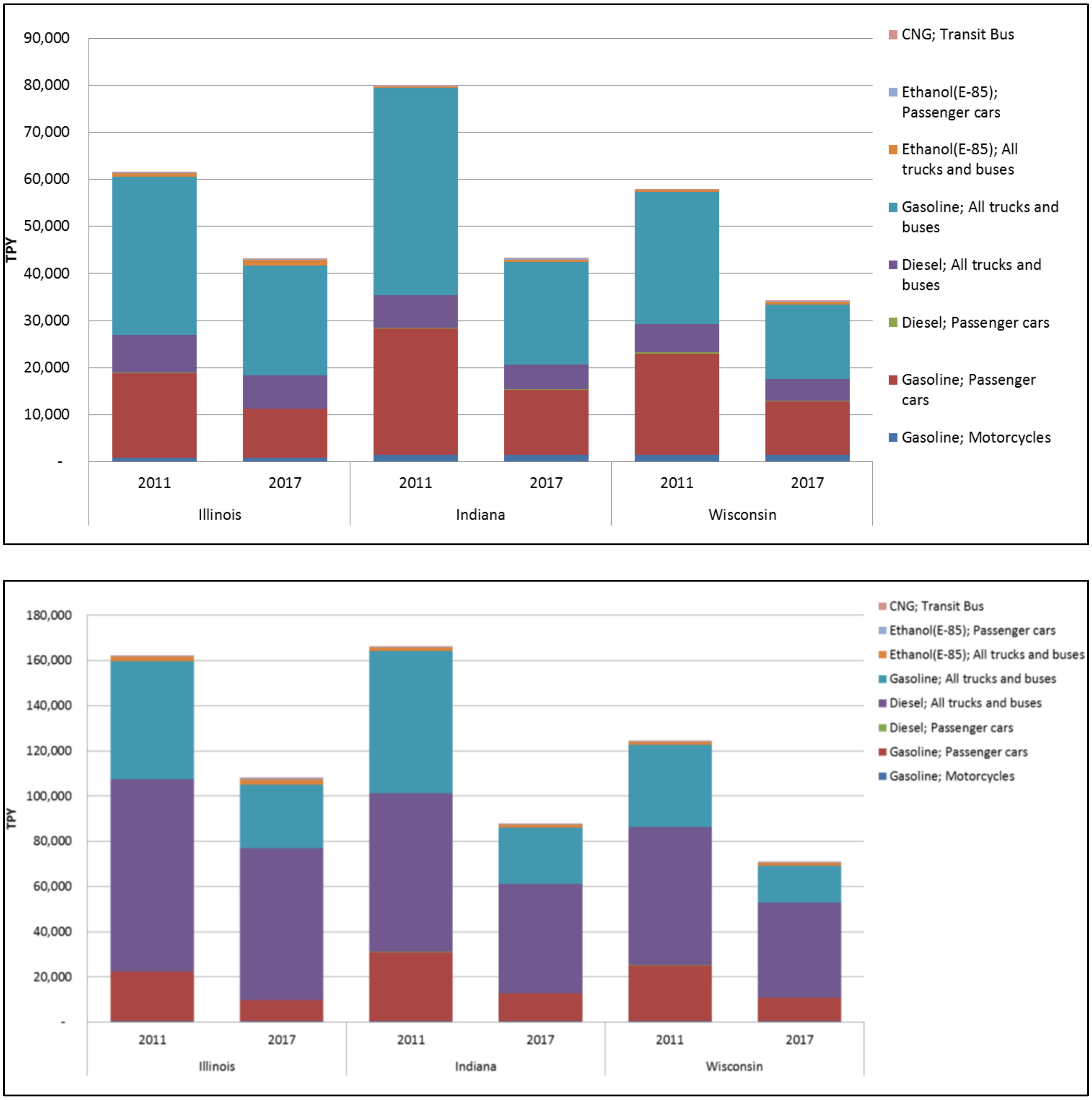


**Figure 3.4. Separation of VOC (top) and NOx (bottom) Emissions by MOVES Vehicle Group**

the IPM model. ERTAC is a collaborative effort to improve emission inventories among the Northeastern, Mid-Atlantic, Southeastern, and Lake Michigan area states. The ERTAC effort involves state regulators in the eastern half of the country, industry representatives, and staff from several of the MJOs.

The ERTAC EGU Forecast Tool is used to project hourly EGU emissions for 2017. The tool uses base year hourly data from U.S. EPA - Clean Air Markets Division (CAMD) data, and fuel specific growth rates from the Annual Energy Outlook (AEO) forecast prepared annually by the EIA to estimate future emissions.

The input files used by the ERTAC EGU Forecast Tool are described in Table 3.1. The enhanced summary files provide NOx and $SO_2$ criteria pollutant data for annual and ozone season time periods.

**Table 3.1. Input Files Used by the ERTAC EGU Forecast Tool**

| | |
|---|---|
| Base Year CAMD input file | An improved version of the 2011 base year hourly CAMD CEM data. The file has anomalous data removed, including Non-EGU units and any U.S. EPA substituted data where CEM operation was questionable. |
| Unit Availability File (UAF) | A table of base year unit-specific information derived from CAMD NEEDS database, state input, EIA Form 860, and data from the North American Electric Reliability Corporation (NERC). States provide additional information on planned new units, unit retirements, fuel switches, and other changes on a frequent basis. |
| Control File | A table of future unit-specific changes that affect a unit's emissions. State air agency staff has provided this information. |
| Season Control File | A table of future year unit-specific emission factors. These data are provided by state air agency staff and are especially helpful in characterizing future year emission rates from seasonal control devices. |
| Growth File | A table of growth factors developed from the EIA - AEO and NERC estimates and other information. |
| Input Variables File | A table of variables used in the modeling run. |
| State File | A table of state level emissions caps or budgets applicable in future years. |
| Group File | A table of emissions caps or budgets applicable to multiple states in future years. |
| Non-CAMD Hourly File | Provides updates to the CAMD hourly 2011 base year data to correct hourly reported values. |

Additional information on the ERTAC EGU Forecast Tool (version 2.5) can be found at: www.marama.org/images/stories/documents/CONUS2.5/C1.01CONUSv2.5ref_2018_05052016_ertac_egu_log.docx. Additional background information on the ERTAC EGU Forecast Tool can be found at: www.ertac.us/index_egu.html and http://www.marama.org/2013-ertac-egu-forecasting-tool-documentation.

To develop inventories for this modeling demonstration, LADCO sought updated information from states and stakeholders on recent EGU unit shutdowns and controls. This effort was initiated in February 2016. LADCO executed the ERTAC EGU Forecast Tool, incorporating the most recent updates and EIA's AEO projection from 2015. ERTAC modeling for these attainment demonstrations incorporated EIA's "High Oil and Gas Reference" projection. This was done because LADCO compared actual coal and natural gas utilization to AEO's 2015 reference case and EIA's "High Oil and Gas Resource" (see Figure 3.5) and found that the AEO2015 reference case forecasts much higher coal use and much lower natural gas use than were actually occurring. LADCO concluded that the “High Oil and Gas Resource” scenario reflected a much more realistic forecast from which to base its 2017 projection of EGU $NO_X$ emissions. Finally, after the release of ERTAC version 2.5, LADCO obtained new information about unit shutdowns in Michigan and Illinois that were incorporated.

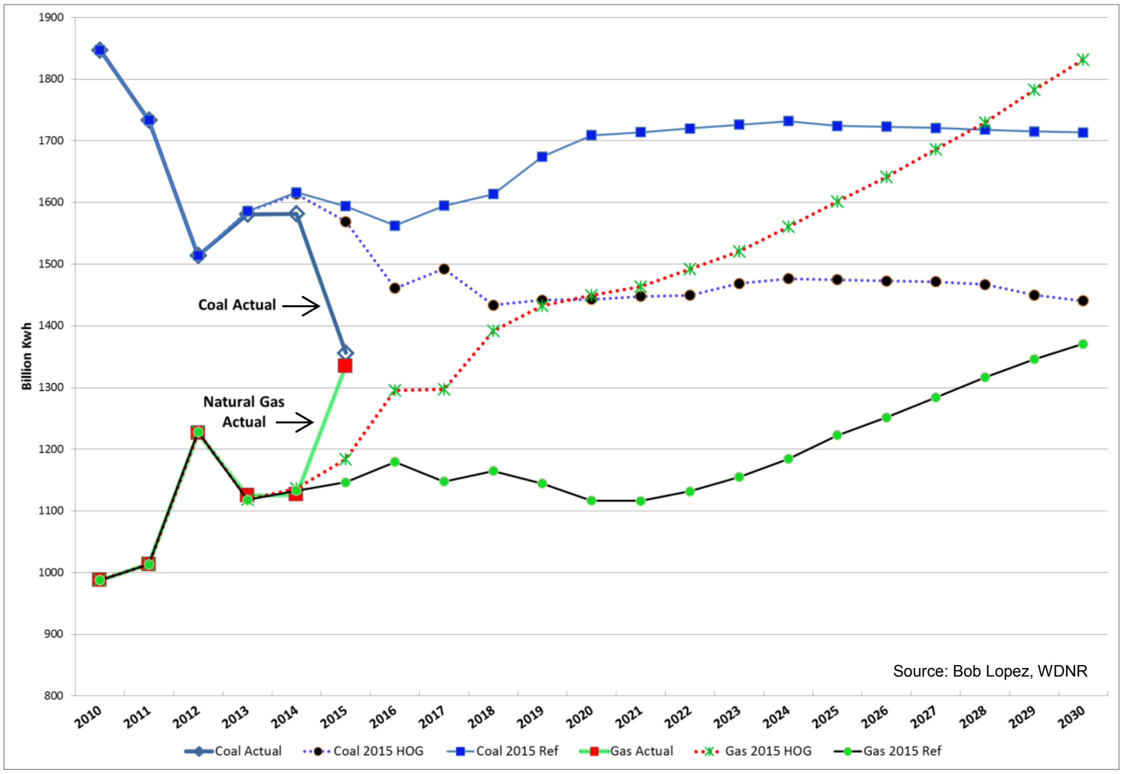


**Figure 3.5. 2015 EIA Annual Energy Outlook –**
**National Forecast of Power Generation for Coal and Natural Gas.**
**(Note: HOG = high oil and gas, Ref = Reference case.)**

It should be noted that the 2017 emissions for EGUs projected by the ERTAC EGU Forecast Tool reflect enforceable “on-the-books” control measures, fuel switches and unit shutdowns. The model does not forecast unit shutdowns or fuel switches or incorporate assumptions about pending regulatory actions such as the Clean Power Plan or the Mercury and Air Toxics Standards. These regulatory programs are expected to reduce emissions from Midwestern EGUs but their impacts are as yet uncertain. LADCO made no attempt to quantify these future reductions and considers the 2017 emissions projections for EGUs to be conservative because future emissions are likely to be less than the emissions used in this analysis.

## Control Measures

On September 7, 2016, U.S. EPA finalized an update to the Cross-State Air Pollution Rule (CSAPR). This rule is expected to further reduce $NO_X$ emissions from EGUs in 22 states in the eastern U.S., including five of the states in the LADCO region. These emissions reductions are expected to begin by the start of the 2017 ozone season. LADCO used the ERTAC EGU Forecast Tool to project likely NOx emissions reductions from the revised CSAPR. LADCO's approach assumed that electric utilities would likely optimize their use of existing controls (SNCRs and SCRs) and shift electric generation from higher emitting units to cleaner ones to comply with CSAPR.

LADCO evaluated the likelihood of states meeting the CSAPR ozone season NOx budgets assuming:

- lower NOx emission rates for units controlled with SCRs, in the range from 0.06 to 0.08 lb/mm Btu, for SCR-equipped units operating above those rates in the base year;
- a lower NOx emission rate for units equipped with SNCRs, to 0.2 lb/mm Btu for SNCR-equipped units operating above that rate in the base year;
- electric utilities would shift generation from higher emitting units to cleaner ones, as needed to reduce regional NOx emissions to meet the CSAPR budget.

The results of this analysis are included in Table 3.2. Finding that NOx emissions would exceed the CSAPR NOx budgets for the affected CSAPR region when the most stringent NOx rates for existing equipment were assumed at the baseline loading balance between facilities, LADCO evaluated the effects of shifting electric generation from higher emitting fossil units to lower emitting fossil units. Two such load-shifting scenarios were tested (see Table 3.2). Based on this analysis, it is likely that the CSAPR budget can be achieved in the region using existing controls combined with modest load shifting between fossil-fueled units, assuming meteorological conditions affecting the demand for electricity are similar to base year 2011 conditions. The unit-level emissions resulting from this analysis were used as input to the photochemical air quality model as a future year 2017 control scenario, as described in Section 4 of this TSD. These scenarios were developed based on reasonable assumptions of the likely responses of electric utilities to federal regulatory requirements for the purpose of generating EGU emission rates for this modeling assessment. However, it should be noted that states are required to meet the regulatory requirements of the CSAPR program, not the emissions and generation rates evaluated here.

In addition to CSAPR, U.S. EPA has adopted a number of national rules over the past few years that require or will require VOC and NOx emission reductions. Emissions standards established for mobile sources have been phased in over recent years but fleet turnover will ensure continued emissions reductions for many years in the future. For the LADCO states, these rules have provided emissions reductions between 2011 (base year) and 2017 (attainment year), and have been factored into the modeling assessment. The national rules that will help states achieve the 2008 ozone NAAQS are listed below.

## Table 3.2. Evaluation of CSAPR Budgets
## (Note: Emissions reflect 2017 NOx tons per ozone season)

| State | 2017 Base | CSAPR NOx Budget | CSAPR NOx Assurance Levels | 2017 NOx (SCR Cap @ 0.08 lb/mm BTU) | 2017 NOx (SCR Cap @ 0.07 lb/mm BTU) | 2017 NOx (SCR Cap @ 0.06 lb/mm BTU) | 2017 NOx Generation Shift Option 1 | 2017 NOx Generation Shift Option 2 |
|---|---|---|---|---|---|---|---|---|
| AL | 11,346 | 13,211 | 15,985 | 9,404 | 9,017 | 8,344 | 7,958 | 7,319 |
| AR | 17,821 | 9,210 | 11,144 | 17,821 | 17,821 | 17,781 | 13,230 | 9,373 |
| IA | 10,307 | 11,272 | 13,639 | 10,307 | 10,307 | 10,288 | 8,730 | 7,613 |
| IL | 14,650 | 14,601 | 17,667 | 14,325 | 14,175 | 13,844 | 15,017 | 15,512 |
| IN | 39,605 | 23,303 | 28,197 | 31,278 | 30,118 | 28,958 | 23,659 | 18,319 |
| KS | 13,569 | 8,027 | 9,713 | 11,887 | 11,690 | 11,494 | 10,865 | 9,720 |
| KY | 28,329 | 21,115 | 25,549 | 24,487 | 24,000 | 23,386 | 19,542 | 13,605 |
| LA | 16,532 | 18,639 | 22,553 | 16,532 | 16,532 | 16,532 | 14,980 | 13,714 |
| MD | 5,751 | 3,828 | 4,632 | 5,345 | 5,291 | 5,157 | 4,277 | 3,529 |
| MI | 21,696 | 17,023 | 20,598 | 21,696 | 21,239 | 20,749 | 16,294 | 13,617 |
| MO | 24,092 | 15,780 | 19,094 | 20,658 | 20,186 | 19,585 | 16,898 | 14,776 |
| MS | 9,222 | 6,315 | 7,641 | 9,222 | 9,222 | 9,222 | 8,360 | 6,793 |
| NJ | 2,953 | 2,062 | 2,495 | 2,569 | 2,478 | 2,387 | 2,428 | 2,400 |
| NY | 6,768 | 5,135 | 6,213 | 6,560 | 6,508 | 6,456 | 6,456 | 6,456 |
| OH | 27,403 | 19,522 | 23,622 | 20,057 | 18,824 | 17,420 | 15,854 | 14,199 |
| OK | 31,357 | 11,641 | 14,086 | 31,357 | 31,357 | 31,357 | 26,991 | 22,391 |
| PA | 24,125 | 17,952 | 21,722 | 18,372 | 17,007 | 15,597 | 15,851 | 16,304 |
| TN | 8,651 | 7,736 | 9,361 | 8,422 | 8,210 | 7,795 | 7,466 | 7,178 |
| TX | 63,079 | 52,301 | 63,284 | 63,079 | 63,079 | 62,912 | 58,605 | 52,164 |
| VA | 8,567 | 9,223 | 11,160 | 7,814 | 7,814 | 7,803 | 6,896 | 5,445 |
| WI | 8,076 | 7,915 | 9,577 | 8,076 | 8,076 | 7,787 | 7,818 | 7,852 |
| WV | 19,435 | 17,815 | 21,556 | 15,110 | 14,464 | 13,798 | 12,962 | 11,711 |
| **Total** | **413,334** | **313,626** | **379,488** | **374,378** | **367,416** | **358,650** | **321,136** | **279,990** |

Green indicates state is meeting CSAPR budget for that scenario
Blue indicates state is meeting CSAPR Assurance Level for that scenario

Mobile Source Requirements

- Tier 2 Light-Duty Vehicle Rule
- Tier 3 Tailpipe and Evaporative Emission and Vehicle Fuel Standards
- Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements
- Clean Air Non-Road Diesel Rule
- Control of Hazardous Air Pollutants from Mobile Sources
- NOx Emission Standards for New Commercial Aircraft Engines
- Control of Emissions for Non-Road Spark Ignition Engines and Equipment
- Emissions Standards for Locomotives and Marine Compression-Ignition Engines

Stationary Source Requirements

- Area Source Boilers, Major Source Boilers and Commercial/Industrial Solid Waste Incinerators NESHAPs

- Reciprocating Internal Combustion Engines NESHAPs
- Mercury and Air Toxics Standards (Note that this modeling demonstration includes reductions from this rule as implemented by early 2016 when modeling was initiated. Further emissions reductions are expected from that have not been accounted for in this analysis.)
- Regional Haze Regulations and Guidelines for Best Available Retrofit Technology

## Emissions Summary

Projected VOC and NOx emissions for 2017 are compared to 2011 base year emissions for all emissions categories in Figure 3.6. Emissions of VOC and $NO_X$ are expected to decrease in the Lake Michigan area and regionally between 2011 and 2017 due to “on-the-books” control measures.

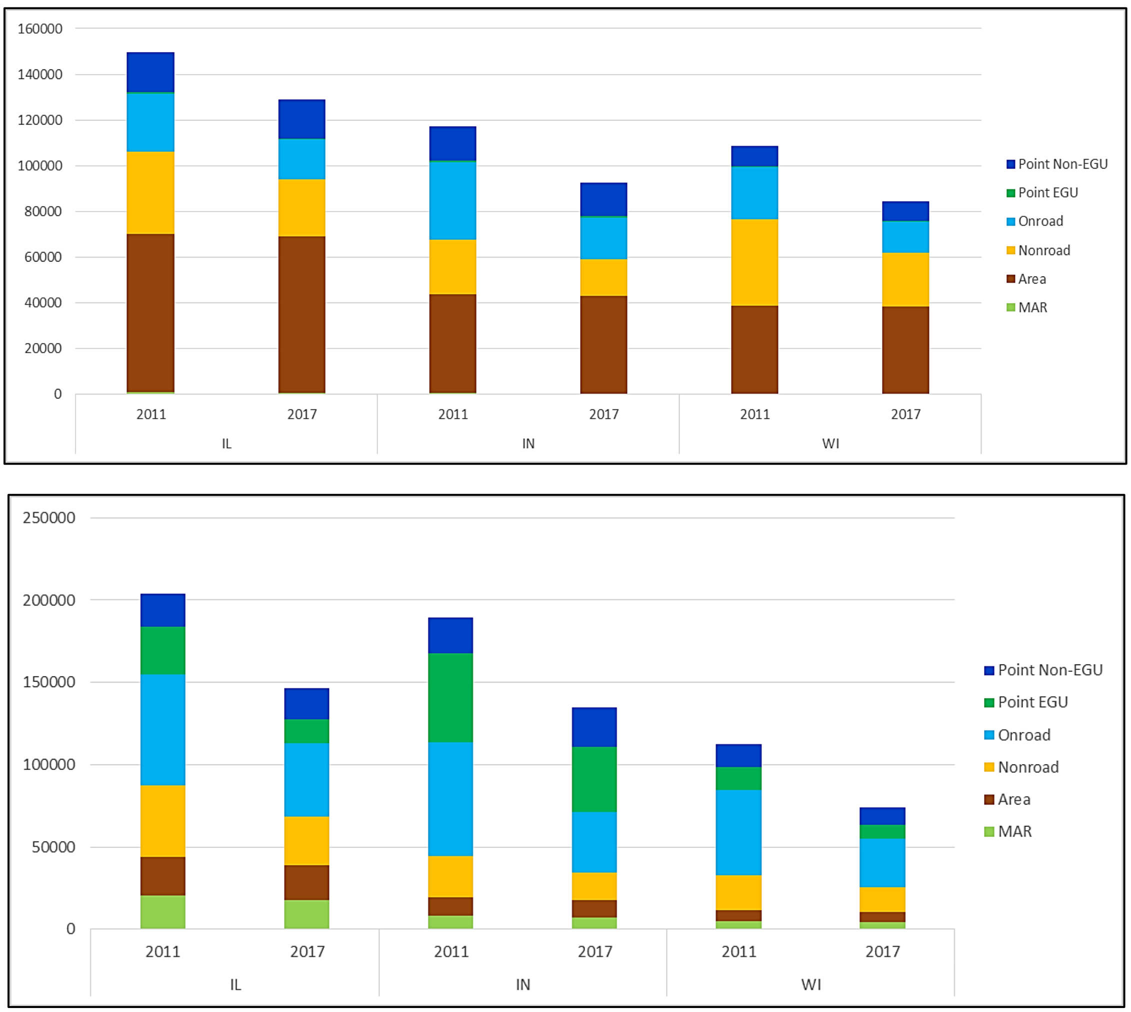


**Figure 3.6. Base Year (2011) and Future Year (2017) VOC (top) and $NO_X$ (bottom) Emissions (tons per ozone season).**

# 4.0 Air Quality Modeling

This section reviews the development and evaluation of the modeling system used for the Chicago and Sheboygan ozone attainment test. LADCO, in cooperation with the Illinois EPA, the Indiana DEM, the Wisconsin DNR and U.S. EPA, conducted the modeling assessment described here to support the development of the states' ozone attainment SIPs. The modeling analyses were conducted in accordance with U.S. EPA's attainment demonstration guidelines (U.S. EPA, 2014B).

