APPENDIX 3

2011 and 2014 Wisconsin Emission Inventories Documentation

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ABBREVIATIONS

AI	Active Ingredient
BTU	British Thermal Unit
CLF	Crop Life Foundation
DOE	Department of Energy
EIA	Energy Information Administration
EIIP	Emission Inventory Improvement Program
EP	Emission Potential
ERTAC	Eastern Regional Technical Advisory Committee
FHWA	Federal Highway Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
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
MOVES	Motor Vehicle Emission Simulator
MPO	Metropolitan Planning Organization
NEC	Not Elsewhere Classified
NEI	National Emissions Inventory
NMIM	National Mobile Inventory Model
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
VMT	Vehicle-Miles of Travel
WDNR	Wisconsin Department of Natural Resources
WDOT	Wisconsin Department of Transportation

1. Introduction

The primary purpose of this appendix is to describe the methodology used to develop the nonattainment and attainment emissions inventories by WDNR to satisfy the U.S. EPA redesignation requirements. This document includes a thorough discussion of the methodology used to develop the sector-specific NO_x and VOC emissions estimates for 2011 and 2014 nonattainment and attainment years respectively. For U.S. EPA to redesignate an area from nonattainment to attainment 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 emissions inventory and attainment year emissions inventory. The Wisconsin Department of Natural Resources (WDNR) decided to use the 3-year cycle emissions inventory from 2011 as the nonattainment year inventory to support this current redesignation request.

At least every three years state and local agencies are required to submit emissions data to U.S. 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 U.S. 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. The latest EPA approved 3-year cycle emissions inventory available for Wisconsin is 2011 NEI. The sector-specific NO_x and VOC emissions inventory data included in this redesignation request for nonattainment year 2011 were based on 2011 NEI version 2.

The sector-specific NOx and VOC emissions inventories for 2014 attainment year were developed as follows: The 2014 point source emissions inventories were created using annually reported point source emissions, the U.S. EPA's Clean Air Markets Division (CAMD) database and approved U.S. EPA techniques for emissions calculation (e.g., emission factors). The 2014 nonpoint source emissions were estimated using data interpolation between 2011 NEI emissions and EPA's 2017 modeling inventory as the official version of 2014 NEI has not been released by EPA yet. In EPA's 2017 modeling inventory, non-EGU point and nonpoint source projections were developed by starting with the 2011 emissions inventory and applying adjustments that represent the impact of national, state, and local rules coming into effect in the years 2012 through 2017, along with the impacts of planned shutdowns, the construction of new plants, specific information provided by states, and specific legal obligations resolving alleged environmental violations, such as consent decrees.[1] The 2014 onroad emission estimates were developed using the U.S. EPA's current mobile source emissions model (MOVES2014a). The 2014 annual nonroad emissions for the Commercial Marine, Aircraft and Rail Locomotive (MAR) categories were obtained from the U.S. EPA's 2011 Emissions Modeling Platform, Version 6.2. This modeling platform includes annual emission estimates for the year 2011 and projections for the years 2017 and 2025. Year 2014 emissions were calculated by linear

[1] https://www3.epa.gov/ttn/chief/emch/2011v6/2011v6_2_2017_2025_EmisMod_TSD_aug2015.pdf

interpolations between 2011 and 2017. The 2014 nonroad emissions for the non-MAR categories were developed using the U.S. EPA's MOVES2014a model.

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 air pollutants in great enough quantities to warrant individual quantification. To better enable detailed control evaluations, the point source EIs included all reporting sources regardless of the magnitude of reported emissions. Portable point sources such as asphalt plants and rock crushers were reported under nonpoint sources to be consistent with other states. The 2011 and 2014 point source emissions inventories were 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 EGU emissions are located in Appendix 5. 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 was normally collected via an internet or a computer diskette submittal, and subsequently loaded into the point source database. Process, boiler, fugitive and tank emissions were 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. 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 and 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.