## Selection of Base Year

The calendar year 2011 was selected as the base year for regional ozone modeling, based on the following considerations:

- The 2011 base year is representative of the observed baseline design values for the time period (2008-2010 and 2009-2011) when U.S. EPA established the final air quality designations for the Sheboygan and Chicago areas for the 2008 ozone NAAQS, respectively.
- There are extensive air quality, meteorological, and emissions databases that have been developed for 2011 by U.S. EPA, and others, for regulatory purposes (U.S. EPA, 2015A).
- The 2011 ozone season was fairly typical in terms of meteorology and ozone conduciveness in the Lake Michigan region.

## Modeling Platform

The modeling platform consists of emissions and transport models that reflect the spatial and temporal characteristics of the study region. U.S. EPA's modeling guidance details several prerequisites for a model to be used to support an attainment demonstration:

- It should have received a scientific peer review;
- It should be appropriate for the specific application on a theoretical basis;
- It should be used with databases that are available and adequate to support its application; and
- It should be shown to have performed well in past modeling applications.

A summary of the models used in the 2011 modeling platform are shown in Table 4.1.

**Table 4.1. 2011 Modeling Platform Components**

| Model | Type | Managing Organization |
|---|---|---|
| WRF | Meteorology | EPA OAQPS |
| GEOS-CHEM | Global Chemical Transport | EPA OAQPS |
| SMOKE | Emissions | EPA OAQPS / LADCO |
| ERTAC | EGU emissions | States, MJOs |
| CAMx | Regional Photochemical | LADCO |

Below is a brief summary of each of the model components:

*WRF*: The Weather Research and Forecasting (WRF) model was developed collaboratively by the National Center for Atmospheric Research, the National Oceanic and Atmospheric Administration, the Department of Defense's Air Force Weather Agency and Naval Research Laboratory, the Center for Analysis and Prediction of Storms at the University of Oklahoma, and the Federal Aviation Administration, with the participation of university scientists. WRF is a prognostic meteorological model routinely used by U.S. EPA and others for urban- and regional-scale photochemical modeling of $PM_{2.5}$, ozone, and regional haze (U.S. EPA, 2014A).

*GEOS-CHEM:* Bey et al. (2001) developed the global chemical transport model GEOS-Chem using assimilated meteorological data from the Goddard Earth Observing System (GEOS) of the NASA Global Modeling and Assimilation Office. The model incorporates modules to account for emissions, photochemistry, and deposition. GEOS-Chem is managed by Harvard University and Dalhousie University with support from the U.S. NASA Earth Science Division and the Canadian National and Engineering Research Council.

*SMOKE*: The SMOKE modeling system is an emissions modeling system that generates hourly gridded, speciated emission inputs of mobile, nonroad, area, point, fire and biogenic emission sources for photochemical grid models. Its purpose is to provide an efficient tool for converting emissions inventory data into the formatted emission files required by an air quality simulation model. For mobile sources, SMOKE actually generates emissions rates based on input mobile-source activity data, using emission factors and outputs from U.S. EPA's MOVES mobile-source emissions model. For EGUs, SMOKE generates hourly emissions based on hourly outputs from the ERTAC EGU Forecast Tool, described below.

*ERTAC*: ERTAC is a collaborative effort to improve emission inventories among the Northeastern, Mid-Atlantic, Southeastern, and Lake Michigan area states; other member states; industry representatives; and MJOs. ERTAC developed the EGU Forecast Tool for states to use for SIP planning. The tool uses base-year reported EGU data obtained from CAMD and applies growth rates by region and fuel type provided by the EIA to estimate future emissions. The ERTAC EGU Forecast Tool is open-source and has been provided to U.S. EPA.

*CAMx*: CAMx is a photochemical grid model that is designed for simulating atmospheric transport and chemical transformation of air pollution over urban to regional scales. CAMx is a state-of-the-science open-source air quality model that is computationally efficient with an extensive history of regulatory applications. The selection of CAMx as the primary photochemical grid model is based on several factors including performance, operational considerations (e.g., ease of application and resource requirements), technical support and documentation, and model extensions (e.g., process analysis, source apportionment, and plume-in-grid).

### Meteorological Inputs

Meteorological modeling is an integral part of the modeling platform that provides hourly inputs for the emissions and photochemical models. Ozone modeling requires a full summer of meteorological inputs covering May 1 through September 30, not including model spin-up. Meteorological modeling for the 2011 modeling platform was performed with the Weather Research and Forecast (WRF-ARW V3.4) model operated by U.S. EPA OAQPS. Sea surface temperatures were initialized with a 1km data set from the Group for High Resolution Sea Surface Temperatures (Stammer et al., 2003). The 12km WRF modeling domain is shown in Figure 4.1. LADCO's modeling assessment utilized the WRF meteorological outputs developed by U.S. EPA as described in their Technical Support Document (U.S. EPA, 2014A).

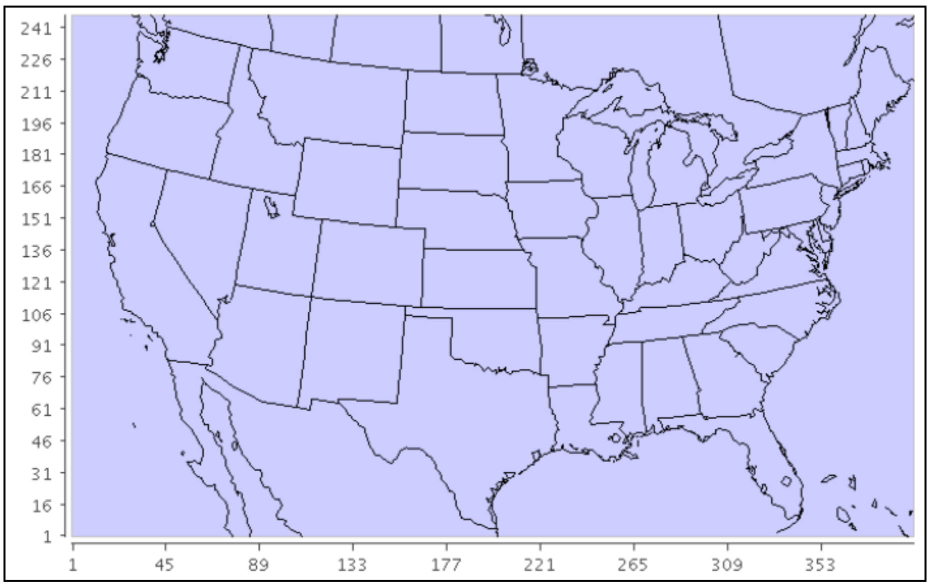


**Figure 4.1. Map of WRF Model Domain (U.S. EPA, 2014A)**

The 2011 WRF meteorological data has been extensively evaluated on a national scale by U.S. EPA - OAQPS as described in U.S. EPA's Technical Support Document (U.S. EPA, 2014A). A summary of the EPA (2014A) performance conclusions are presented here:

- Surface temperatures are slightly under-predicted, with a slight over-prediction in the early morning hours.

- Wind speeds are slightly over-predicted in the early morning and slightly under-predicted in the evening and night.
- Mixing ratios are generally under-predicted in the central and western US and over-predicted in the eastern states.
- Precipitation is overestimated in elevated terrain such as northern CA and the Pacific Northwest.

Regarding the performance of the WRF meteorological model, U.S. EPA found that, overall, model performance was deemed adequate and an improvement compared with previous meteorological modeling efforts.

### Photochemical Model Configuration

Photochemical modeling of criteria air pollutants is performed with the Comprehensive Air quality Model with Extensions (CAMx V6.30[1]). CAMx is commonly used for attainment demonstrations (U.S. EPA, 2014B), has been extensively peer reviewed (Baker and Scheff, 2007; Vizuete et al., 2011), and has performed well in previous applications (Simon et al., 2012).

CAMx is applied following standard procedures recommended by Ramboll-Environ (2015) and U.S. EPA (2014B). Table 4.2 describes the CAMx modeling configuration used by LADCO for this modeling assessment. The model configuration options are based on U.S. EPA's (2016) modeling, although LADCO employed a more recent chemical mechanism (CB6r3).

**Table 4.2. CAMx Modeling Configuration**

| Module | Option |
|---|---|
| Chemistry Solver | Euler-Backward Iterative |
| Horizontal Advection Solver | Piecewise Parabolic Method (Colella and Woodward, 1984) |
| Vertical Diffusion | K-theory |
| Dry Deposition | Zhang et al. (2003) |
| Particle Size Distribution | Two-Mode Coarse/Fine (CF) |
| Chemical Mechanism | CB6r3 (Emery et al., 2015) |

*Grid Projection and Domain*

The 12-km photochemical modeling domain adopted for the 2011 modeling platform is referred to as 12US2 by U.S. EPA and shown in Figure 4.2. There are 25 vertical layers with irregular spacing, finer spacing near the ground and more coarse spacing near the top.

[1] Available at http://www.camx.com/home.aspx

*Photolysis Rates*

Photolysis rates and ozone columns are provided by the U.S. EPA as part of their 2011 modeling platform.

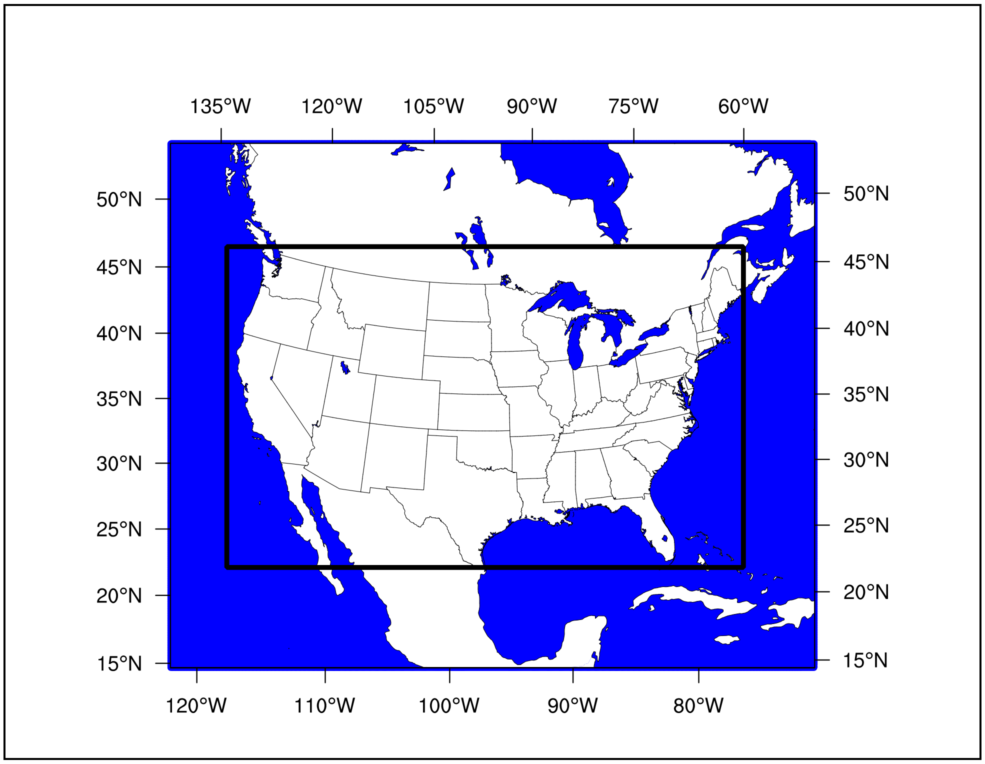


**Figure 4.2. Photochemical Modeling Domain (shown in black).**

*Initial and Boundary Conditions*

Initial and boundary conditions are derived from a 2011 global simulation. GEOS-CHEM v8-03-02 is run with 2 x 2.5 degree resolution and up to 38 vertical layers. Global emissions are based on the Emission Database for Global Atmospheric Research with U.S. EPA regional improvements for U.S., Canada, Europe, Mexico, and Asia. See Henderson et al. (2014) for a complete description of the methodology and model evaluation.

**Summary of Model Performance Evaluation**

LADCO evaluated the 2011 base case modeling to assess the model's ability to reproduce observed ozone and precursor concentrations regionally and in the Lake Michigan area. The model performance evaluation examines the platform’s ability to replicate the magnitude, spatial, and temporal pattern of measured concentrations. This exercise is intended to assess whether confidence in the model is warranted and, if so, to what degree. Model performance is assessed by comparing paired modeled and monitored concentrations.  Graphical (e.g., spatial plots) and statistical analyses are presented. Consistent with U.S. EPA's modeling guidance, no rigid acceptance/rejection criteria are used for this study. The model performance results presented here describe how well the model replicates observed ozone concentrations and ozone precursors.

LADCO conducted a performance evaluation of the 2011 modeling platform using ambient monitoring data from the Air Quality System (AQS). The AQS comprises a national database of ambient air pollution including criteria pollutants and particulates. A variety of statistics including mean observed, mean modeled, mean bias, mean error, mean fractional bias, mean fractional error, and correlation coefficient are calculated at each monitor site. A summary of these analyses are provided below. The complete performance evaluation is contained in Appendix A.

Maps of average observed and predicted maximum daily 8-hour ozone (MDA8) considering observations above 60 ppb are shown for the Lake Michigan region and the Midwest in Figures 4.3 and 4.4, respectively.  Comparing the two figures, the model performs well in reproducing the locations and magnitudes of elevated ozone concentrations overall, although it is noted that CAMx predicts higher MDA8 at some sites in eastern Wisconsin along the Lake Michigan shoreline.

The performance evaluation uses statistical metrics to evaluate how well the model reproduces ozone measurements. Model "error" is an absolute measure of the deviation or difference between modeled concentrations and observed values, while bias shows the direction of deviation. A positive bias indicates that the model over-predicts observed concentrations, while a negative bias indicates that the model under-predicts. U.S. EPA's modeling guidance does not specify rigid acceptance/rejection criteria for model performance, although ozone model performance is generally considered good if bias is within 15% (positive or negative) and error is within 30%. Simon & Baker (2012) present a thorough discussion and summary of regional modeling performance statistics.

Figure 4.5 depicts the spatial distribution of the model's fractional bias for the Lake Michigan region and the Midwest. The model's bias is within 15% at virtually all locations in the Lake Michigan region and in the Midwest, which is less than the 20% fractional bias reported Simon et al (2012) for past modeling studies.

As shown in Figure 4.6, the mean fractional error is within 20% at most locations in the Midwest. Monitoring sites near Lake Michigan exhibit higher mean fractional error than at other Midwestern locations, likely due to the complexity of the meteorology in the nearshore environment. However, the mean fractional error is still within 20% at all locations near Lake Michigan, which is within the range of 15-30% fractional error reported by Simon et al (2012) for past modeling studies.

The Pearson Correlation Coefficient (*r*) is a measure of the linear dependence between two variables, with a value of 1 indicating perfect correlation and a value of -1 indicating anti-correlation. Overall, the modeled MDA8 ozone is well correlated with observations (Figure 4.7), which indicates that daily increases and decreases predicted by the model

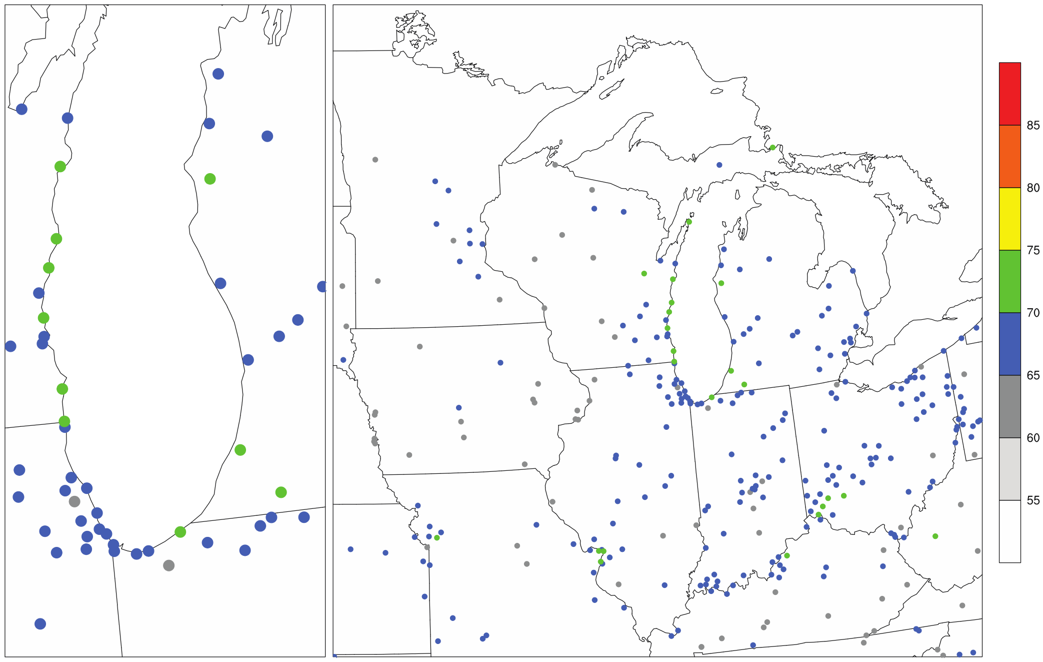


**Figure 4.3. 2011 Mean Observed MDA8 Ozone (ppb) with a 60 ppb Ozone Threshold**

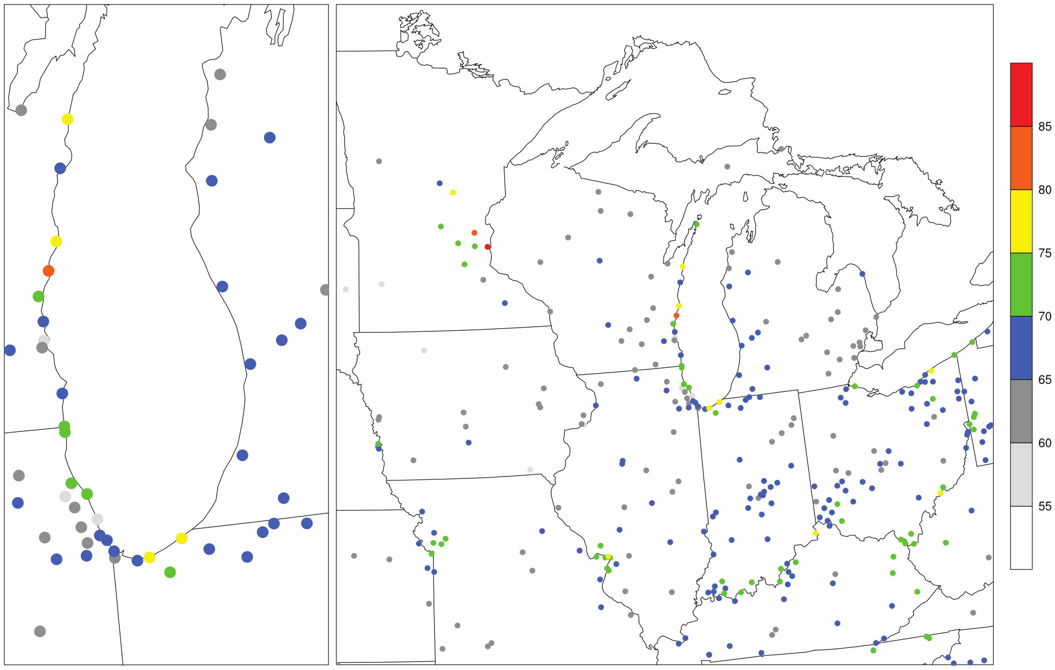


**Figure 4.4. 2011 Mean CAMx Predicted MDA8 Ozone (ppb) with a 60 ppb Ozone Threshold.**

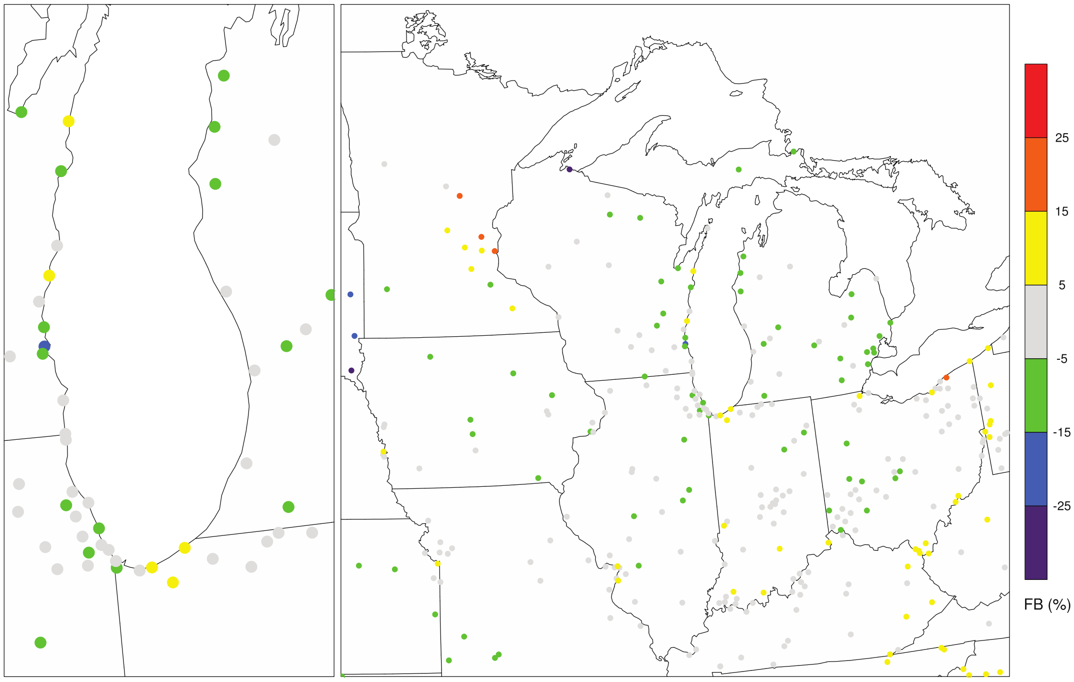


**Figure 4.5. 2011 Mean Fractional Bias of MDA8 Ozone (ppb) with a 60 ppb Ozone Threshold**

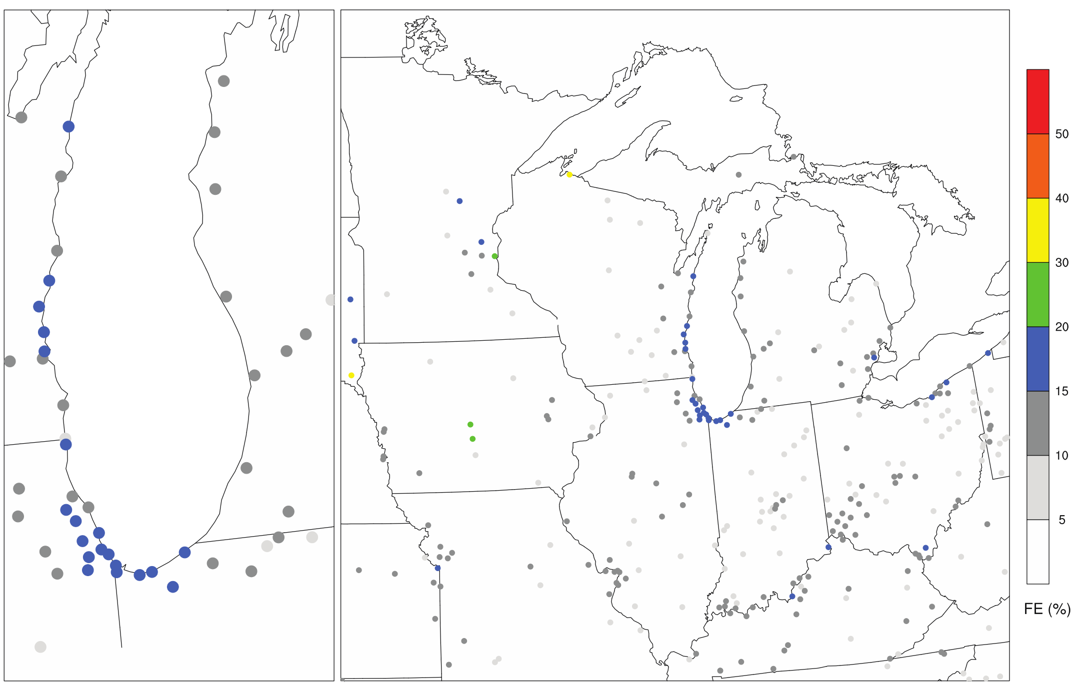


**Figure 4.6. 2011 Mean Fractional Error of MDA8 Ozone (ppb) with a 60 ppb Ozone Threshold**

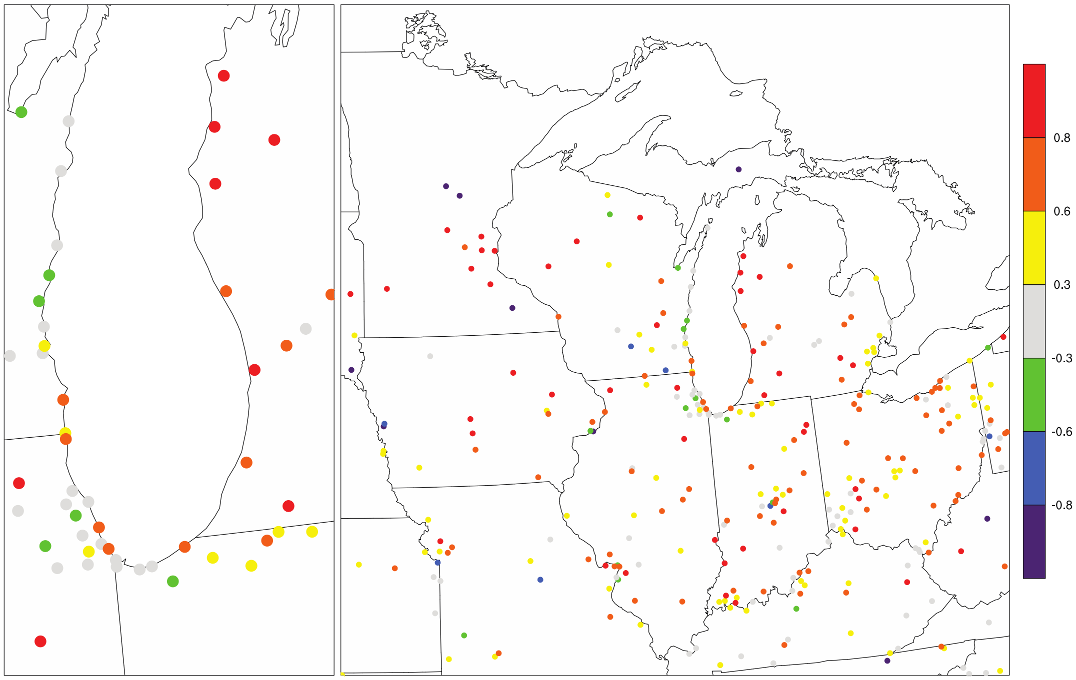


**Figure 4.7. 2011 Pearson Correlation Coefficient of MDA8 Ozone (ppb) with a 60 ppb Ozone Threshold**

track well with observations. Not all monitors are well correlated with modeling results; some monitors exhibit a low or even negative correlation. The model is not expected to perform perfectly at every individual monitor. Simon et al (2012) reported values ranging from 0.2 to 0.75 for MDA8 ozone.

One easy way to summarize model performance and compare it to the performance goals is through the use of box plots. Box plots summarizing fractional error and fractional bias aggregated by month are shown in Figures 4.8 and 4.9 for the LADCO states and selected cities in the LADCO region, respectively. The dotted lines show performance criteria goals defined from ranges of performance statistics reported by Simon et al (2012). Generally, the modeling results fall within the performance goals, since the model's bias is less than 10% and the model's mean error is less than 20% for most areas. Some sites exhibit strongly positive or negative bias during the months of May and September when there are fewer ozone episodes. The performance of the model in LADCO states is similar to national model performance, although the model tends to have a slightly negative bias predicting MDA8 ozone. This finding is consistent with past modeling studies (Simon et al, 2012).

Focusing on the lakeshore nonattainment sites, time series of modeled and monitored MDA8 ozone for the 2011 ozone season are shown in Figures 4.10 and 4.11 for the monitors at Chiwaukee Prairie and Sheboygan. The modeled values for MDA8 ozone are of similar magnitudes as the measured values and follow temporal variations well. While the model generally under-predicts MDA8 ozone, as described above, the

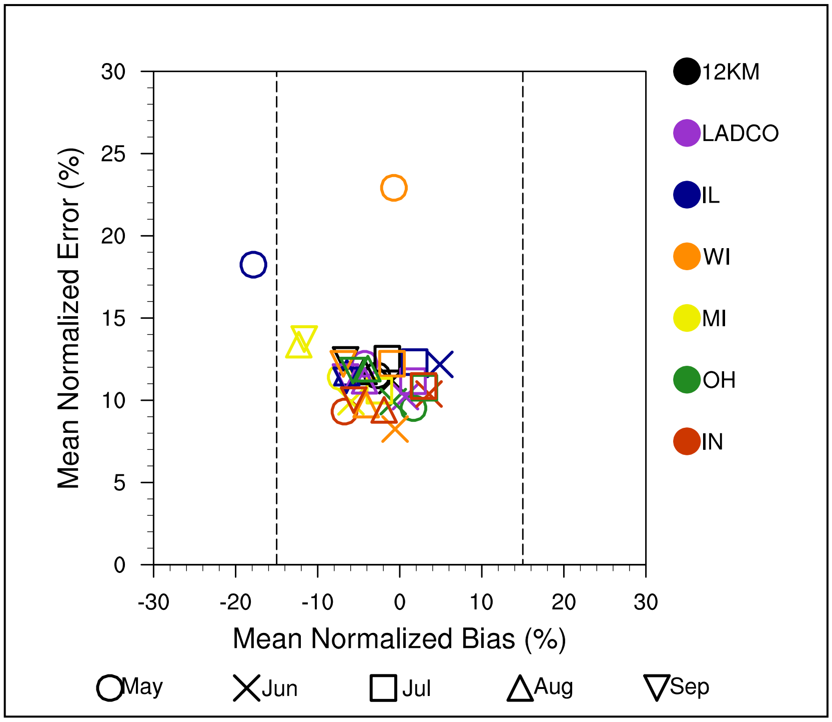


**Figure 4.8. MDA8 Ozone Model Performance by Month for the LADCO States, LADCO Aggregated (purple), and National Average (black)**

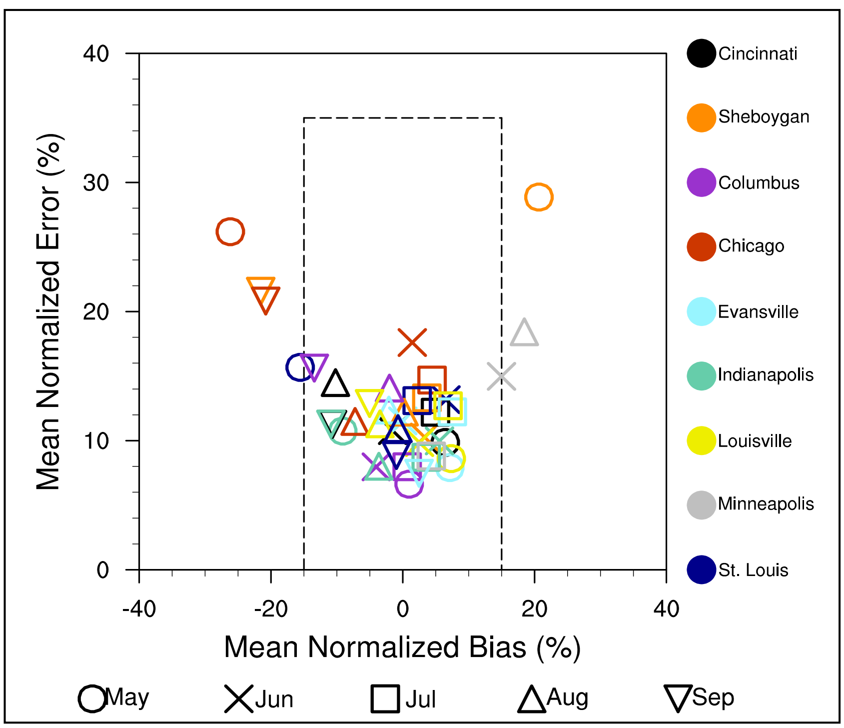


**Figure 4.9. MDA8 Ozone Model Performance for Selected Cities in the LADCO Region**

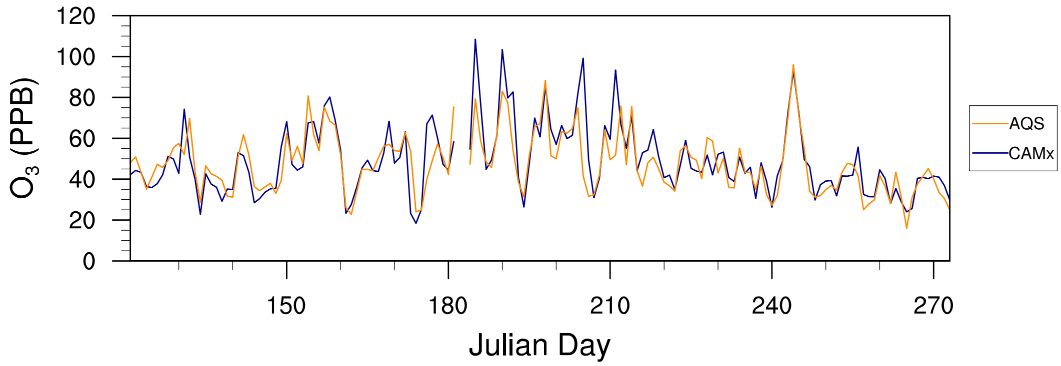


**Figure 4.10. MDA8 Ozone Showing Monitoring and Modeling in Chiwaukee Prairie, WI (AQS site ID 550590019)**

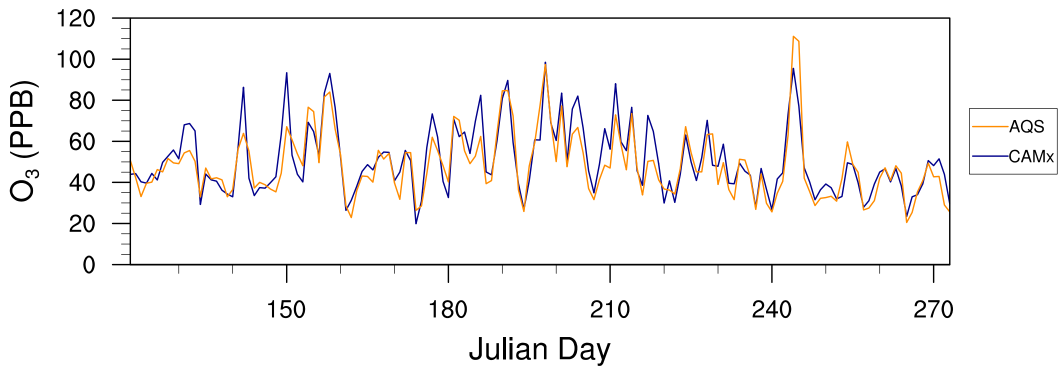


**Figure 4.11. Time Series Comparing Observed and Predicted MDA8 Ozone in Sheboygan, WI (AQS site ID 551170006)**

Sheboygan and Chiwaukee monitors exhibit a slight over-prediction of MDA8 ozone as shown in Figures 4.10 and 4.11, respectively.

As discussed, U.S. EPA's modeling guidance does not specify rigid acceptance/rejection criteria for model performance, although ozone model performance is generally considered good if bias is within 15% (positive or negative), error is within 30%. The performance of the 2011 modeling platform meets these metrics, both in the Lake Michigan area and in the wider region. This modeling is an improvement over past modeling studies (Simon et al, 2012) and is acceptable for supporting the states' attainment SIPs.

**Modeled Attainment Test**

An attainment demonstration based on air quality modeling is used to determine whether identified emissions reduction measures are sufficient to reduce projected pollutant concentrations to a level that meets the NAAQS by the statutory deadline established by U.S. EPA. This modeling analysis uses 2017 as the projection year to demonstrate attainment of the 2008 ozone NAAQS. As described previously in Section 3, LADCO and U.S. EPA developed emissions scenarios for 2017 representing on the books control measures, including CSAPR. These scenarios are evaluated using the CAMx model to determine the likelihood that the 2008 ozone NAAQS will be achieved in the Lake Michigan region in 2017.

LADCO performed this modeling assessment consistent with the draft guidance issued by U.S. EPA in 2014 (U.S. EPA, 2014B). LADCO has estimated the amount of emission reductions expected by 2017 and has applied the CAMx photochemical model to simulate both base year and future year ozone concentrations. In this section, the application of U.S. EPA's "model attainment test" for the ozone nonattainment areas in the Lake Michigan region is described.

The model attainment test uses model estimates in a relative sense to estimate future year design values. U.S. EPA's Air Quality Modeling Group has developed the Modeled Attainment Test Software (MATS[2]) for this purpose. The MATS software computes the fractional changes, or relative response factors of ozone concentrations at each monitor location using results of the model base year and the future year. Meteorological conditions are assumed to be unchanged for the base and projection years. The resulting estimates of future ozone design values are then compared to the NAAQS. If the future ozone design values are less than or equal to the NAAQS, then the analysis suggests that attainment will be reached.[3]

LADCO has used the MATS software according to U.S. EPA's recommended approach (U.S. EPA, 2014B). All modeling results are time shifted to local time to be consistent with monitoring measurements. It should be noted that the modeled attainment test calculates the baseline 2011 design value differently than the method used for calculating the monitored design values shown previously in Table 2.1 (which are three-year averages). U.S. EPA's MATS software calculates the baseline 2011 design value by averaging three successive three-year design values centered on 2011 (2009-2011, 2010-2012, 2011-2013). The baseline 2011 design values are therefore weighted averages using ambient data from 2009-2013 at each location (Abt Associates, 2014).

Table 4.3 summarizes the results of the model attainment test for the 2017 future year that includes ERTAC EGU emissions for 2017 ("LADCO 2017 Base") and LADCO's projection of the impact of U.S. EPA's CSAPR Update Rule ("LADCO 2017 with CSAPR"). Also shown in the table are the 2017 ozone design values projected by U.S. EPA ("EPA 2017"). Baseline 2011 design values for monitoring sites in the Chicago and Sheboygan nonattainment areas are compared to the 2017 design values projected for

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[2] Available at http://www.epa.gov/scram001/modelingapps_mats.htm

[3] It is noted that U.S. EPA is developing new software to replace MATS for performing modeled ozone attainment tests. This new software is called the Software for the Modeled Attainment Test - Community Edition (SMAT-CE). However, the SMAT-CE software is still being tested by U.S. EPA and has not yet been released to the public. Accordingly, LADCO relied on the MATS software (v2.6.1), which is readily available.

each 2017 scenario. While the LADCO projections are generally consistent with U.S. EPA's projections, some of the monitors show higher or lower values. This difference is mostly caused by two factors: 1) differences in model versions (U.S. EPA used CAMx v6.11 and LADCO used CAMx v6.30), and 2) differences in emissions (LADCO used ERTAC for EGU emissions and U.S. EPA used IPM, and LADCO used ENVIRON's MOVES modeling results for onroad emissions).

As shown in Table 4.3, all monitoring locations in the Chicago ozone nonattainment area are projected to meet the level of the 2008 ozone NAAQS (75 ppb) by 2017. The monitor in Sheboygan, WI (AQS site 551170006) is not projected to attain, however, at the emissions levels evaluated.

**Table 4.3. Projected Ozone Design Values (ppb) for 2017 in the Chicago and Sheboygan Ozone Nonattainment Areas**

| AQS ID | State | County | LADCO 2017 Base | LADCO 2017 w/ CSAPR | EPA 2017 |
|---|---|---|---|---|---|
| 170310001 | Illinois | Cook | 66.5 | 66.3 | 67.5 |
| 170310032 | Illinois | Cook | 64.7 | 64.5 | 63.7 |
| 170310064 | Illinois | Cook | 59.4 | 59.2 | 58.4 |
| 170310076 | Illinois | Cook | 66.1 | 65.9 | 67.0 |
| 170311003 | Illinois | Cook | 55.2 | 55.1 | 55.9 |
| 170311601 | Illinois | Cook | 65.8 | 65.5 | 66.4 |
| 170314002 | Illinois | Cook | 59.0 | 58.8 | 57.9 |
| 170314007 | Illinois | Cook | 54.0 | 53.9 | 54.1 |
| 170314201 | Illinois | Cook | 62.2 | 62.1 | 62.3 |
| 170317002 | Illinois | Cook | 60.4 | 60.3 | 61.2 |
| 170436001 | Illinois | DuPage | 61.3 | 61.0 | 61.8 |
| 170890005 | Illinois | Kane | 66.0 | 65.8 | 66.5 |
| 170971007 | Illinois | Lake | 64.9 | 64.8 | 65.0 |
| 171110001 | Illinois | McHenry | 64.7 | 64.4 | 65.2 |
| 171971011 | Illinois | Will | 58.2 | 58.0 | 58.9 |
| 180890022 | Indiana | Lake | 59.2 | 59.0 | 60.2 |
| 180890030 | Indiana | Lake | 61.2 | 61.0 | 61.3 |
| 180892008 | Indiana | Lake | 59.7 | 59.6 | 59.8 |
| 181270024 | Indiana | Porter | 62.2 | 62.0 | 62.5 |
| 181270026 | Indiana | Porter | 58.0 | 57.9 | 58.4 |
| 550590019 | Wisconsin | Kenosha | 66.5 | 66.4 | 66.7 |
| 551170006 | Wisconsin | Sheboygan | 76.4 | 76.1 | 77.0 |

## Weight of Evidence Support for Attainment

U.S. EPA (2014B) recommends accompanying all modeling attainment demonstrations with additional supplemental analysis. Supplemental analysis can be used to support conclusions or provide information contrary to the model test. The following weight of evidence analyses are provided to support the conclusion that the Chicago and Sheboygan area will meet the ozone NAAQS by 2017.

*The ERTAC EGU Projection Tool is conservative*

The ERTAC EGU Projection Tool is conservative, and by design will likely overestimate future year EGU emissions. As described previously, the ERTAC tool does not use an economics model to forecast future utilization of generating units beyond the forecasts provided by EIA. Economic models attempt to anticipate responses in this sector to future regulatory mandates (such as the Clean Power Plan, and the CSAPR Update Rule) or anticipated fuel prices (especially future prices of natural gas). As a result, economic models, including U.S. EPA's Integrated Planning Model (IPM), predict future controls (if a minimum installation time exists within the forecast), unit shutdowns and fuel conversions that may or may not occur. Figure 4.12 depicts projected EGU

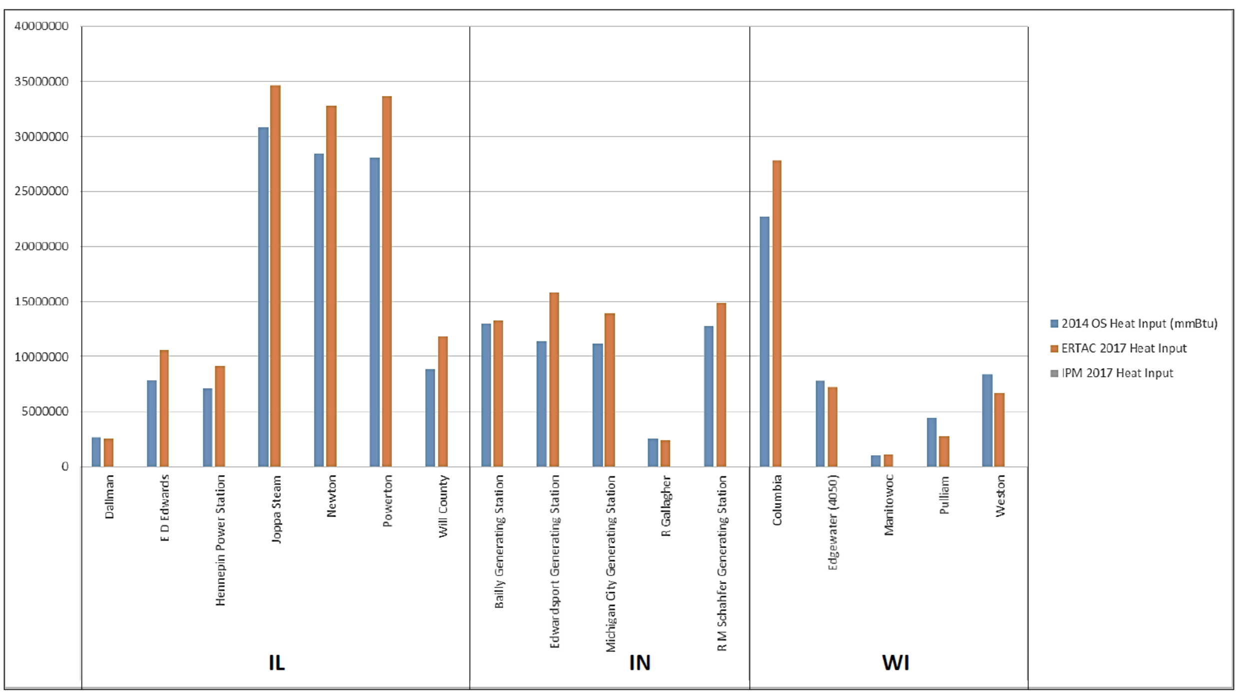


**Figure 4.12. Coal Utilization (heat input) Projected by the ERTAC EGU Projection Tool for Power Plants in the LADCO States that IPM Projects to be Shut Down by 2017**.

utilization (heat input) for coal-fired power plants in the LADCO states that were projected to shut down in 2017 by IPM but are projected by ERTAC to be still in operation. The ERTAC EGU Projection Tool only incorporates new controls, unit shutdowns and fuel conversions that have been identified by the states based on commitments made by the utilities and vetted by state staff, and is therefore more conservative than economics models that are anticipating the effects of future regulatory requirements and fuel prices.