For 2011nonattainment year, nonpoint source emissions inventory estimates were based on the NEI. 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 U.S. 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.
For 2014 attainment year, nonpoint source emissions inventory estimates were based on data interpolation between 2011 NEI and EPA's 2017 emissions modeling inventory as the agency submitted 2014 NEI area source emissions were under U.S. EPA review by the time of developing this redesignation request. Methodologies used to develop 2017 emissions modeling inventory is available in the EPA's Technical Support Document (TSD) of the 2011 Emission Modeling Platform.[2]

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 Kenosha County population for 2014 was estimated by interpolating the population between 2010 census data and 2015 population projections from the Wisconsin Department of Administration. 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 and 2014, 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 the State of Wisconsin were obtained from the U.S. Department of Energy (DOE)'s Energy Information Administration (EIA). Their annual publication, titled the State Energy Data (SED) report provides total consumption for most of the fuel oils and kerosene.[3] A separate EIA data source was used for distillate 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.

[2] https://www3.epa.gov/ttn/chief/emch/2011v6/2011v6_2_2017_2025_EmisMod_TSD_aug2015.pdf

[3] U.S. Energy Information Administration, http://www.eia.gov

Emission Factors:
The EPA has compiled criteria and hazardous air pollutant emission factors for nonpoint source industrial fuel combustion categories.[4] 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

This industrial sector category included the total of boilers and internal combustion (IC) engines that use distillate oil as the fuel type. 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

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

inventories, EPA has 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 .[5,6]
For fuels where boiler and engine emission factors are considered and only one emission factor was available, that single energy 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 were used for emissions estimation. In developing the 2011 NEI, distillate fuel oil types No.1, No.2 and No.4 were combined for 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 the total of all boilers that use residual oil as the fuel type. 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 the total of all boilers and IC engines that use natural gas as the fuel type. 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 Oil (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 the total of all boilers that use LPG as the fuel type. The activity is estimated in thousand barrels of LPG consumed using EIA's SEDS as the data source.

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

[5] 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.
[6] 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.

This industrial sector category included the total of all boilers that use wood as the fuel type. 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 the total of all boilers that use kerosene as the fuel type. 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. One potential approach to distinguish such consumption is contacting a small number of local distributors to obtain estimates for the commercial/institutional deliveries. 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 estimation of most of the categories except wood. The EPA has compiled criteria and hazardous air pollutant emission factors for nonpoint source commercial/institutional fuel combustion categories[7].The emissions factor for commercial/institutional wood combustion was downloaded from WebFIRE, the U.S. 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)

[7] 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 were subtracted from the total emissions to estimate the adjusted area source emissions. Another approach for making such adjustments is to subtract the activity assigned for point sources from the total activity to estimate the adjusted area source activity.

Usually, a portion of the activity data may represent deliveries to lager commercial/institutional facilities that may be inventoried as point sources. Due to differences in emissions estimation methods and/or emissions factors, it is more appropriate to use activity data in point source adjustments. However, the usage of activity data is preferred for the convenience of comparison, for the scenarios that only emission estimates are available, it would be more appropriate to subtract pre-controlled emissions representing point sources from total stationary emission estimates in order to make adjustments.

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.[8] The space heating and water heating equipment that consume bituminous/subbituminous coal were considered in developing the inventory for this category with the assumption of 100% coal consumption comes from bituminous/subbituminous coal.

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

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

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 data and heating degree days. The employment information was obtained from the State Department of Labor. The significance of this category during the time of the inventory period for a certain geographic region is also an important factor for apportioning emissions from state-level to county-level. Commercial use may be temporally apportioned based on information from local distributors. Monthly deliveries should be obtained from a small sample of commercial/institutional coal distributors. The monthly percentages of annual deliveries found for the sampled distributors may be used to apportion consumption for the inventory area.[9]

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

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

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 was calculated using following equation:

[9] 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

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

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
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 combustions occur at wholesale and retail businesses, health institutions, social and educational institutions, and federal, state and local government institutions 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.[10] Their annual SED report provides total consumption by fuel type for distillate oil, residual oil, and kerosene. Another useful resource would be contacting a small number of local fuel oil distributers to obtain estimates for the commercial portion of deliveries. Only if very few households consume a certain fuel oil, then deliveries could be assumed entirely to the commercial sector.

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

[10] 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".