Figure 4.13 illustrates these differences for 2017. As shown, $NO_X$ emission projections are consistently higher from ERTAC than from IPM for virtually every state in the region. It follows then the air quality modeling using emissions projected by the ERTAC EGU Projection Tool will be more conservative than modeling based on emissions derived from IPM.

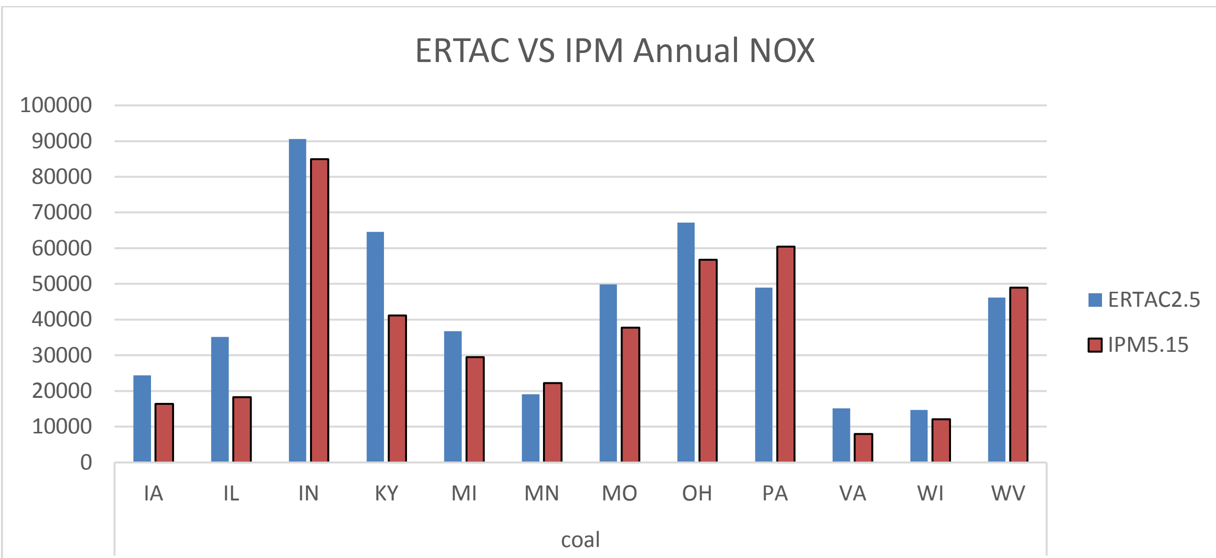


**Figure 4.13. Comparison of ERTAC and IPM 2017 NOx Emissions (tons per year)**

*EIA's forecasts overestimate coal utilization*

As mentioned previously, the ERTAC EGU Projection Tool bases projected generation by fuel type on the AEO forecasts provide by EIA. However, EIA's forecasts have historically overestimated the amount of coal expected to be used for generating electricity in future years. Figure 4.14 compares EIA's AEO projections for successive years beginning in 2008. As shown in the figure, EIA has lowered its coal generation forecast each year to account for decreases in coal utilization that actually occurred (shown in solid blue line). Given this inherent bias in EIA's projections, it is likely that the current EIA projection of coal-based electric generation will overestimate coal use in future years. Since the ERTAC EGU Projection Tool incorporates the EIA projection, it follows that projected $NO_X$ emissions from EGUs that are based on this forecast will be conservative.

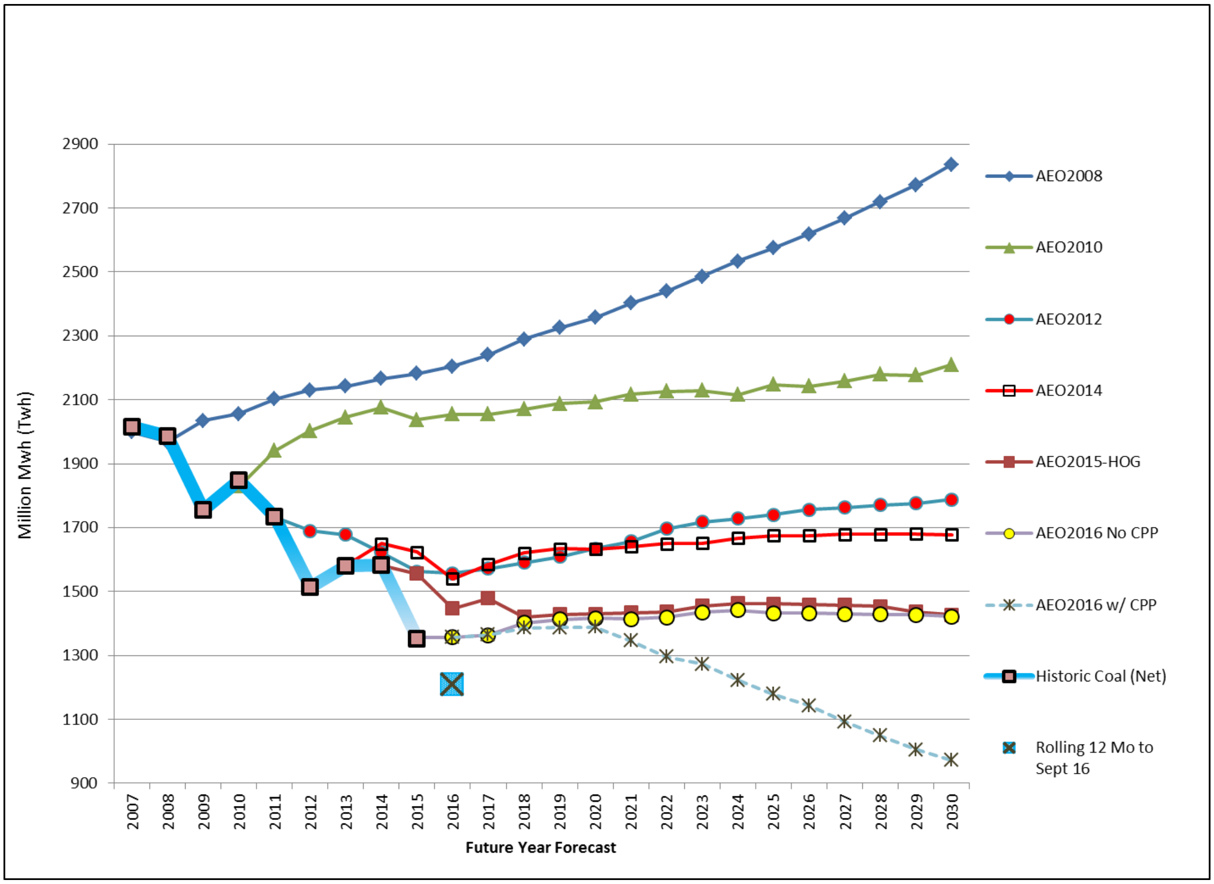


**Figure 4.14. Downward Trend in U.S. Coal Net Generation Forecasts from EIA, 2008-2016.**

*U.S. EPA's regional modeling for 2017 showed that Chicago is expected to attain by 2017*

U.S. EPA conducted modeling in 2015 in support of regulatory initiatives regarding the revised ozone NAAQS and interstate transport (for Good Neighbor SIPs/FIPs). (EPA, 2015B) As shown previously in Table 4.3, U.S. EPA's modeling indicates the likelihood that the Chicago area, including Kenosha County, will attain the 2008 ozone NAAQS by the 2017 attainment deadline. U.S. EPA's modeling does not indicate that the Sheboygan monitor will attain by 2017 without further emissions reductions beyond those included in their analysis.

*Some emission reductions are expected to occur but have not been included*

In addition to the Federal "on-the-books" control measures listed in Section 3, the states have adopted a number of state rules during recent years that require or will require emission reductions from sources of ozone precursors VOC and NOx. These rules will provide emissions reductions between 2011 (base year) and 2017 (attainment year). These measures have not been included in the modeling but are expected to improve ozone air quality in Chicago and Sheboygan. Such measures include:

- Consumer products and AIM requirements in Illinois and Indiana
- Stage II removal and low permeable hose requirements
- Certain shutdowns and restrictions that have occurred since development of the attainment modeling
- Illinois' NOx regulations for ozone nonattainment areas

*Alternate MATS Inputs Yield Range of Future Year Design Values*

LADCO has used the MATS software according to U.S. EPA's recommended approach (U.S. EPA, 2014B). As mentioned previously, MATS calculates the baseline 2011 design value differently than the method used for calculating the monitored design values (which are three-year averages). U.S. EPA's MATS software calculates the baseline 2011 design value by averaging three successive three-year design values centered on 2011 (2009-2011, 2010-2012, 2011-2013). The baseline 2011 design values are therefore weighted averages using ambient data from 2009-2013 at each location.

LADCO evaluated the sensitivity of the 2017 projections to an alternate methodology of representing the 2011 baseline design values. Rather than using the five-year weighted average baseline value for 2011, LADCO used MATS to calculate the 2017 design values at key monitoring sites using the actual (three-year) 2011 design values for 2009-2011, 2010-2012, and 2011-2013. The results of this evaluation for the "2017 LADCO Base" and the "2017 LADCO with CSAPR" scenarios are shown in Table 4.4. The results demonstrate the sensitivity of the future year projections to the 2011 ozone baseline design values used in MATS. As described in Section 2, 2012 was a warmer than average summer throughout the Midwest and was very conducive to the production of ozone. Conversely, 2009 and 2010 were cooler than average years and were not as ozone-conducive as 2012. As shown in Table 4.4, the 2011 baseline values which include 2012 (2010-2012 and 2011-2013), yield higher 2017 projected design values than does the 2009-2011 baseline value.

All Chicago area monitors are projected to attain using the alternate methodologies for projecting 2017 ozone design values. Sheboygan is projected to attain based on the 2009-2011 baseline.

**Table 4.4. Projected Ozone Design Values (ppb) for 2017 Assuming Alternate 2011 Baseline Design Values**

| | 2017 LADCO Base | | | 2017 w/ CSAPR | | |
|---|---|---|---|---|---|---|
| 2011 Baseline | Kenosha | Sheboygan | Zion | Kenosha | Sheboygan | Zion |
| 2009-2011 | 63.2 | 73.4 | 62.2 | 63.1 | 73.1 | 62.1 |
| 2010-2012 | 69.0 | 78.8 | 67.1 | 68.8 | 78.5 | 67.0 |
| 2011-2013 | 67.3 | 77.0 | 65.5 | 67.2 | 76.7 | 65.4 |

# 5.0 Conclusions

To support the development of ozone attainment SIPs for the States of Illinois, Indiana, and Wisconsin, LADCO conducted technical analyses including preparation of regional emissions inventories and meteorological modeling data, evaluation and application of a regional chemical transport model, and review of ambient monitoring data.

Analyses of monitoring data were conducted to produce a conceptual model, which is a qualitative summary of the physical, chemical, and meteorological processes that control the formation and distribution of pollutants in a given region. Key findings of the analyses include:

- Ozone monitoring data following the 2008 revision of the ozone NAAQS (2008-2010 and 2009-2011) showed some sites in and downwind of the Chicago metropolitan area to be in violation of the revised standard of 75 parts per billion (ppb).

- Historical ozone data generally show a downward trend in the region, and most sites are currently meeting the 2008 NAAQS.

- Ozone concentrations are strongly influenced by meteorological conditions, with a higher number of ozone days and higher ozone levels during summers with above normal temperatures. Ozone concentrations in the Lake Michigan region are also influenced by local-scale wind circulations (lake breezes) which cause elevated concentrations at shoreline sites and decreasing concentrations at locations further inland.

- Inter- and intra-regional transport of ozone and ozone precursors affects the Lake Michigan region, and can be a principal cause of nonattainment in some areas far from population or industrial centers.

An air quality modeling platform was developed to evaluate the adequacy of current and potential emission reduction strategies needed to demonstrate attainment of the 2008 ozone NAAQS by the 2017 ozone season. LADCO conducted modeling for the base year 2011 to evaluate model performance (i.e., assess the model's ability to reproduce the observed concentrations). Model performance for ozone is considered to be adequate to support the states' attainment SIPs.

Future year strategy modeling was conducted to determine whether existing ("on the books") controls would be sufficient to provide for attainment of the 2008 8-hour ozone standard and, if not, what additional emission reductions would be necessary for attainment. Based on the modeling and other supplemental analyses, the following general conclusions can be made:

- Existing controls are expected to produce significant improvement in ozone concentrations between 2011 and 2017.

- Modeling demonstrates that all monitoring sites in the Chicago nonattainment area, including sites in northwest Indiana, northeast Illinois, and southeast Wisconsin, are expected to meet the 2008 ozone air quality standard by the 2017 ozone season.

- Modeling indicates that one site in eastern Wisconsin, in Sheboygan County, may not meet the 2008 8-hour ozone standard by the 2017 ozone season. This finding of limited residual nonattainment for ozone is consistent with current (2014-2016) monitoring data which continues to show ozone concentrations above the NAAQS in this area (e.g., ozone design values on the order of 76-79 ppb). It is noted that the modeling analysis is, by design, conservative and that air quality in future years may be better than the modeling indicates.

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# Appendix A
# Model Performance Evaluation

## Appendix A: Extended Model Performance Evaluation

This section presents additional model performance analysis. Maps of performance at individual monitors showing mean error and mean bias with an observed 60 ppb MDA8 $O_3$ threshold are shown in figures A.1 and A.2, respectively.

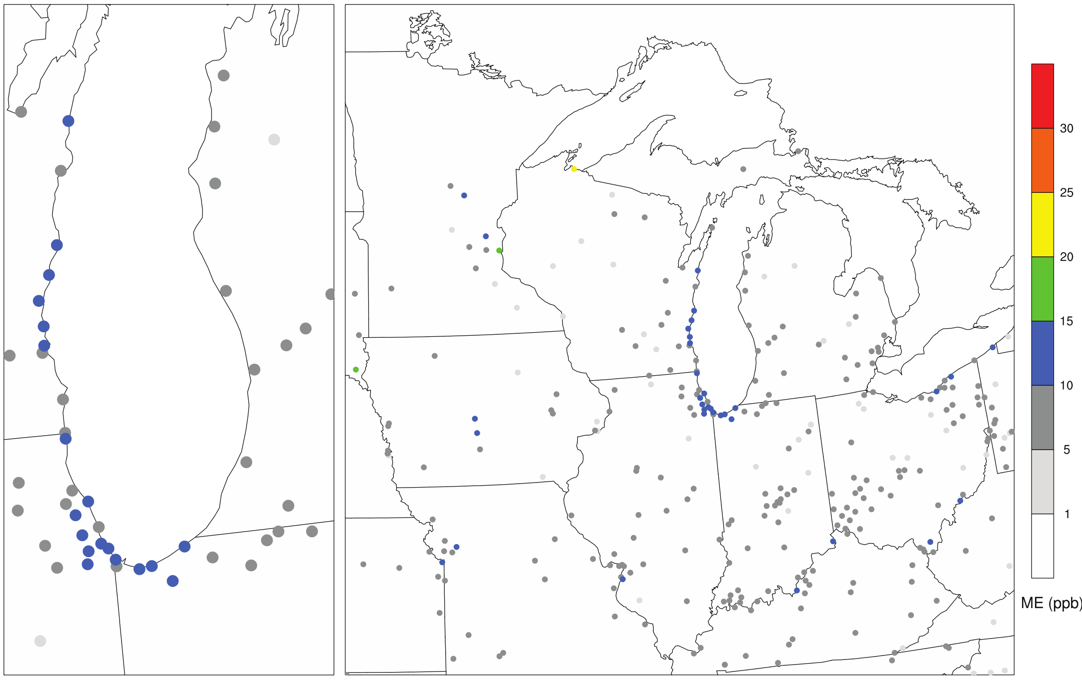


**Figure A.1. 2011 mean error of MDA8 ozone (ppb) with a 60 ppb ozone threshold.**

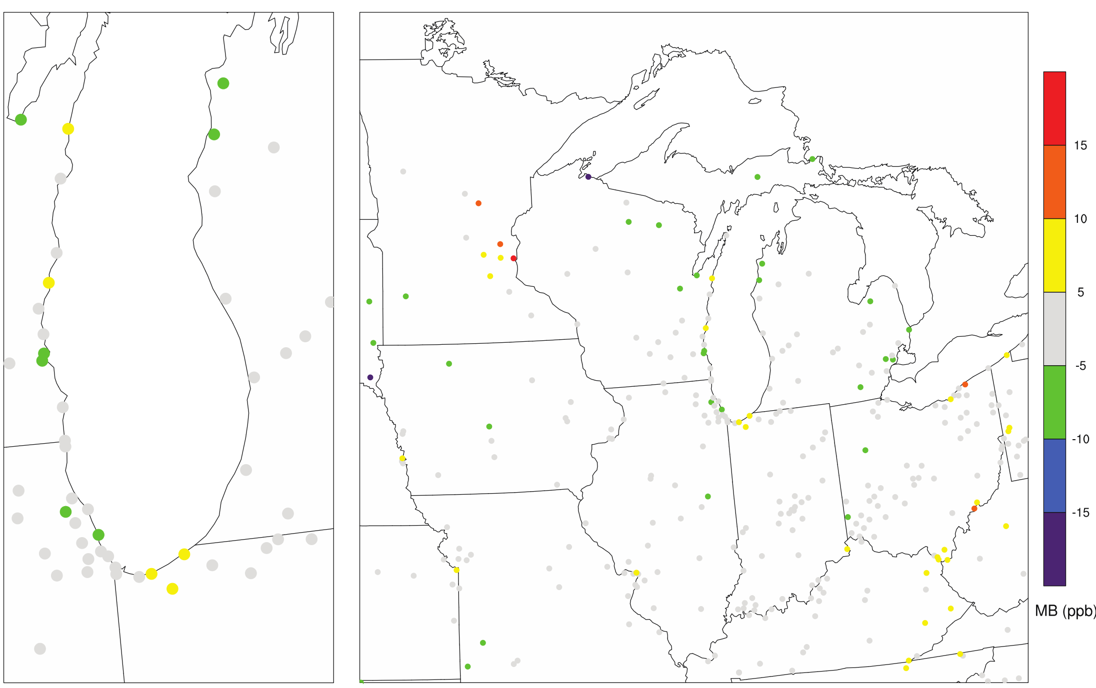


**Figure A.2. 2011 mean bias of MDA8 ozone (ppb) with a 60 ppb ozone threshold.**

Maps of MDA8 $O_3$ performance at individual monitors showing mean observed, mean modeled, mean bias, fractional bias, mean error, fractional error, and correlation coefficient with an observed 75 ppb MDA8 $O_3$ threshold are shown in figures A.3 through A.9, respectively.

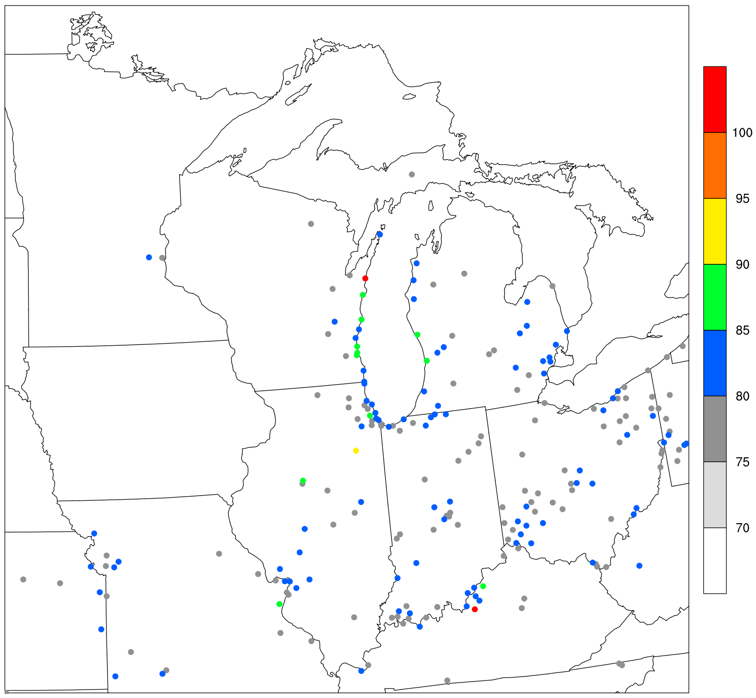


**Figure A.3. 2011 mean monitored MDA8 ozone (ppb) with a 75 ppb ozone threshold**.

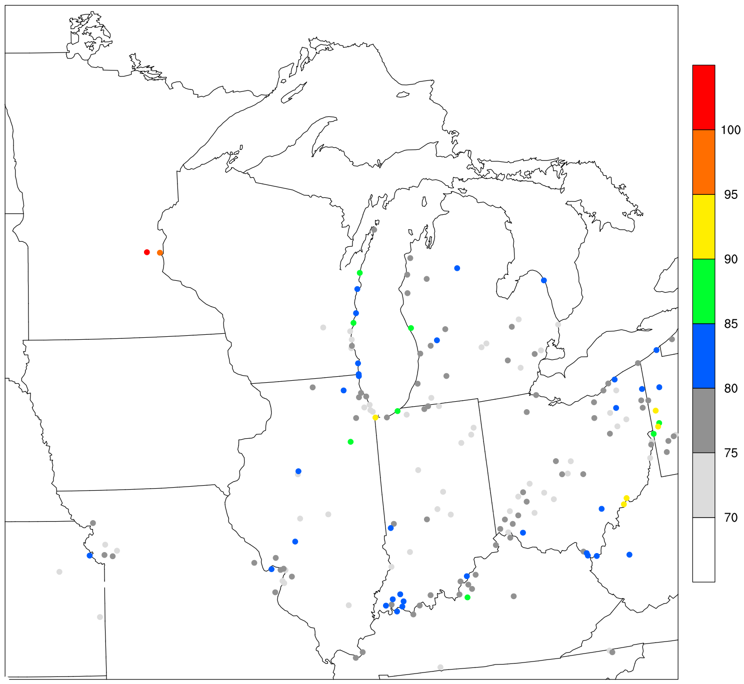


**Figure A.4. 2011 mean CAMx predicted MDA8 ozone (ppb) with a 75 ppb ozone threshold.**

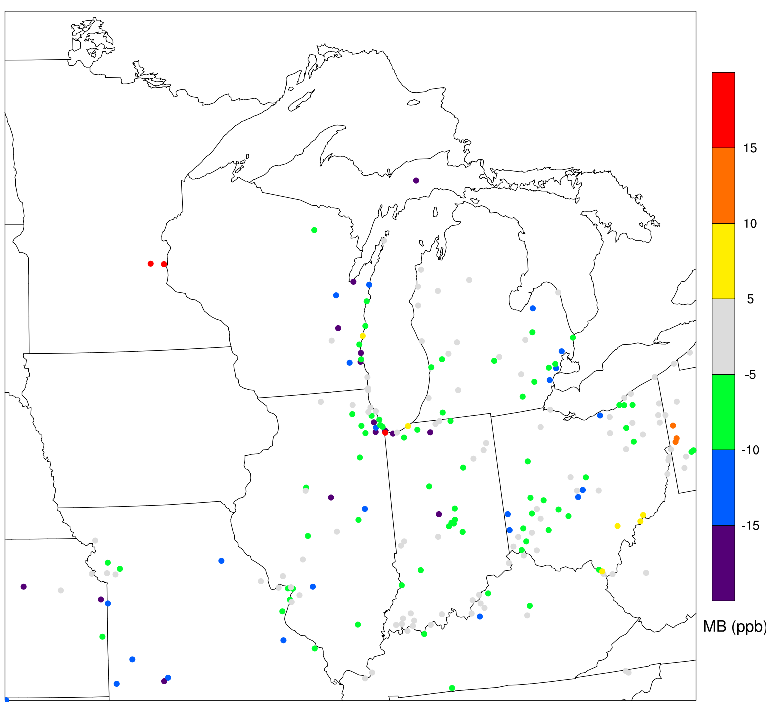


**Figure A.5. 2011 mean bias of MDA8 ozone (ppb) with a 75 ppb ozone threshold.**

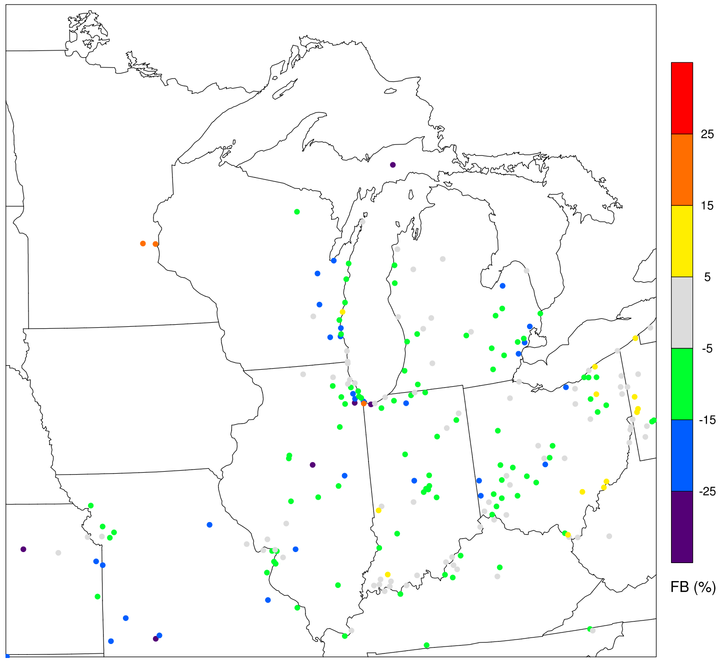


**Figure A.6. 2011 mean fractional bias of MDA8 ozone (ppb) with a 75 ppb ozone threshold.**

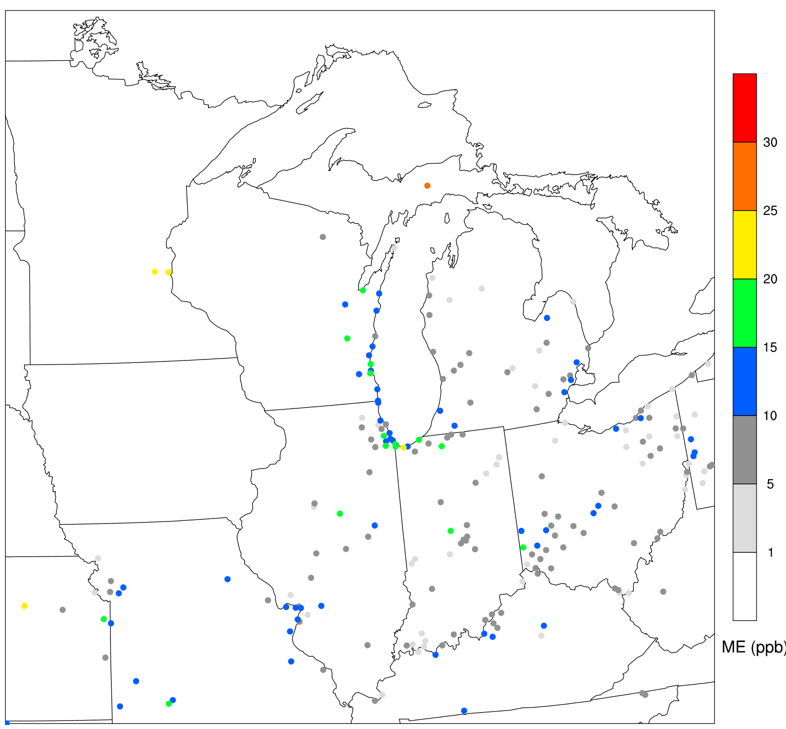


**Figure A.7. 2011 mean error of MDA8 ozone (ppb) with a 75 ppb ozone threshold.**

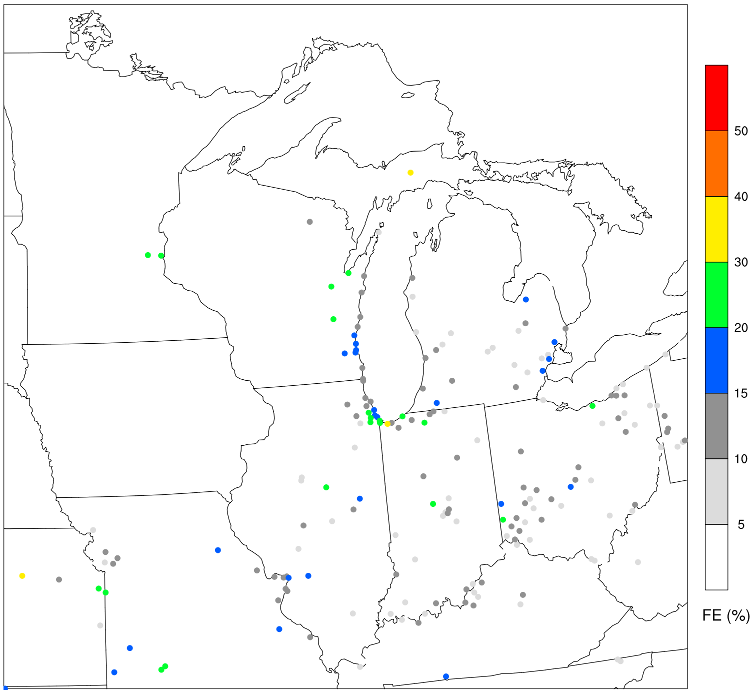


**Figure A.8. 2011 mean fractional error of MDA8 ozone (ppb) with a 75 ppb ozone threshold.**

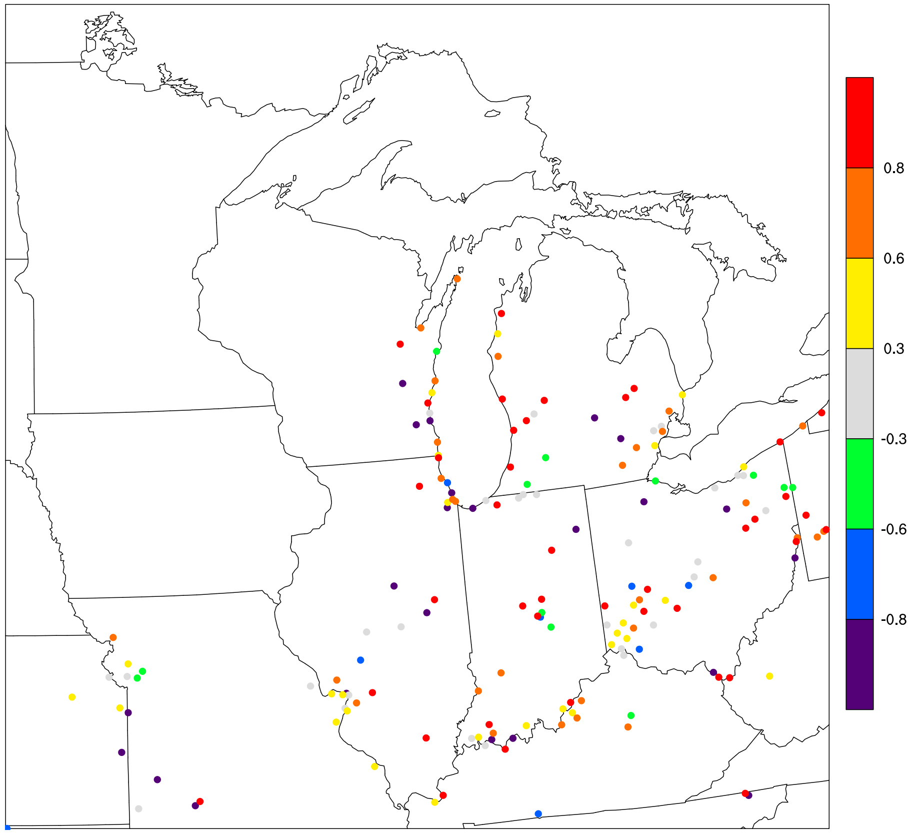


**Figure A.9. 2011 Pearson correlation coefficient of MDA8 ozone with a 75 ppb ozone threshold.**

Soccer plots of mean normalized bias and mean normalized error are shown in figures A.10 and A11.

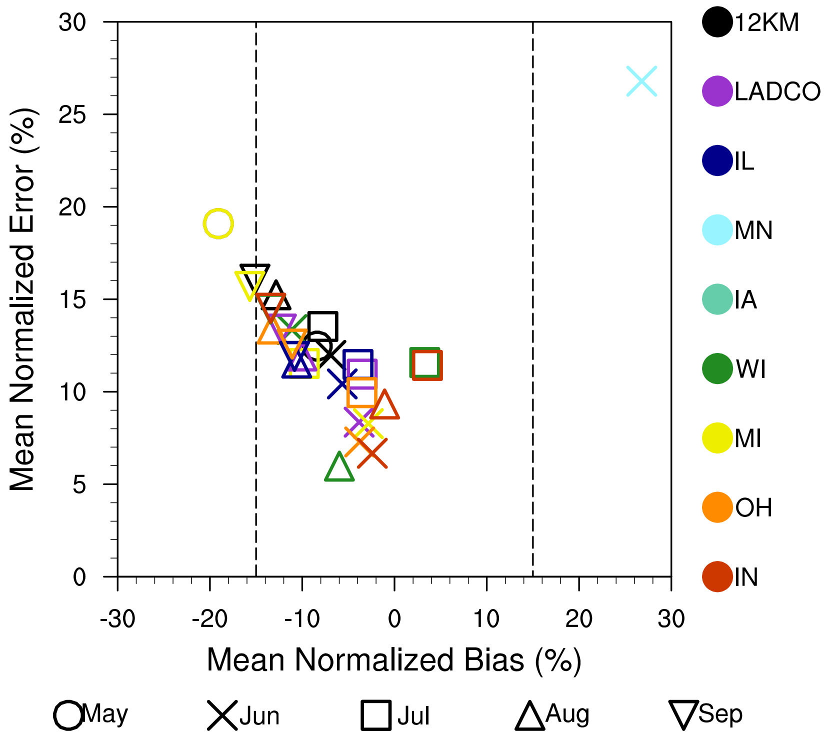


**Figure A.10. MDA8 ozone Model Performance by month for the LADCO states, LADCO aggregated (purple), and national average (black) with a 75 ppb ozone threshold.**

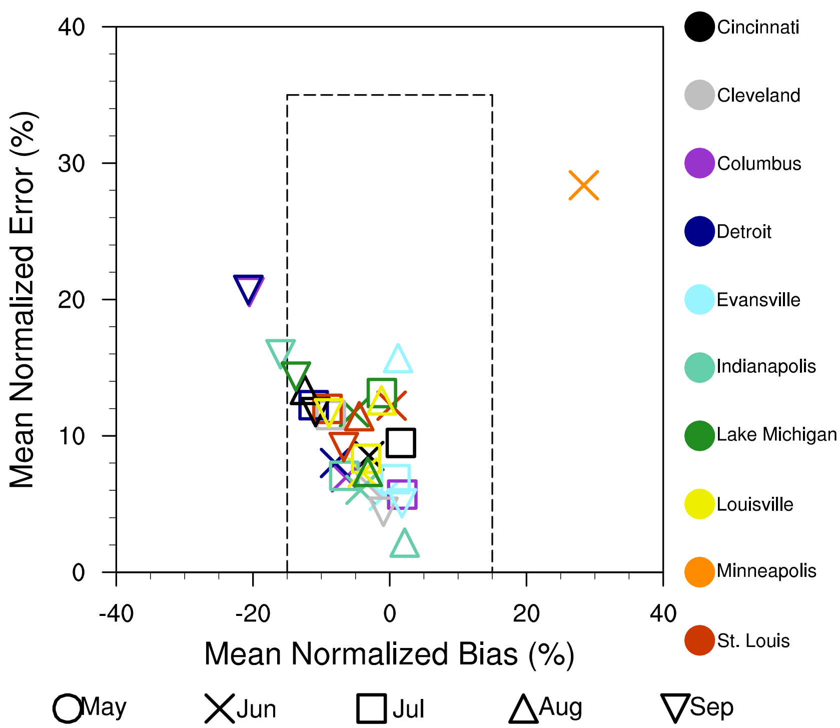

**Figure A.11. MDA8 ozone model performance for select LADCO cities with a 75 ppb ozone threshold. Lake Michigan area refers to monitor near the Lake Michigan shoreline.**

In general, the model shows a stronger negative bias with 75 ppb threshold compared with a 60 ppb threshold. The performance statistics with a 75 ppb threshold are within the range reported by Simon & Baker (2012).

Figures A.12 and A.13 show hourly ozone from monitors and modeled by CAMx at Sheboygan and Chiwaukee, respectively.

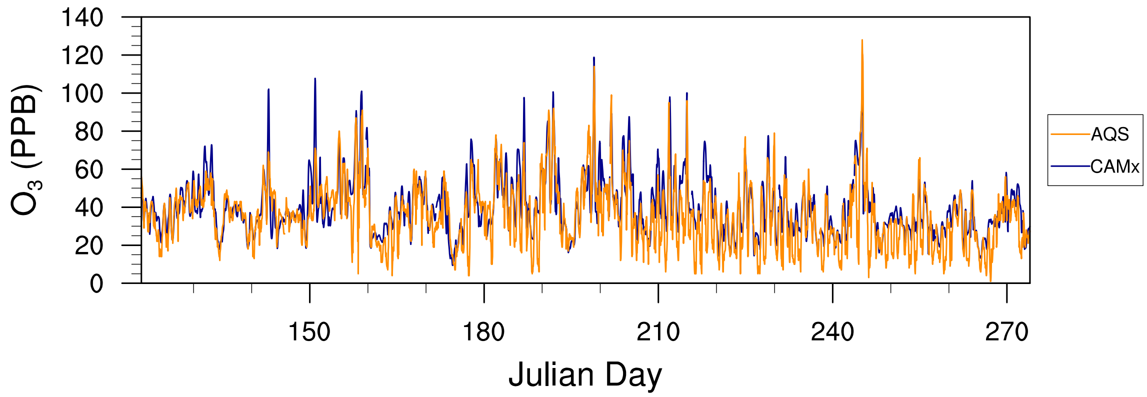


**Figure A.12. 1-hour ozone showing monitoring (orange) and modeling (blue) in Sheboygan WI (AQS site ID 551170006).**

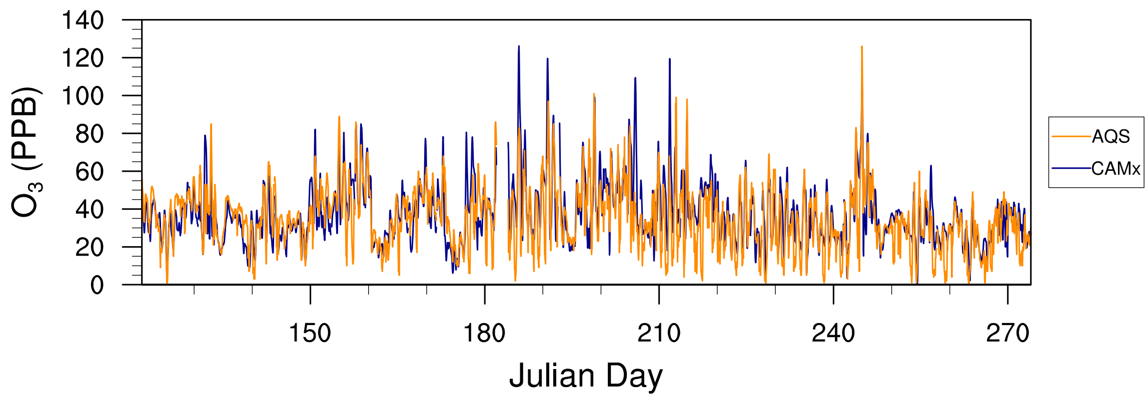


**Figure A.13. 1-hour ozone showing monitoring (orange) and modeling (blue) in Chiwaukee Prairie WI (AQS site ID 550590019).**

Additional time series of modeled and monitored MDA8 $O_3$ for monitors in and near the LADCO region are shown in figures A.14 through A.23.