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:

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

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 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 the fuel source and are not inventoried as point sources. Such combustions occur at wholesale and retail businesses, health institutions, social and educational institutions, and federal, state and local government institutions are considered in developing the inventory for this category. [11]

Pollutants: NO_x, VOC

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

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:

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

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
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 combustions occur at wholesale and retail businesses, health institutions, social and educational institutions, and federal, state and local government institutions are considered in developing the inventory for this category.

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:

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

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 may be obtained from the DOE's EIA's SED Report.[12] The number of households at county-level that use certain fuel type for heating purposes could be accessed from U.S. Census Bureau data. Residential and commercial fuel deliveries may separate out by obtaining samples of sales data from local fuel distributors. Emission factors for NO_x and VOC are from AP-42.[13]

2.2.1.3.a Coal

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

Pollutants: NOx

For coal combustion, emission factors are from AP-42. 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 could be 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.[14]

Emissions Calculation[15]

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

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

[13] 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.

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

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

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

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.

2.2.1.3.b Distillate Oil

The distillate oil burned in residential units is covered in this category. For this category, Wisconsin DNR 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.[16] 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.[17] 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.[18] 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 is obtained from the EIA and allocates it out 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:

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

[16] 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.
[17] https://www.census.gov/hhes/www/housing/census/historic/fuels.html
[18] 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.

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 $FC_x = A_{State} \times (H_{county} / H_{State})$

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.

Pollutants: NO_x, VOC

Activity data is available in the SED consumption tables published by the EIA.[19] Year 2009 consumption data were used to develop 2011 NEI. To allocate the state-wide distillate oil consumption data to county-level, U.S. Census Bureau's house heating fuel type data were used.[20] 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.[21] According to AP-42, natural gas has a heat content of 1,050 million BTU per million cubic feet.

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 $FC_x = A_{State} \times (H_{county} / H_{State})$

[19] 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.
[20] https://www.census.gov/hhes/www/housing/census/historic/fuels.html
[21] 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.

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 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.[22] In developing 2011 NEI, year 2009 volume of LPG consumed was used. To allocate the state-wide LPG consumption data to county-level, U.S. Census Bureau's house heating fuel type data were used.[23] 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.[24] The natural gas consumed by residential combustion is assumed to have a heating value of 1,020 Btu per cubic foot. Some emission factors were revised based on recommendations by an ERTAC advisory panel composed of state and EPA personnel.[25]

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 :

[22] 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.
[23] https://www.census.gov/hhes/www/housing/census/historic/fuels.html
[24] 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.
[25] ftp://ftp.epa.gov/EmisInventory/2011nei/doc/

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

The 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:

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

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.[26]

Emissions Calculation

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

$$E_{Wood,p} = Wood\ Consumption_{Inventory\ County} \times EF_{Wood,p}$$

where:
$E_{Wood,p}$ = annual emissions for wood for pollutant p
$Wood\ Consumption_{Inventory\ County}$ = annual wood consumption in Inventory County
$EF_{Wood,p}$ = 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 emissions estimations.

[26] http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii02_apr2001.pdf

Activity data is available in the State Energy Data consumption tables published by the EIA.[27] In developing 2011 NEI, year 2009 volume of Kerosene consumed was used. To allocate the state-wide Kerosene consumption data to county-level, U.S. Census Bureau's house heating fuel type data were used.[28] 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). [29]

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 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

[27] 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.
[28] https://www.census.gov/hhes/www/housing/census/historic/fuels.html
[29] 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.

In developing 2011 NEI, Wisconsin DNR 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 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.[30]

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.

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[30] 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

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
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, VOCs are used as the solvent if the coatings are not water-based. During the application as well as the coating dries, VOCs emit 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 emit as reaction byproducts. To estimate the emissions by secondary sources the amount of solvents used to clean such application equipment is used.

To control the amount of primary emissions, product reformulation, product substitution and/or recycling of unused coating may be practiced. 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, Wisconsin DNR adopted EPA estimates for 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.[31]

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.[32]

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 may 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

Spatial allocation may be needed in two possible cases during the preparation of an inventory: (1) allocation of state or regional activity to a county-level, and (2) allocation of county-level emission estimates to a modeling grid cell. In each case, a surrogate for activity should be found that can approximate spatial variation for this category.