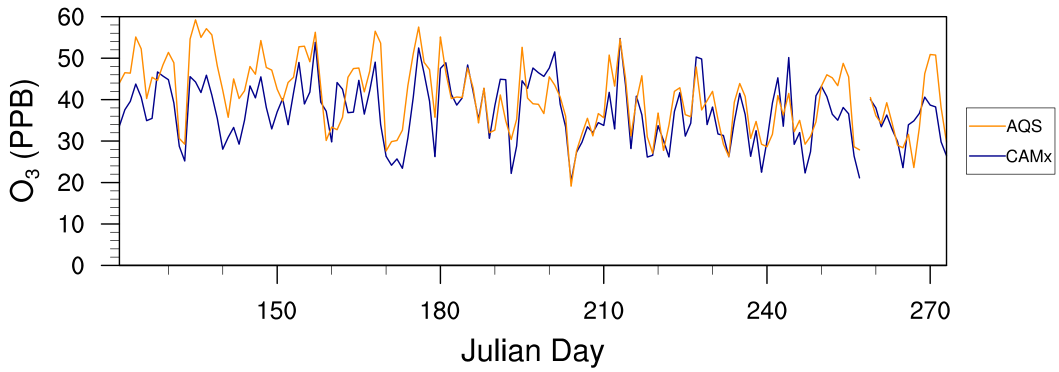


**Figure A.14. MDA8 ozone showing monitoring (orange) and modeling (blue) in Voyageurs MN (AQS site ID 271370034).**

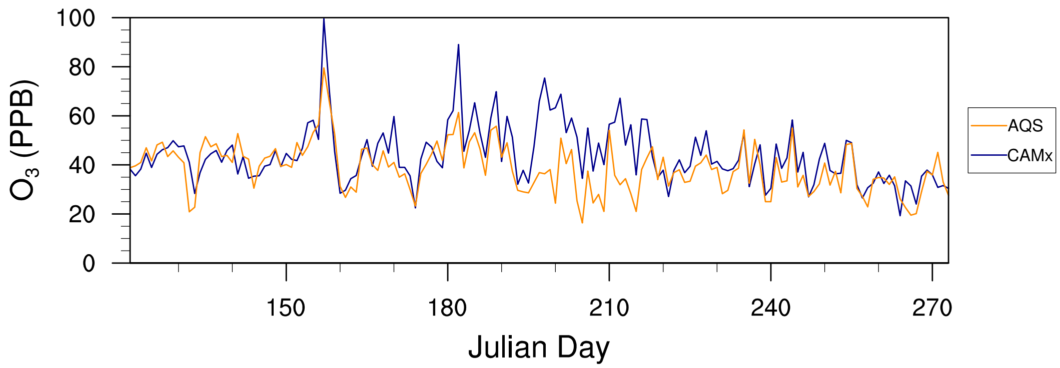


**Figure A.15. MDA8 ozone showing monitoring (orange) and modeling (blue) in Stillwater MN (AQS site ID 271636015).**

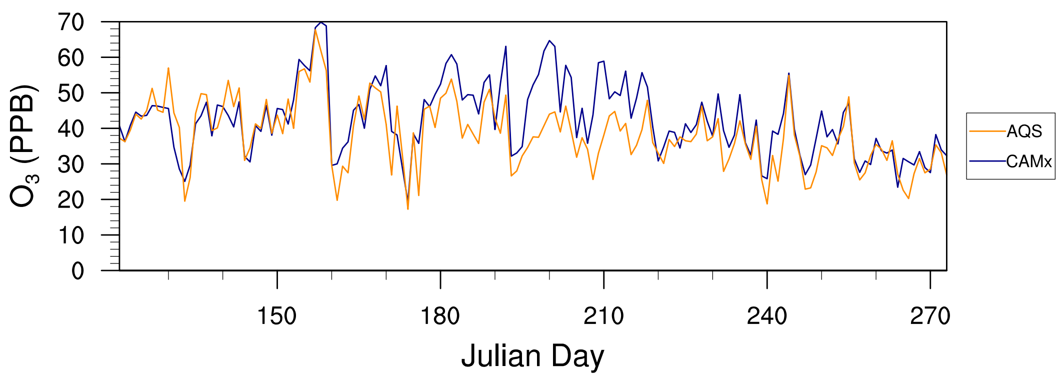


**Figure A.16. MDA8 ozone showing monitoring (orange) and modeling (blue) in Rochester MN (AQS site ID 271095008).**

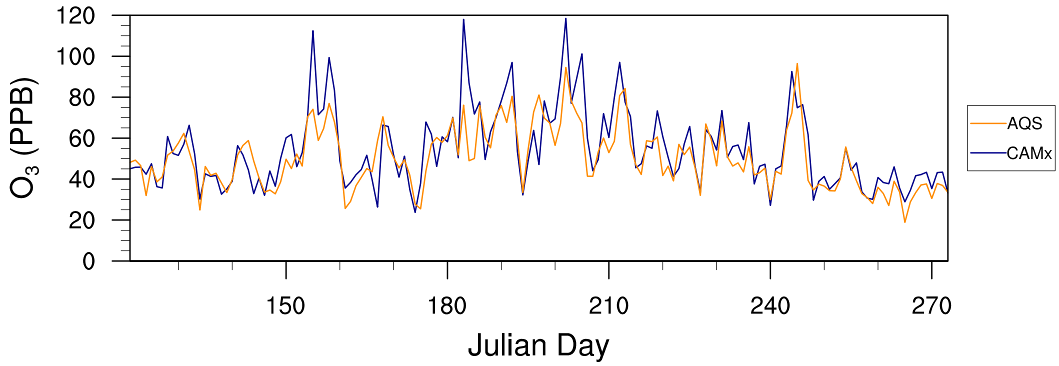


**Figure A.17. MDA8 ozone showing monitoring (orange) and modeling (blue) in Michigan City IN (AQS site ID 180910005).**

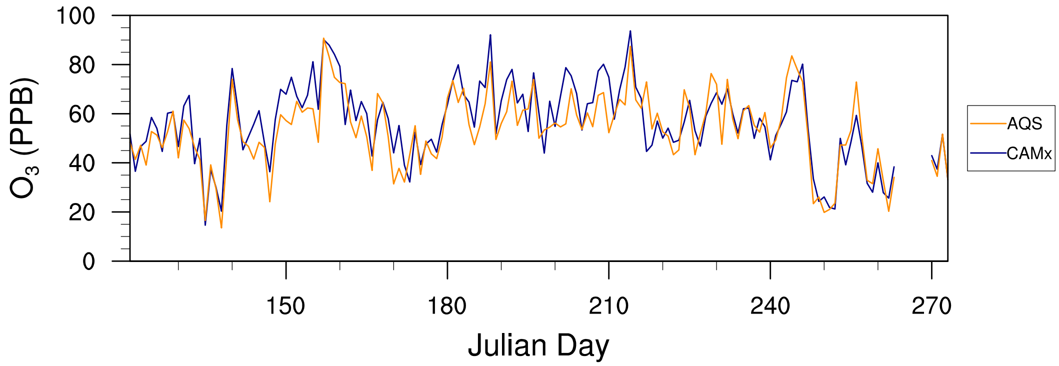


**Figure A.18. MDA8 ozone showing monitoring (orange) and modeling (blue) in Charlestown IN (AQS site ID 180190008).**

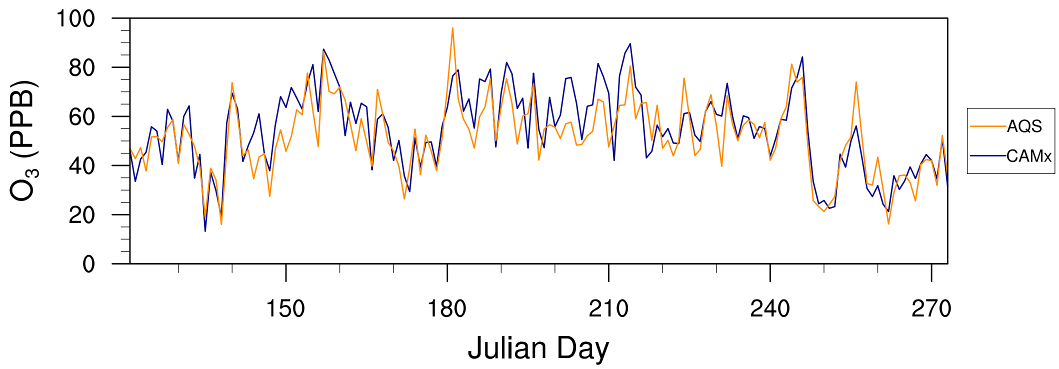


**Figure A.19. MDA8 ozone showing monitoring (orange) and modeling (blue) in New Albany IN (AQS site ID 180431004).**

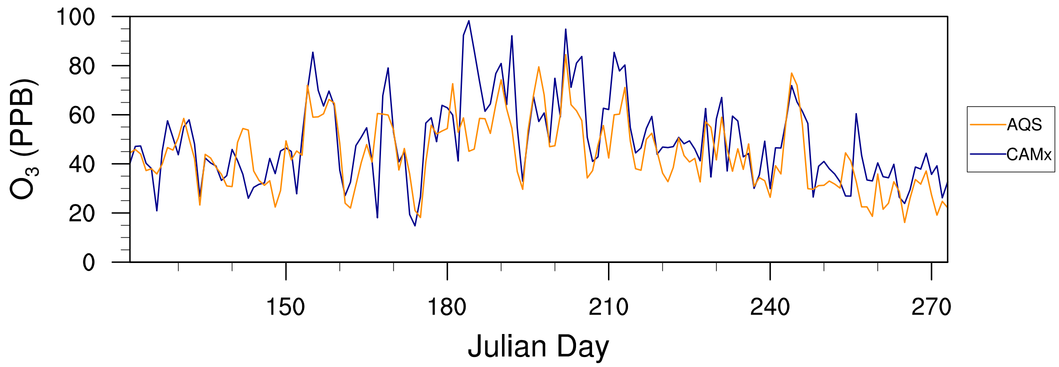


**Figure A.19. MDA8 ozone showing monitoring (orange) and modeling (blue) in Chicago IL (AQS site ID 170310063).**

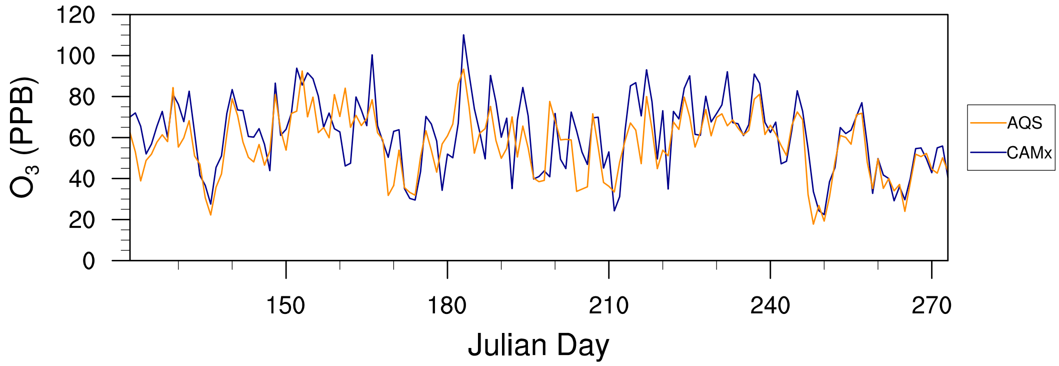


**Figure A.19. MDA8 ozone showing monitoring (orange) and modeling (blue) in Atlanta GA (AQS site ID 131210053).**

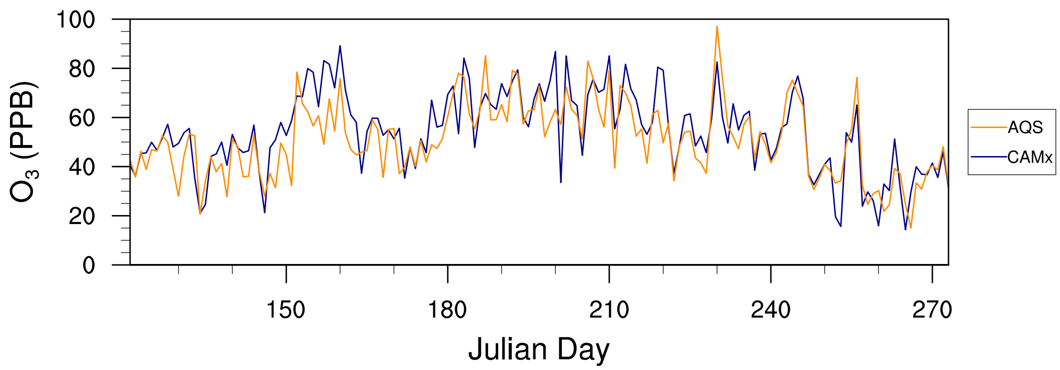


**Figure A.20. MDA8 ozone showing monitoring (orange) and modeling (blue) in St. Louis MO (AQS site ID 295100085).**

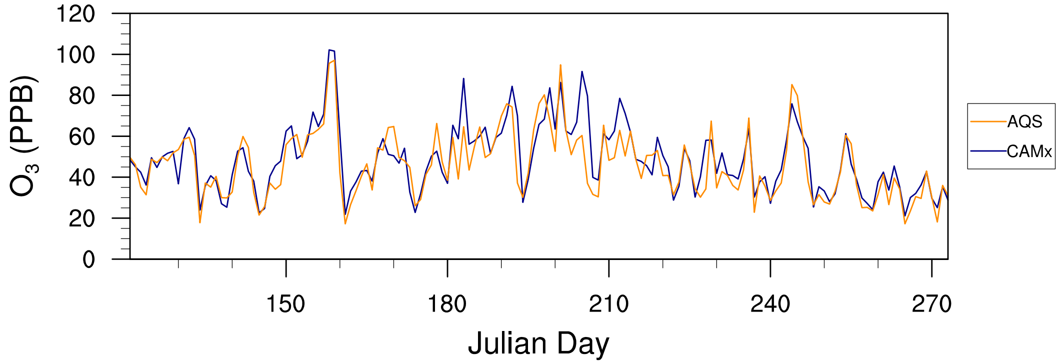


**Figure A.21. MDA8 ozone showing monitoring (orange) and modeling (blue) in Holland MI (AQS site ID 260050003).**

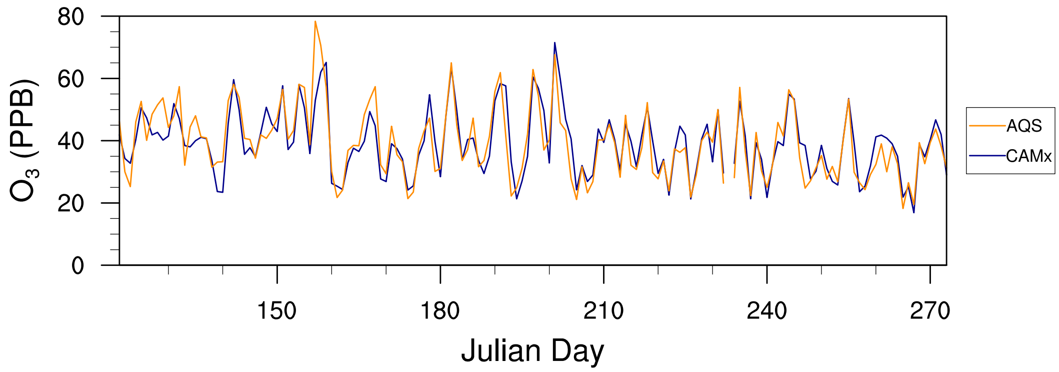


**Figure A.22. MDA8 ozone showing monitoring (orange) and modeling (blue) in Seney MI (AQS site ID 261530001).**

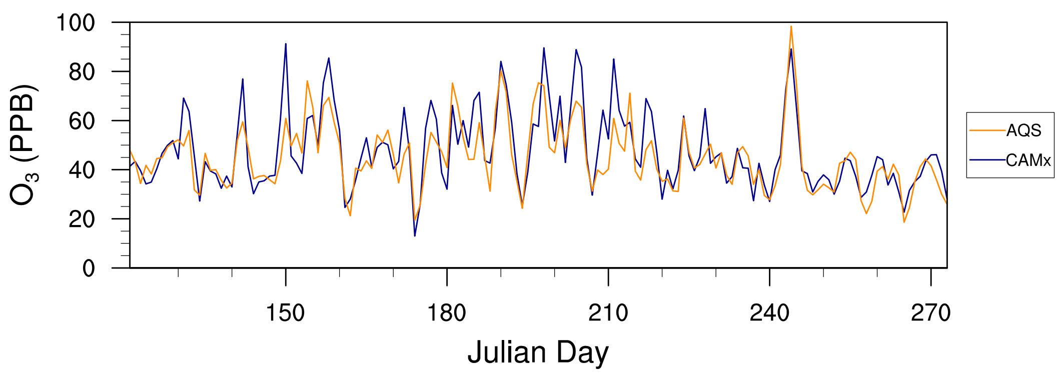


**Figure A.23. MDA8 ozone showing monitoring (orange) and modeling (blue) in Ozaukee WI (AQS site ID 550890008).**

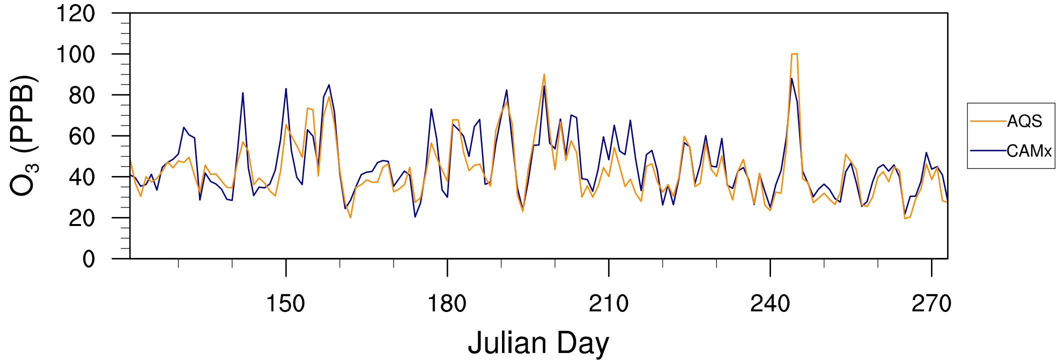


**Figure A.23. MDA8 ozone showing monitoring (orange) and modeling (blue) in Manitowoc WI (AQS site ID 550710007).**

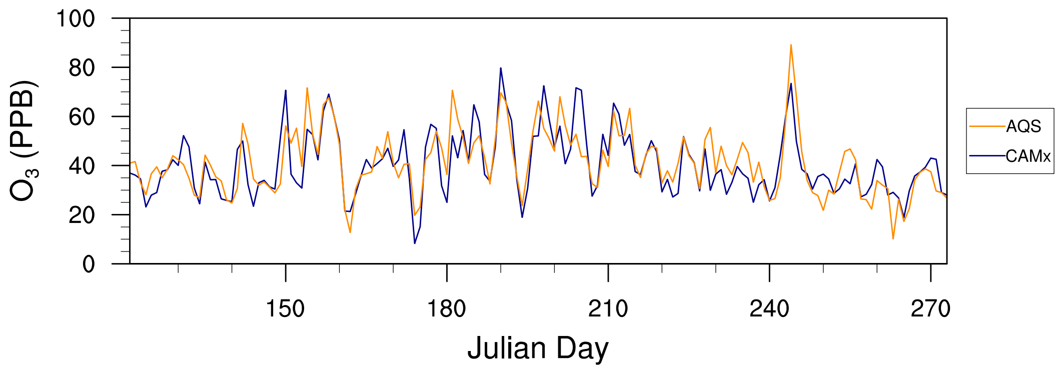


**Figure A.23. MDA8 ozone showing monitoring (orange) and modeling (blue) in Milwaukee WI (AQS site ID 550790010).**

Maps of 1-hour $NO_2$ performance at individual monitors showing mean bias, fractional bias, mean error, fractional error, and correlation coefficient are shown in figures A.3 through A.9, respectively.