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. Some spatial approaches use land use data from county planning departments, or population distributions,

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

[32] U.S. Census Bureau, "Population Estimates," at http://www.census.gov/popest/estimates.html.

available from the Census Bureau. Using population to allocate estimated emissions or activity by county or within a grid cell is also a fairly straight forward. Land use data can be used to generalize building size and type.

Temporal Resolution
Seasonal influence on architectural surface coating temporally apportions the emissions estimates into different quarters for a particular year. Since temperatures below 50°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 can be used to estimate the total amount of VOC emitted in the inventory area from architectural surface coating operations.[33]

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

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

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

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 of the 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 indicates 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 indicates the total employment in each county for automobile refinishing category based on county business patterns.

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 US 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.[34] EPA provided emission factor for VOC.[35]

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.

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

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 were developed by ERTAC.

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

[34] 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
[35] ftp://ftp.epa.gov/EmisInventory/2011nei/doc/

$Emissions_{i,p}$ = (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 operations used in graphic arts: 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 type.[36] Emission factors define the pounds of VOC per capita per year as developed by ERTAC. Type 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.[37]

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:

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

[36] U.S. Department of Labor, Bureau of Labor Statistics, "Occupational Employment Statistics", found at http://www.bls.gov/oes/current/oes_dc.htm
[37] http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii07.pdf

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

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 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 involve: detailing products and maintenance

and repair products. The detailing products sub-category include the products used for cosmetic purposes on cleaning, polishing, and waxing while products used as engine and part cleaners, carburetor fuel injector cleaners, lubricants, antifreeze, radiator cleaners, and brake fluids are considered as maintenance and repair sub-category.

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.

Uncertainties may encounter 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.[38]

Emissions could be 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)

[38] Agricultural_Pesticides_2461850000_Documentation downloaded from ftp://ftp.epa.gov/EmisInventory/2011nei/doc/

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 guidance. [39]

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 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)

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

[39] 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.

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

WDNR adopted the EPA estimated emissions for residential portable fuel containers.
For the completeness of this document, the emission estimation method based on a survey is listed below. These categories associated with the emissions from the fuel containers commonly known as "gas cans" and contribute VOC emissions to the ambient air in different ways. The methods and equations listed for both residential and commercial portable fuel container emission estimates are from the California Air Resources Board's Mail-out MSC 99-25.[40]

Pollutant: VOC

Emissions Calculation:

The general formula to estimate emissions:

$$E = EF * A$$

where,
E = emissions
EF = VOC emission factor
A = activity level

A survey could be used to evaluate the number of gas cans per household. According to this methodology, the population of residential gas cans in a state is estimated as:

$$Pop_R = N_h \times P_h \times A_R$$

where
Pop_R = population of gas cans
N_h = number of household units
P_h = percentage of households with gas cans
A_R = average number of gas cans per household

2.2.4.1.a Portable Fuel Containers, Residential Permeation

After fuel has been stored in a container for a long period, permeation emissions may produce.

[40] Mail-Out MSC 99-25: Notice of Public Meeting to Consider the Approval of California's Portable Gasoline-Container Emissions Inventory. Mobile Source Control Division. Downloaded from http://www.arb.ca.gov/msei/offroad/pubs/msc9925.pdf

The following formula calculates the emissions for this category:

$$E_p = \sum \left(Pop_R \times S \times EF_p \times B_R \times Size_R \times Level \right)$$

where:
E_p= Permeation emissions in tons per day
Pop_R = Statewide residential gas can population
S = Percentage of gas cans stored with fuel
EF_p= Appropriate permeation emission factor (g/galday)
B_R= Percentage of cans stored in closed condition with respect to material
$Size_R$= Weighted average capacity of residential gas cans
$Level$= Weighted average amount of stored fuel

2.2.4.1.b Portable Fuel Containers, Residential Spillage During Transport

This category included fuel spillage emissions from gas cans when they are transporting form one place to another.