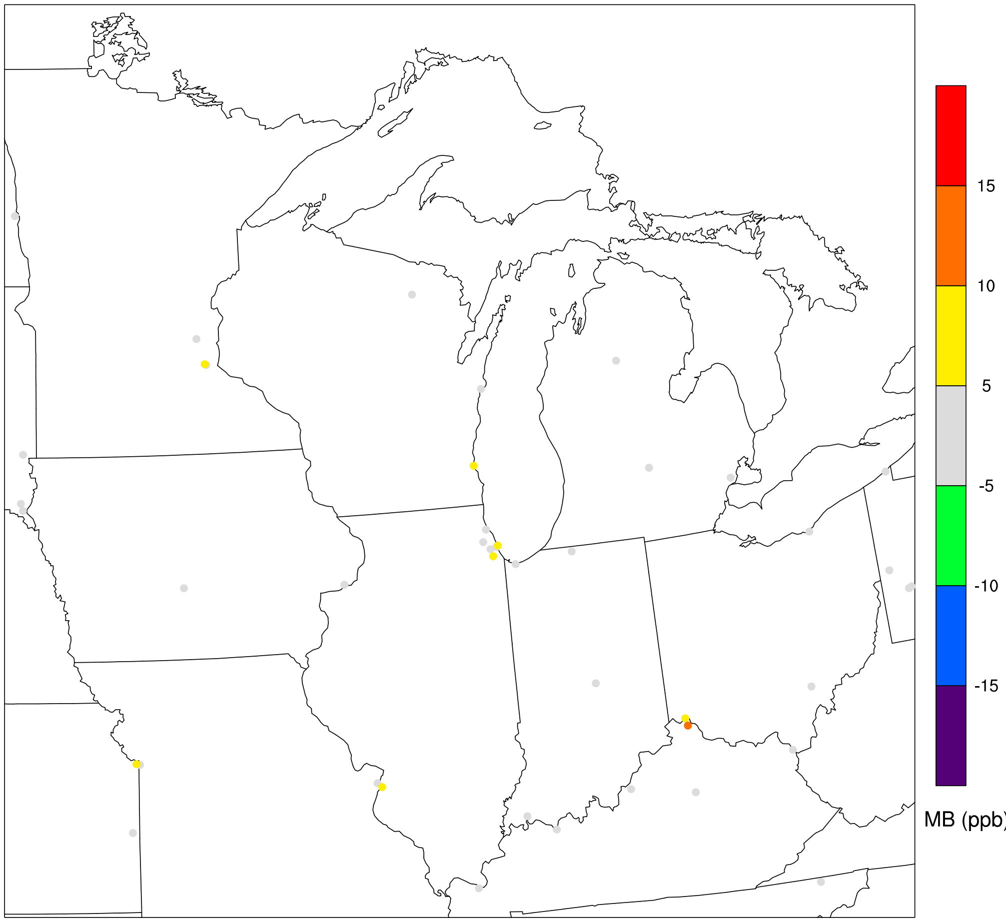


**Figure A.24. 2011 mean bias of 1-hour $NO_2$ (ppb).**

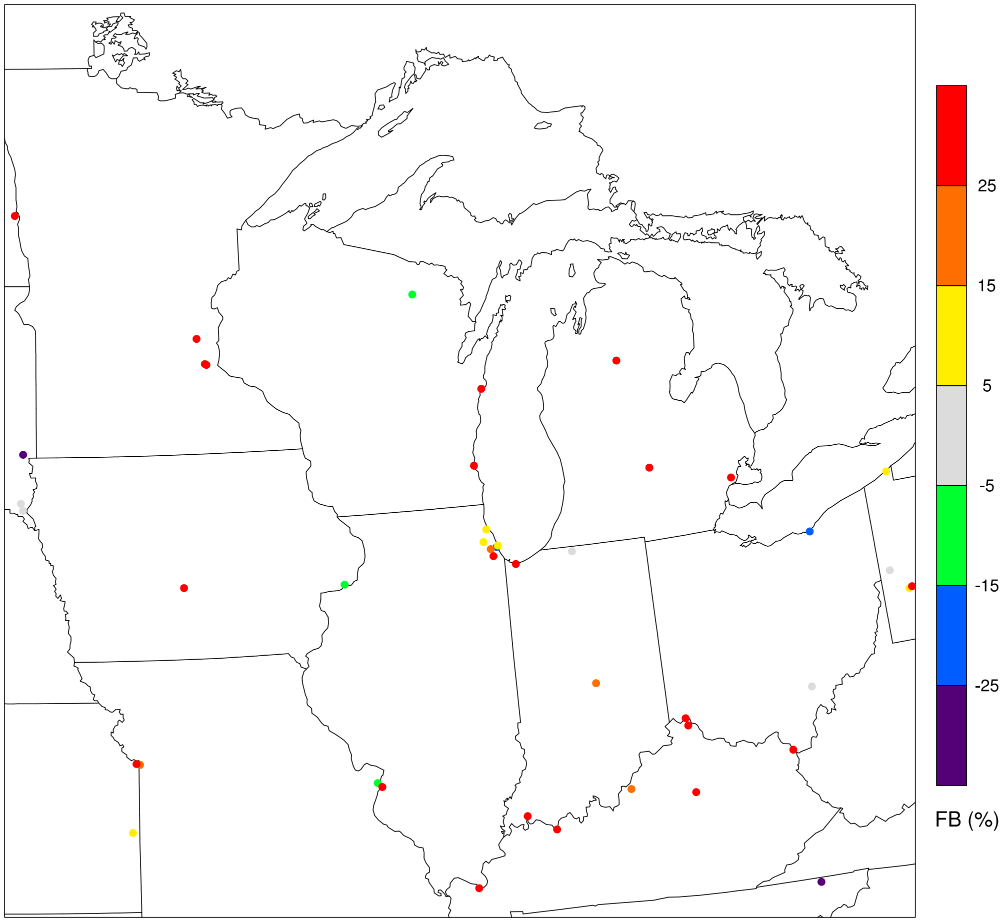


**Figure A.25. 2011 fractional bias of 1-hour $NO_2$ (%).**

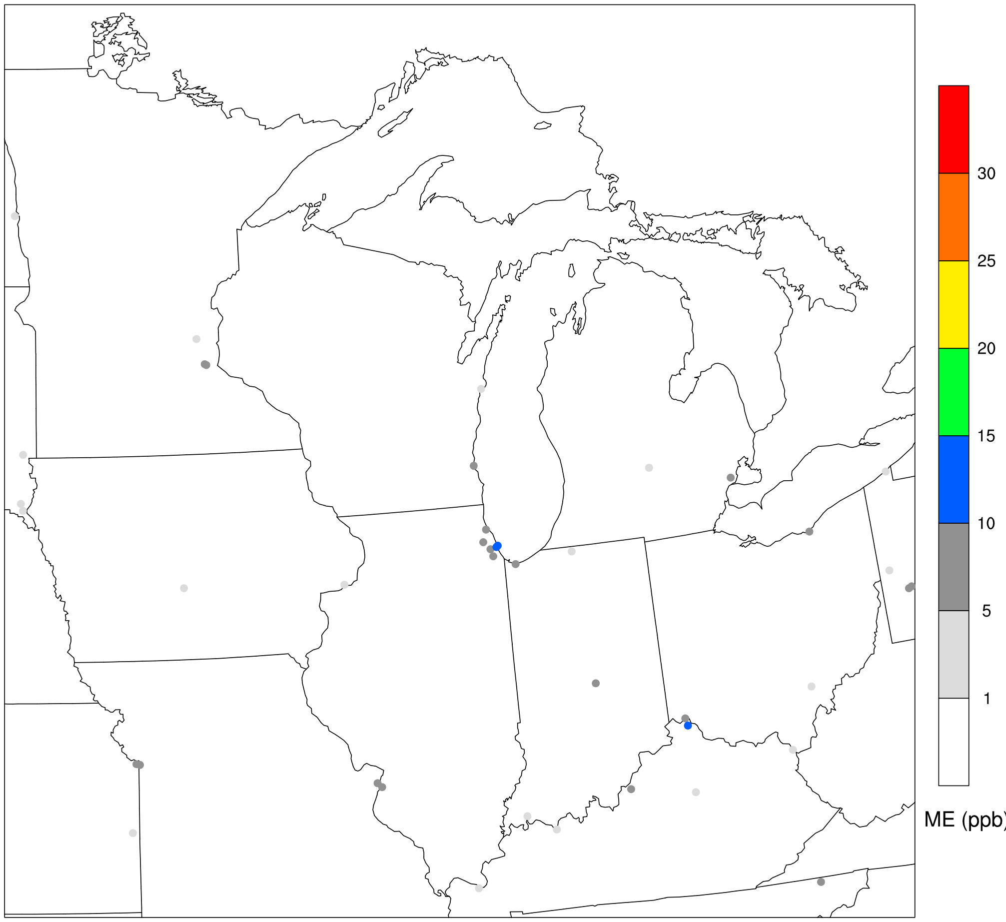


**Figure A.26. 2011 mean error of 1-hour $NO_2$ (ppb).**

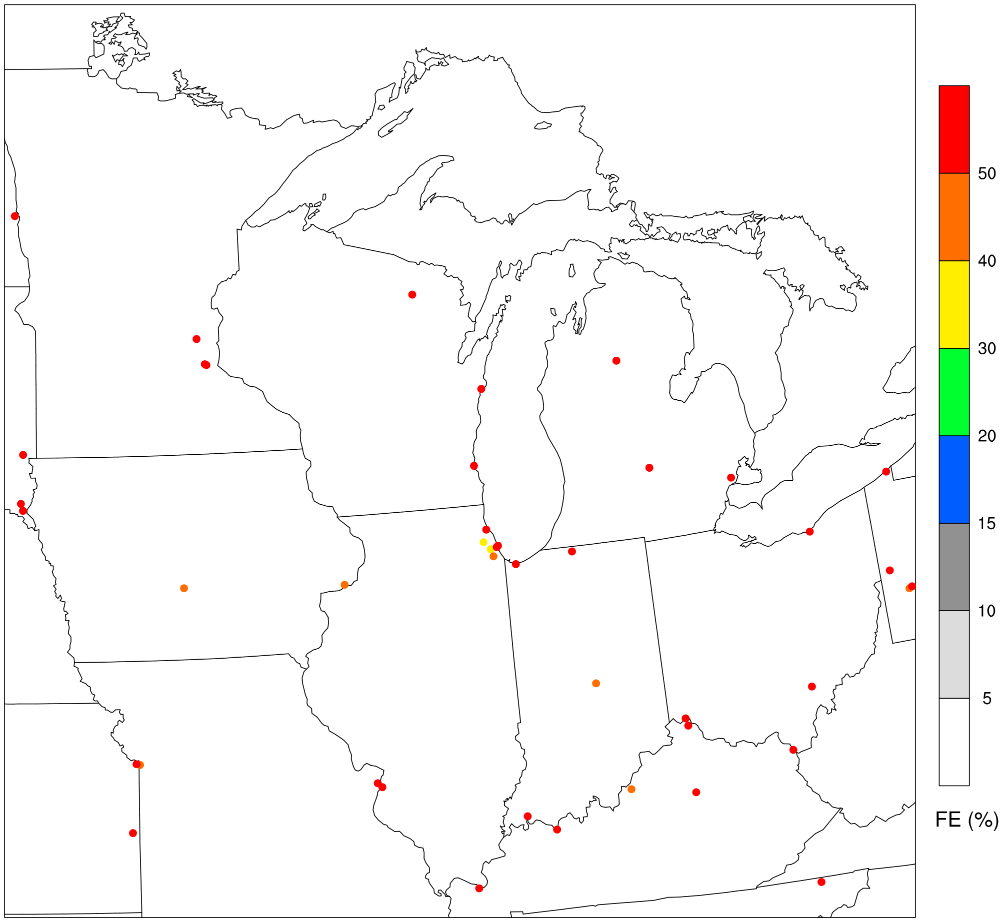


**Figure A.27. 2011 fractional error of 1-hour $NO_2$ (%).**

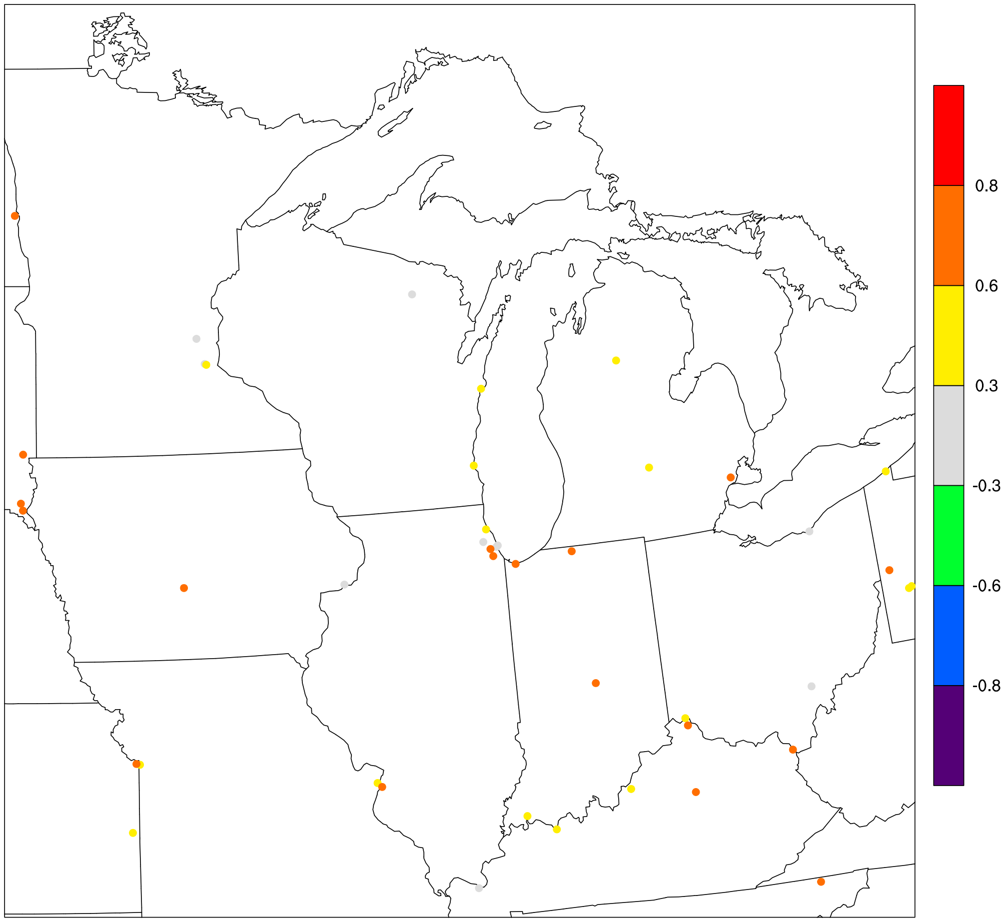


**Figure A.28. 2011 Pearson correlation coefficient of 1-hour $NO_2$.**

# APPENDIX 10 –

# Supplemental Information for Ozone, NOx and VOC Trends Analysis

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# 1. SUPPLEMENTAL INFORMATION ON OZONE TRENDS

## 1.1. Explanation of CART Analysis

Classification and regression tree (CART) analysis is a statistical tool to classify data. Here, it is applied to 8-hour ozone and meteorological data to determine the meteorological conditions most commonly associated with high-ozone days. Once days are classified by their meteorology, ozone concentration trends among days with the same conditions can be developed. By examining trends only on days with similar meteorology, the influence of year-to-year meteorological variability on ozone concentrations is minimized and we assume that any remaining trend is the result of reductions in emissions of ozone precursors and other non-meteorological factors.

A CART analysis was conducted by LADCO using 8-hour ozone monitoring data for two monitors in the northern part of the nonattainment area: Chiwaukee Prairie (ID number 55-059-0019) and Zion (17-097-1007). These monitors are located within a few miles of each other in the northern part of the Chicago nonattainment area. A second analysis was conducted for a group of monitoring sites in Cook County, Illinois, including Alsip (17-031-0001), Chicago-SWFP (17-031-0032), Chicago-Taft H.S. (17-031-1003), Lemont (17-031-1601), Cicero (17-031-4002), Northbrook (17-031-4201), and Evanston (17-031-7002). The analysis included data from the years 2000-2015, which encompasses many years prior to the promulgation of the 2008 ozone NAAQS. This analysis therefore addresses long-term trends rather than the direct impacts of the 2008 ozone NAAQS. The goal of the analysis was to determine the meteorological conditions associated with high ozone episodes in the Chicago airshed and to construct linear trends for the high-ozone days identified as sharing similar meteorological characteristics.

The CART analyses for the Chicago area processed multiple meteorological variables for each day to determine which are the most effective at predicting ozone. Meteorological data for the Chiwaukee/Zion monitors were taken from Mitchell Field (Milwaukee) NWS station and processed by LADCO. Upper air observations were taken from the Green Bay, Wisconsin NWS site. Meteorological data for the Cook County monitor analysis was taken from the Chicago O’Hare Airport National Weather Service (NWS) station and processed by LADCO. Upper air observations, taken from the Lincoln, Illinois NWS site, were downloaded from the National Climatic Data’s Center (NCDC) Integrated Global Radiosonde Archive. Meteorological variables for both analyses included maximum and average daily temperature, dew point, relative humidity and air pressure at the surface and different levels of the atmosphere, wind direction and wind speed, change in temperatures and air pressure from the previous day, average wind speed and temperature over a 2 or 3-day period, day of the week, cloud cover, daily precipitation and many other parameters.[1]

Regression trees, in which each branch describes the meteorological conditions associated with different ozone concentrations, were developed to classify each summer day (May – September). Although the exact selection of predictive variables changes from site to site, temperature, wind direction, and relative humidity are common predictors. These are included in the dataset as

[1] The original meteorological database used to support this effort, called MetDat, was developed by EPA Office of Air Quality Planning and Standards (OAQPS) and subsequently revised by both Sonoma Technology and LADCO.

daily averages and maximums as well as averages at specific times throughout the day (morning 7-10 am, afternoon 1-4 pm, etc.). Similar days were assigned to nodes, which are equivalent to branches of the regression tree. By grouping days with similar meteorology, the influence of meteorological variability on the underlying trend in ozone concentrations is partially removed; the remaining trend is presumed to be due to trends in precursor emissions combined with other non-meteorological influences. Ozone trends in these nodes were then plotted.

For the Chiwaukee Prairie and Zion monitors, the CART analysis determined that four sets of meteorological conditions had average ozone concentrations above 50 ppb. Analysis of the Cook County monitors identified three high-ozone nodes (with average concentrations above 50 ppb). Tables 1 and 2 show the shared meteorological conditions for each high-ozone node along with the frequency and average ozone concentration for each node. All of the high-ozone nodes had high maximum temperatures, and many were distinguished by southerly or southeasterly winds and/or low relative humidity. The highest average ozone concentrations (72.4 ppb) were observed for node 11 for the northern monitors. This node was characterized by maximum temperatures and average morning temperatures above 76.5 °F and 77.56 °F, respectively, average afternoon winds of greater than 2.41 m/s from the south and no precipitation.

Figure 5.4 in the main attainment demonstration document shows the trends in average ozone concentration at the Chiwaukee Prairie and Zion monitors for the four primary nodes from the year 2000 through 2015. Figure 1 in this appendix shows the same trends for the Cook County monitors. These analyses demonstrate that ozone concentrations for a given set of high-ozone meteorological conditions have decreased over time. In particular, this analysis shows that ozone concentrations have decreased on days with high average temperatures and the right combination of (mostly south-southeasterly) winds, low relative humidity and other characteristics. While maximum temperatures play an important role in the formation of ozone, the CART analysis reveals that other meteorological parameters (such as wind direction, wind speed and morning temperature) also play significant roles in creating conditions conducive for ozone formation. This analysis demonstrates that the observed reductions in ozone concentrations have not been driven solely by favorable meteorological conditions. These results further suggest that progress in reducing ozone precursor emissions was likely an important driver of the observed reductions in 8-hour ozone concentrations in the Chicago nonattainment area over this 16 year time period.

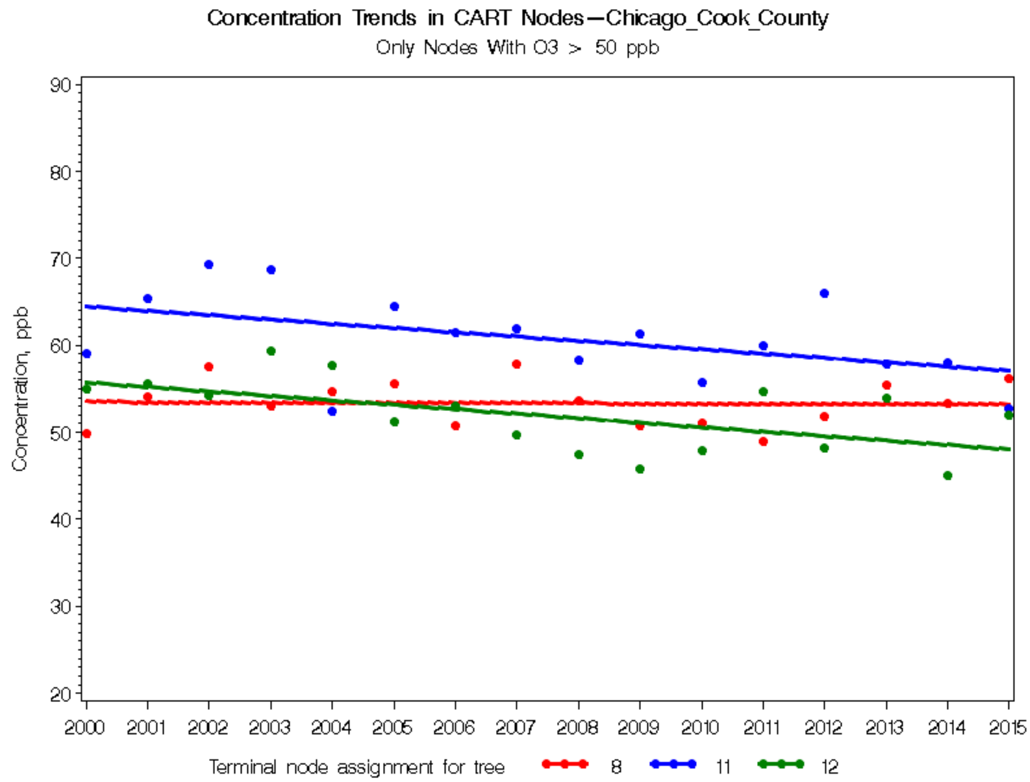
**Table 1. Meteorological conditions, occurrence and average ozone for the four high-ozone nodes identified by CART from Chiwaukee Prairie and Zion monitoring data**

| Conditions | Node | | | |
|---|---|---|---|---|
| | **8** | **10** | **11** | **12** |
| Maximum temperature, deg F | >76.5 | | | |
| Average morning temperature, deg F | ≤ 77.56 | >77.56 | | |
| Southerly component of 24-hr transport vector, km | >-131.21 | | | |
| Average relative humidity, % | ≤75.65 | | | |
| Southerly component of average afternoon winds, m/s | | ≤2.41 | >2.41 | |
| Precipitation | | | none | some |
| Average ozone, ppb | 57.5 | 56.8 | 72.4 | 61.1 |
| Number of days | 681 | 334 | 358 | 154 |

**Table 2. Meteorological conditions, occurrence and average ozone for the four high-ozone nodes identified by CART from Cook County monitoring data**

| Conditions | Node | | |
|---|---|---|---|
| | **8** | **11** | **12** |
| Maximum temperature, deg F | >76 | | |
| Average afternoon temperature, deg F | ≤84.8 | >84.8 | |
| Average midday relative humidity, % | ≤67.9 | ≤54.5 | >54.5 |
| Southerly component of 24-hr transport vector, km | >-190.8 | | |
| Average midday relative humidity, % | ≤50.7 | | |
| Average ozone, ppb | 53.4 | 62.4 | 51.9 |
| Number of days | 2547 | 2130 | 728 |

**Figure 1. Concentration trends from the CART analysis for Cook County, IL, monitors.**




## 1.2. Additional Ozone-Temperature Correlation Plots

Section 5.2.3 of the main attainment plan document presents and discusses trends in monthly averages of two ozone concentration parameters with four temperature parameters. However, that document only incorporates the four plots with the best correlation coefficients comparing ozone at the Chiwaukee Prairie monitor with temperature at the inland Lake Geneva monitor. Figure 2 shows all of the correlations for these locations. This includes plots of three ozone concentration parameters (average maximum daily 8-hour average ozone (MDA8), maximum MDA8, and days with MDA8 above 75 ppb)[2] versus four temperature parameters[3] (number of ozone season days with temperatures above 80 degrees, cooling degree days relative to 70 degrees, mean afternoon temperature, and mean temperature). Figure 3 shows the correlations in the three ozone concentration parameters with two temperature parameters (cooling degree days relative to 65 degrees and days above 90 degrees) measured at the Milwaukee Airport. These figures show that the trends discussed in the main document are representative of all of the ozone-temperature correlations. Namely, ozone concentrations observed for a given temperature level have consistently decreased over each three-year period. The one regular exception to this trend is the recession years (2008-2010), which often had levels of ozone that were similar to or

[2] One of these ozone parameters is a measure of ozone concentrations over the whole month (average MDA8) and includes data from each day in that month. The other two parameters are measures of maximum ozone days only. These parameters only consider extreme days (the highest-ozone day in a month or days with MDA8 ozone above 70 ppb).

[3] Three of these temperature parameters measure temperature over the whole month (cooling degree days, mean afternoon temperatures and mean temperature) and include data from each day in that month. The other parameter (number of days above 80 degrees) is a measure of just the hottest days in that month.

even lower than the most recent set of years (2014-2016), presumably due to lower emissions resulting from reduced economic activity because of the recession. In all of these plots, 2014-2016 had the lowest or near-lowest amounts of ozone for a given temperature level. This analysis supports the conclusion that when adjusted for meteorology, ozone concentrations have decreased consistently through the most recent years.

**Figure 2. Trends in monthly averages of three ozone concentration parameters (average MDA8, maximum MDA8, and days with MDA8 above 75 ppb) plotted versus four temperature parameters. Temperature data are for the inland Lake Geneva Monitor and ozone data for the Chiwaukee Prairie monitor.**

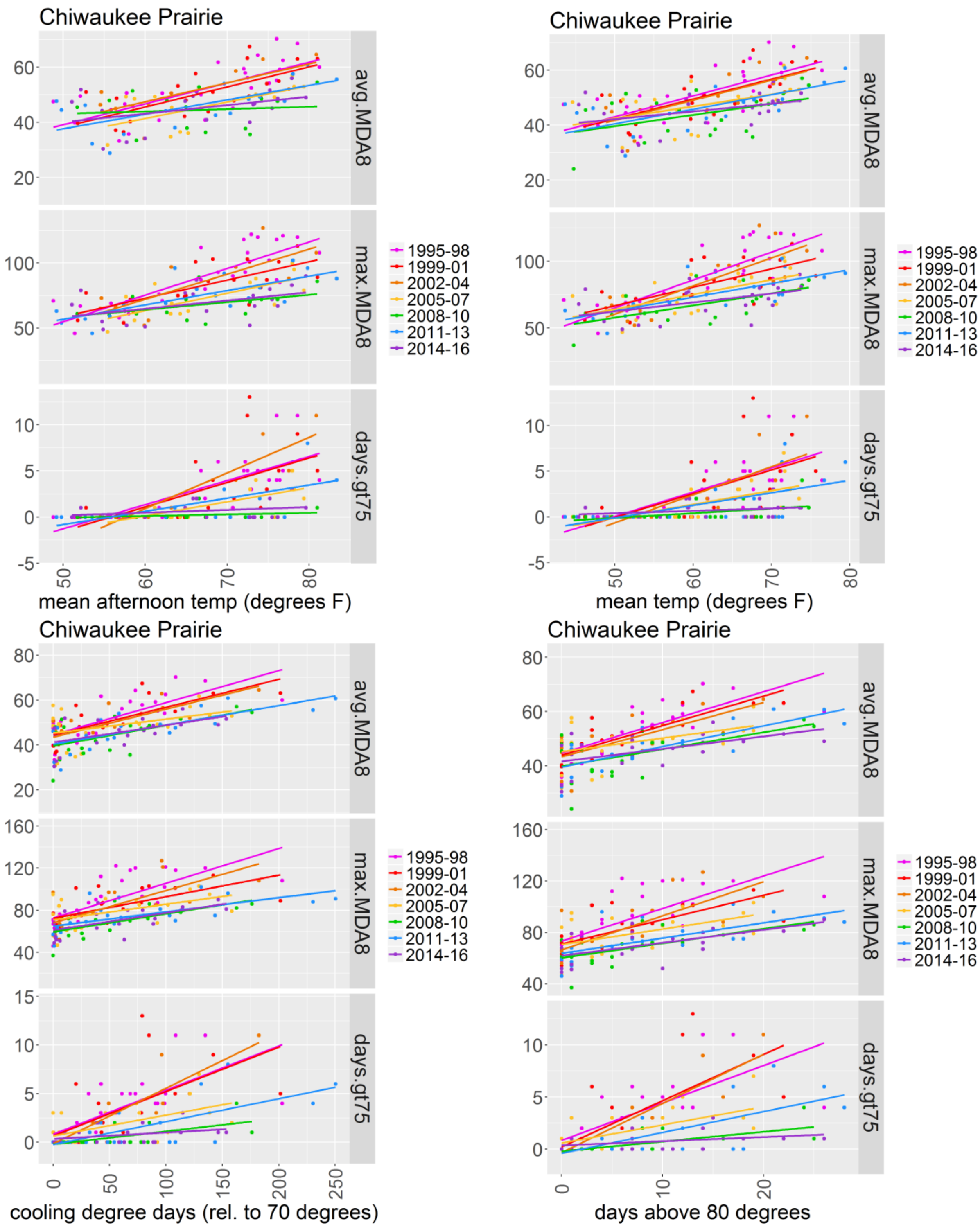
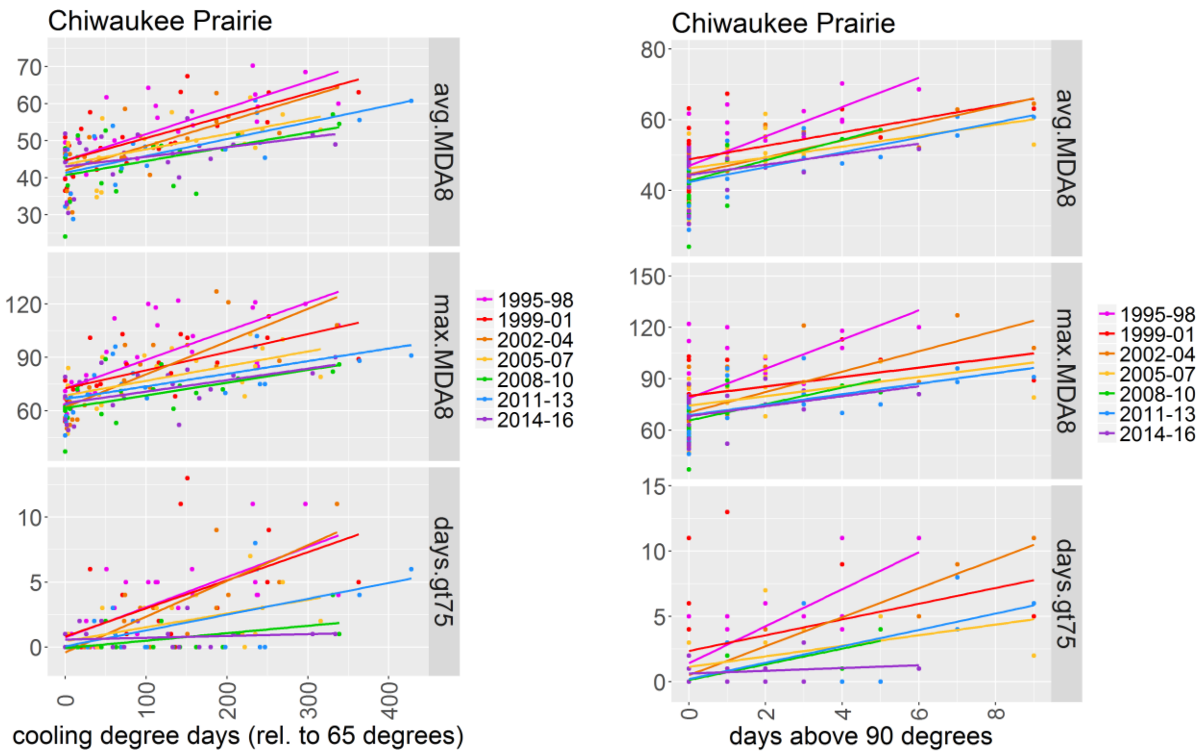


**Figure 3. Trends in monthly averages of three ozone concentration parameters (average MDA8, maximum MDA8, and days with MDA8 above 75 ppb) plotted versus two temperature parameters. Temperature data are for the Milwaukee Airport and ozone data for the Chiwaukee Prairie monitor.**




## 2. TRENDS IN NOx CONCENTRATIONS IN WISCONSIN

NOx consists of both nitric oxide (NO) and nitrogen dioxide ($NO_2$). WDNR measured concentrations of NO, $NO_2$ and NOx at two sites along Wisconsin's Lake Michigan lakeshore. Monitored concentrations for selected years are shown in Table 3.

**Table 3. Concentrations and concentration changes of total NOx at the Milwaukee SER and Manitowoc monitors. Data for 2008 is shown as a midpoint in the record.**

| | | Summer mean | | | Percent Change | | |
|---|---|---|---|---|---|---|---|
| Compound | First year monitored | First year | 2008 | 2015 | First-2008 | 2008-2015 | First-2015 |
| **Milwaukee SER** | | | | | | | |
| NO | 2000 | 6.37 | 2.59 | 1.77 | -59% | -13% | -72% |
| $NO_2$ | 2000 | 14.29 | 10.33 | 7.74 | -28% | -18% | -46% |
| NOx | 2000 | 20.40 | 12.83 | 9.44 | -37% | -17% | -54% |
| **Manitowoc** | | | | | | | |
| NO | 2007 | 0.08 | 0.10 | 0.09 | 24% | -8% | 16% |
| $NO_2$ | 2007 | 1.90 | 2.47 | 1.49 | 30% | -51% | -22% |
| NOx | 2007 | 1.95 | 2.50 | 1.51 | 28% | -51% | -23% |

## 3. TRENDS IN VOC CONCENTRATIONS IN WISCONSIN

Concentrations of up to 56 different VOC compounds (listed in Table 4) were measured at Wisconsin monitors. These compounds include both carbonyl (compounds containing carbon-oxygen double bonds) and hydrocarbon (which contain only carbon and hydrogen) VOCs. The hydrocarbons can be further grouped into four classes based on their chemical properties. These compound classes include branched and cyclic hydrocarbons, aromatic hydrocarbons, n-alkanes, and unsaturated hydrocarbons. In addition, isoprene is a hydrocarbon that comes from biogenic (not anthropogenic) sources. These different compound classes often have different origins.

Concentrations of all of the sub-classes of anthropogenic hydrocarbons also decreased during this time period (Figure 4 and Table 4), with the largest decrease from branched and cyclic hydrocarbons (62%) and the smallest decrease from aromatic hydrocarbons (31%). Concentrations of isoprene were variable but did not show any apparent trend during this time period. Figure 5.10 in the main document shows plots for total hydrocarbons and carbonyls.

**Figure 4. Trends in sums of compound classes of hydrocarbons. Note that trends for most compound classes are only shown for the Milwaukee SER monitor because the other monitors either did not measure any of these compounds or only measured a few.**

**Table 4. Concentrations and concentration changes of VOC compounds at Wisconsin monitoring sites. Data for 2008 are shown as a midpoint in the record.**

| Compound Class & Name | First year monitored | Summer Mean (ppb) | | | Change (%) | | |
|---|---|---|---|---|---|---|---|
| | | First year | 2008 | 2015 | First-2008 | 2008-2015 | First-2015 |
| **Milwaukee SER DNR** | | | | | | | |
| **Carbonyls (mg/m$^3$)** | | | | | | | |
| Acetaldehyde | 2004 | 1.65 | 1.83 | 1.41 | 11% | -23% | -15% |
| Acetone | 2004 | 2.45 | 2.42 | 2.03 | -1% | -16% | -17% |
| Formaldehyde | 2004 | 2.96 | 3.43 | 2.75 | 16% | -20% | -7% |
| **Total Carbonyls** | | **7.06** | **7.67** | **6.19** | **9%** | **-19%** | **-12%** |
| **Isoprene (ppb)** | | | | | | | |
| Isoprene | 2000 | 0.09 | 0.08 | 0.09 | -12% | 10% | -3% |
| **Aromatic Hydrocarbons (ppb)** | | | | | | | |
| Benzene | 2000 | 0.37 | 0.24 | 0.15 | -34% | -40% | -60% |
| Toluene | 2000 | 0.97 | 0.52 | 0.31 | -47% | -40% | -68% |
| *o*-Xylene | 2000 | 0.14 | 0.09 | 0.02 | -36% | -78% | -86% |
| *m*/*p* Xylene | 2000 | 0.35 | 0.24 | 0.11 | -33% | -54% | -69% |
| Ethylbenzene | 2000 | 0.11 | 0.09 | 0.02 | -23% | -82% | -86% |
| Styrene | 2000 | 0.04 | | 0.07 | | | 71% |
| 1,2,3-Trimethylbenzene | 2000 | 0.08 | 0.04 | 0 | -46% | -100% | -100% |
| 1,2,4-Trimethylbenzene | 2000 | 0.15 | 0.09 | 1.07 | -39% | 1058% | 607% |
| 1,3,5-Trimethylbenzene | 2000 | 0.06 | 0.04 | 0 | -31% | -90% | -93% |
| N-Propylbenzene | 2000 | 0.03 | 0.02 | 0 | -34% | -100% | -100% |
| Isopropylbenzene | 2000 | 0.01 | 0.01 | 0 | -50% | -100% | -100% |
| O-Ethyltoluene | 2000 | 0.04 | 0.04 | 0 | -5% | -100% | -100% |
| M-Ethyltoluene | 2000 | 0.09 | | 0.01 | | | -85% |
| P-Ethyltoluene | 2000 | 0.05 | 0.03 | 0 | -36% | -100% | -100% |
| M-Diethylbenzene | 2000 | 0.04 | | 0 | | | -100% |
| P-Diethylbenzene | 2000 | 0.03 | | 0 | | | -88% |
| **Total Aromatic HCs** | | **2.56** | **1.44** | **1.76** | **-44%** | **22%** | **-31%** |
| **Normal Alkanes (*n*-Alkanes; ppb)** | | | | | | | |
| Ethane | 2000 | 3.38 | 2.35 | 2.25 | -30% | -5% | -34% |
| Propane | 2000 | 1.20 | 1.12 | 0.90 | -7% | -19% | -25% |
| *n*-Butane | 2000 | 0.59 | 0.51 | 0.39 | -13% | -25% | -34% |
| *n*-Pentane | 2000 | 0.47 | 0.43 | 0.30 | -8% | -29% | -35% |
| *n*-Hexane | 2000 | 0.36 | 0.25 | 0.10 | -30% | -60% | -72% |
| *n*-Heptane | 2000 | 0.18 | 0.09 | 0.03 | -49% | -62% | -81% |
| *n*-Octane | 2000 | 0.07 | 0.04 | 0 | -41% | -100% | -100% |
| *n*-Nonane | 2000 | 0.05 | 0.04 | 0.02 | -12% | -48% | -54% |
| *n*-Decane | 2000 | 0.06 | 0.06 | 0.01 | -7% | -75% | -77% |
| *n*-Undecane | 2000 | 0.05 | | 0 | | | -100% |
| **Total *n*-Alkanes** | | **6.41** | **4.90** | **4.01** | **-24%** | **-18%** | **-37%** |

**Table 4. (continued)**

| Compound Class & Name | First year monitored | Summer Mean (ppb) | | | Change (%) | | |
|---|---|---|---|---|---|---|---|
| | | First year | 2008 | 2015 | First-2008 | 2008-2015 | First-2015 |
| **Milwaukee SER DNR** | | | | | | | |
| **Branched & Cyclic Hydrocarbons (ppb)** | | | | | | | |
| Isobutane | 2000 | 0.36 | 0.31 | 0.18 | -14% | -41% | -49% |
| Isopentane | 2000 | 1.01 | 0.75 | 0.57 | -26% | -25% | -44% |
| Cyclopentane | 2000 | 0.03 | 0.04 | 0 | 7% | -100% | -100% |
| Cyclohexane | 2000 | 0.09 | 0.05 | 0 | -45% | -100% | -100% |
| 2,2-Dimethylbutane | 2000 | 0.03 | 0.04 | 0 | 39% | -100% | -100% |
| 2,3-Dimethylbutane | 2000 | 0.14 | 0.09 | 0.03 | -34% | -65% | -77% |
| 2-Methylpentane | 2000 | 0.29 | 0.23 | 0.31 | -22% | 33% | 4% |
| 3-Methylpentane | 2000 | 0.20 | 0.16 | 0.07 | -23% | -57% | -67% |
| Methylcyclopentane | 2000 | 0.19 | 0.14 | 0.05 | -25% | -65% | -74% |
| 2,3-Dimethylpentane | 2000 | 0.27 | 0.15 | 0.04 | -45% | -72% | -85% |
| 2,4-Dimethylpentane | 2000 | 0.18 | 0.09 | 0.03 | -50% | -72% | -86% |
| 2,2,4-Trimethylpentane | 2000 | 0.55 | 0.30 | 0.14 | -46% | -54% | -75% |
| 2,3,4-Trimethylpentane | 2000 | 0.20 | 0.09 | 0.03 | -56% | -67% | -85% |
| 2-Methylhexane | 2000 | 0.14 | 0.09 | 0.06 | -39% | -30% | -57% |
| 3-Methylhexane | 2000 | 0.18 | 0.14 | 0.06 | -25% | -57% | -68% |
| Methylcyclohexane | 2000 | 0.11 | 0.06 | 0.01 | -43% | -84% | -91% |
| 2-Methylheptane | 2000 | 0.05 | 0.04 | 0 | -11% | -100% | -100% |
| 3-Methylheptane | 2000 | 0.06 | 0.04 | 0 | -36% | -100% | -100% |
| **Total B & C HCs** | | **4.08** | **2.80** | **1.57** | **-31%** | **-44%** | **-62%** |
| **Unsaturated Hydrocarbons (ppb)** | | | | | | | |
| Ethylene | 2000 | 1.75 | 1.06 | 0.84 | -39% | -21% | -52% |
| Acetylene | 2000 | 0.68 | | 0.54 | | | -21% |
| Propylene | 2000 | 0.55 | 0.36 | 0.16 | -35% | -55% | -71% |
| Cis-2-Butene | 2000 | 0.04 | | 0 | | | -100% |
| Trans-2-Butene | 2000 | 0.10 | | 0 | | | -100% |
| 1-Pentene | 2000 | 0.02 | 0.04 | 0 | 98% | -100% | -100% |
| Cis-2-Pentene | 2000 | 0.01 | 0.02 | 0 | 89% | -100% | -100% |
| Trans-2-Pentene | 2000 | 0.03 | 0.04 | 0.01 | 64% | -79% | -65% |
| **Total Unsaturated HCs** | | **3.18** | **1.52** | **1.54** | **-52%** | **1%** | **-51%** |
| **Totals** | | | | | | | |
| Total Non-Methane Organic Carbon (NMOC; ppb C) | 2000 | 95.30 | 95.77 | 63.10 | 0% | -34% | -34% |
| **Total of 53 Hydrocarbons (listed above; ppb)** | **2000** | **16.32** | **10.74** | **8.97** | **-34%** | **-16%** | **-45%** |

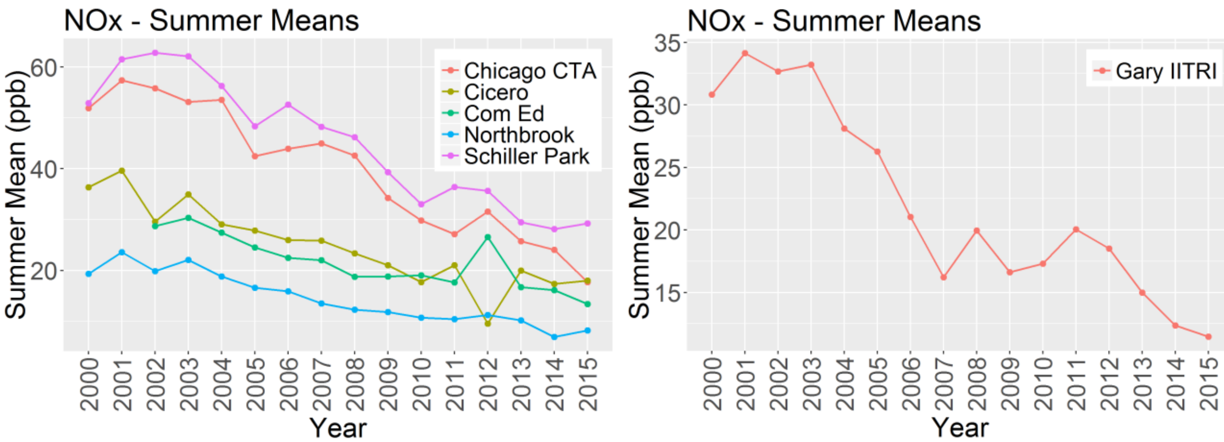
**Table 4. (continued)**

| Compound Class & Name | First year monitored | Summer Mean (ppb) First year | Summer Mean (ppb) 2008 | Summer Mean (ppb) 2015 | Change (%) First-2008 | Change (%) 2008-2015 | Change (%) First-2015 |
|---|---|---|---|---|---|---|---|
| **Milwaukee Health Center** | | | | | | | |
| **Carbonyls (mg/m$^3$)** | | | | | | | |
| Acetaldehyde | 2000 | 2.06 | 2.18 | 1.55 | 6% | -29% | -25% |
| Acetone | 2000 | 2.20 | 2.48 | 1.80 | 13% | -27% | -18% |
| Formaldehyde | 2000 | 2.87 | 4.90 | 2.70 | 71% | -45% | -6% |
| **Total Carbonyls** | | **7.13** | **9.56** | **6.05** | **34%** | **-37%** | **-15%** |
| **Aromatic Hydrocarbons (ppb)** | | | | | | | |
| Benzene | 2000 | 0.52 | 0.37 | 0.21 | -29% | -43% | -60% |
| Toluene | 2000 | 1.48 | 0.87 | 0.42 | -41% | -52% | -72% |
| *o*-Xylene | 2000 | 0.24 | 0.17 | 0.12 | -27% | -28% | -48% |
| *m*/*p* Xylene | 2000 | 0.68 | 0.47 | 0.37 | -31% | -21% | -46% |
| Ethylbenzene | 2000 | 0.18 | 0.21 | 0.05 | 19% | -78% | -74% |
| Styrene | 2000 | 0.06 | 0.06 | 0 | 3% | -100% | -100% |
| **Total Aromatic HCs** | | **3.14** | **2.15** | **1.16** | **-32%** | **-46%** | **-63%** |
| Unsaturated Hydrocarbons (ppb) | | | | | | | |
| Propylene | 2000 | 0.80 | 0.52 | 0.37 | -35% | -28% | -54% |
| Horicon/Mayville | | | | | | | |
| Carbonyls (mg/m$^3$) | | | | | | | |
| Acetaldehyde | 2004 | 0.99 | 1.52 | 0.91 | 54% | -40% | -8% |
| Acetone | 2004 | 1.70 | 2.44 | 1.67 | 43% | -31% | -2% |
| Formaldehyde | 2004 | 2.01 | 3.40 | 2.03 | 69% | -40% | 1% |
| **Total Carbonyls** | | **4.70** | **7.36** | **4.62** | **56%** | **-37%** | **-2%** |
| Aromatic Hydrocarbons (ppb) | | | | | | | |
| Benzene | 2004 | 0.04 | 0.02 | 0.07 | -50% | 237% | 68% |
| Toluene | 2004 | 0.08 | 0.16 | 0.08 | 106% | -49% | 5% |
| *o*-Xylene | 2004 | 0.01 | 0.00 | 0.01 | -50% | 22% | -39% |
| *m*/*p* Xylene | 2004 | 0.05 | 0.01 | 0.01 | -87% | 29% | -83% |
| Ethylbenzene | 2004 | 0.01 | 0.00 | 0.01 | -73% | 43% | -61% |
| Styrene | 2004 | 0 | 0.00 | 0.15 | | | |
| **Total Aromatic HCs** | | **0.20** | **0.20** | **0.33** | **1%** | **64%** | **66%** |
| Unsaturated Hydrocarbons (ppb) | | | | | | | |
| Propylene | 2004 | 0.00 | 0.06 | | | | |

## 4. TRENDS IN NOx AND VOCs IN THE CHICAGO AREA (ILLINOIS AND INDIANA)

Figure 5 shows monitored NOx concentrations[4] in the upwind Illinois and Indiana portions of the Chicago nonattainment area. Similarly, Figure 6 shows trends in monitored VOC concentrations in these same areas for both total hydrocarbon VOCs and total carbonyl VOCs.

**Figure 5. Trends in mean summer NOx concentrations for monitors in the (left) Illinois and (right) Indiana portions of the Chicago nonattainment area.**




[4] NOx and VOC data were downloaded from EPA's Air Quality Systems database.

**Figure 6. Trends in mean summer VOC concentrations of (left) hydrocarbons and (right) carbonyls for (top) Chicago area monitors in Illinois and (bottom) Chicago area monitors in Indiana.**