The following formula calculates the emissions for this category:

$$E_{TR} = \sum (Pop_R \times S \times Refill_{TR} \times EF_{TR} \times B_R)$$

where:
E_{TR}= Transportation spillage emissions in tons per day
Pop_R = Statewide residential gas can population
S = Percentage of gas cans stored with fuel
EF_{TR}= Transport emission factor (g/galday)
B_R= Percentage of cans with respect to storage condition and material

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

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501012017	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Fuel Containers	Refueling Equipment-Spillage

The commercial gas can population in the state can be calculated as follows:

$$Pop_c = N_c \times A_c$$

where:
Pop_c = State-wide commercial population of gas cans
N_c = number of occupied business units in the state
A_c = average number of gas cans per business

2.2.4.2.a Portable Fuel Containers, Commercial Permeation

Permeation emission rates for commercial gas cans are assumed to be the same as those for residential gas cans. Statewide commercial gas can permeation emissions can be computed as follows:

$$E_{pc} = \sum \left(Pop_c \times S \times EF_{pc} \times B_c \times Size_c \times Level\right)$$

where:
E_{pc}= Permeation emissions in tons per day
Pop_c = Statewide commercial gas can population
S = Percentage of gas cans stored with fuel
EF_{pc}= Permeation emission factor (g/galday)
B_c= Percentage of cans stored in closed condition
$Size_c$= Weighted average capacity of commercial gas cans
$Level$= Weighted average amount of stored fuel

2.2.4.2.b Portable Fuel Containers, Commercial Spillage During Transport

Transport spillage emission rates for commercial gas cans are assumed to be the same as those for residential gas cans. Statewide commercial gas can transport spillage emissions can be computed as follows:

$$E_{TC} = \sum (Pop_C \times S \times Refill_{TC} \times EF_{TC} \times B_C)$$

where:
E_{TC}= Transportation spillage emissions in tons per day
Pop_C = Statewide commercial gas can population
S = Percentage of gas cans stored with fuel
$Refill_{TC}$= Average number of gas cans pump refills per day per can
EF_{TC}= Transport emission factor (g/galday)
B_C= Percentage of cans with respect to storage condition and material

2.2.4.2.c Portable Fuel Containers, Commercial/Residential Refiling at the Pump, Vapor Displacement

The refueling-displacement-vapor emissions result when fuel vapor is displaced from equipment and vehicle fuel tanks, gas cans, etc., by fuel dispensed from gas cans.

The amount of daily vapor displacement emissions from all applicable residential and commercial gas cans can be calculated as follows:

$$E_D = \{(Disp) \times (Fuel) \times (F)\}$$

where:
E_D=Total refueling vapor displacement from all gas cans
$Disp$=Refueling vapor displacement emission rate
$Fuel$=Applicable equipment/vehicle type fuel consumptions
F=Frequency of refuels (per day) with respect to equipment/vehicle

2.2.4.2.d Portable Fuel Containers, Commercial/Residential Refiling at the Pump, Spillage

Spillage emissions are produced when fuel is dispensed from a gas can to an equipment or vehicle fuel tank, another gas can and fails to either be delivered into the intended reservoir or to remain inside the reservoir.

The amount of daily spillage emissions from all applicable residential and commercial gas cans can be calculated as follows:

$$E_s = \sum \left\{ \left[\frac{(Fuel) \times (Spill)}{(Tank)} \right] \times F \right\}$$

where:
E_s=Daily spillage emissions from all gas cans (tpd)
$Fuel$=Applicable equipment/vehicle type fuel consumption (gal/day)
$Spill$=Spillage emission rate per refill of gas can refueled equipment/vehicles
$Tank$=Applicable equipment/vehicle fuel tank capacity (gal/refill)
F= Frequency of refuels (per day) with respect to equipment/vehicle

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 petroleum and petroleum product storage categories. 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.[41,42]

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 (dollars of sales, not gasoline volume) are available from the Bureau of the Census's Census of Retail Trade.[41]

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

[41] EIIP, Chapter 11, Gasoline Marketing (Stage I & Stage II): http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii11_apr2001.pdf
[42] Gasoline_Distribution_Statge I_Documentation_2011: ftp://ftp.epa.gov/EmisInventory/2011nei/doc/

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:

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

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 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. 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 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. It may include spillage of gasoline (and subsequent evaporation) during either delivery activity above. 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, point source adjustment is not necessary.

Activity is provided by MOVES model by estimating of refueling emissions in units of grams per mile. These values are multiplied by fuel economy (in units of miles per gallon) and total gasoline sales (in units of gallons purchased/sold) in the study area resulting in refueling emissions in terms of grams.

$$E_{StII} = \frac{(G_i \times EF_{StII} \times MPG \times SAF)}{2000}$$

where:

E_{StII} = Emissions of VOC in tons per day from stage I refueling
G_i = gallons of gasoline sold in county *i* during 2011
EF_{StII} = Emission factor for stage II refueling
MPG = Average fuel economy (miles/gallon)
SAF =seasonal adjustment factor to reflect summer weekday emissions

2.2.5 Waste Disposal

2.2.5.1 Publicly Owned Treatment Work (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 publicly owned treatment work category. POTW 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. Emission factor for VOC in pounds of VOC per million gallons of waste water discharged were provided by ERTAC.

Adjustment for point sources

It is important to note that the emission estimates for this category represent total emissions. It may be 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 can be 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 can be allocated to county-level using county proportion of population data.[43]

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 Wisconsin DNR 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.[44, 45] 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.

[43] U.S. Census Bureau, "Population Estimates," at http://www.census.gov/popest/estimates.html.
[44] Cremation Association of North America, *2007 Statistics and Projections to the Year 2025: 2008 Preliminary Data*, August 2009, available at http://www.cremationassociation.org/
[45] 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.

Emission Calculation

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

where:
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 and 2014 (as well as the 2020 and 2030 projections) are presented in Appendix 9, broken down by source type (vehicle class), fuel type and road type. Tables summarizing vehicle activity data are presented in Appendix 9 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 has provided WDNR MOVES input files for the eastern Kenosha County nonattainment area for 2011 and 2014 (as well as the 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 the 2011 data during July 2014 and the 2014 data (as well as the2020 and 2030 projected data) 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 and 2014, 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. Since SEWRPC's travel demand model outputs traffic volumes for an *average* weekday (all 12 months), adjustments were made to their output, based on adjustment factors previously agreed upon by WDNR and SEWRPC. The net result of these adjustments is that the summer weekday VMT is greater than the average day VMT by 6.487%.

To be consistent with MOVES inputs requirements for all versions of MOVES before version 2014a, SEWRPC provided WDNR annual VMT data rather than summer weekday data. SEWRPC estimated annual VMT by applying a factor of 335.84 to the average weekday VMT outputted from their travel demand model. WDNR then ran MOVES2014a using adjustment factors for July (0.092096) and weekday (0.762365) to arrive at a summer (July) weekday VMT which equaled the 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 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 this 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 the 2011 and 2014 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 vehicles.

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 8.

2.4.1 Non-MAR Sources

The 2011 and 2014 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 6.2. This modeling platform includes annual emission estimates for the year 2011 and projections for the years 2017 and 2025. Year 2014 emissions were calculated by linearly interpolating between 2011 and 2017. Countywide emissions were allocated to the eastern Kenosha County nonattainment area based on airport location for aircraft and rail link

location for rail locomotives. All commercial marine emissions were allocated to the nonattainment area, since all those emissions originate from Lake Michigan. More detail on the allocation 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 countywide 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 the 2010 census, 76.1% of the county's population is in the nonattainment area. 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 platform years (2011, 2017 and 2025)

Thus, **Aircraft** emissions inside the nonattainment area were calculated by adding the emissions for those airports located in the nonattainment area.

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 both NOx and VOC
- General aviation, piston engine: 59.6% to 62.9% for both NOx and VOC
- General aviation, turbine engine: 61.5% to 64.7% for both NOx and VOC
- Air taxi, turbine engine: 97.5% to 98.8% for both NOx and VOC
- Air taxi, piston engine: 97.5% to 98.8% for both NOx and VOC

Ranges are given above (e.g., 59.6% to 62.9%) when the percentages differ by WDNR inventory year (2011, 2014, 2020 and 2030).

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 platform years (2011, 2017 and 2025).

Thus, **Railroad** emissions inside the nonattainment area were calculated by adding the emissions for those rail links located in the nonattainment area. 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.