State of Ohio
2008 Base Year Emissions Inventory Report

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1 Executive Summary

This document provides the results of the Ohio EPA SIP Emission Inventory for 2008 and a general description of the methods used to calculate the emissions. This inventory uses the up-to-date emission factors and calculation methodologies that were available at the time. Every three years, the Ohio EPA is required to submit a complete emissions inventory to USEPA. A complete inventory includes point, area and mobile (on-road and off-road) source categories. For an ozone inventory, daily and annual emissions of CO, NOx and VOC are required. For the PM10/PM2.5 inventories, annual emissions of CO, NH3, NOx, PM10, PM2.5, SO2 and VOC are required.

The primary source of data for point sources was the Title V facility reported 2008 annual emission reports. Area source emissions are typically estimated by multiplying an emission factor by a known indicator of activity (e.g., population) for a source category. On-road mobile source emissions were calculated using MOVES2010a computer model. Off-road mobile source emissions were calculated using the NMIM model. Aircraft sources are included with the point source inventory. Marine and Rail inventories are included with the area source inventories.

To ensure this inventory is of the highest quality, Ohio EPA implemented quality assurance (QA) procedures and quality control (QC) checks throughout the inventory development process. Ohio EPA specifically followed the procedures outlined in USEPA's guidance documents pertaining to inventory quality assurance and believes the inventory to be complete, accurate and of high quality.

2 Introduction

Every three years (e.g., 2002, 2005, 2008 etc.) the Ohio EPA is required to conduct a state-wide emissions inventory for all source categories (i.e., point, area, mobile). This document presents the 2008 Base Year Inventory for Ohio as required by the Clean Air Act Amendments of 1990 and it reflects the items included in the inventory plus the methodology used to calculate those emissions.

The primary source of data for point sources was the facility reported 2008 annual emission reports. Starting with inventory year 2008 and beyond, Ohio Title V facilities are required to submit annual emissions reports through the Ohio EPA web interface, Air Services.

Area source emissions are typically estimated by multiplying an emission factor by a known indicator of activity (e.g., population, employment, etc.) for a source category. Calculation of emissions for area sources primarily used 2008 activity data and in a few cases either actual data or projections from previous years were used. Area source calculation methodologies were updated to the most recent calculation methods identified by USEPA. The point and area source emissions files are provided to the Lake Michigan Air Directors Consortium (LADCO) for spatial and temporal allocation of emissions. LADCO processes the data in the CONCEPT (Consolidated Community Emissions Processing Tool) emissions model.

On-road mobile source emissions were calculated by running MOVES2010a, and CONCEPT. Ohio EPA prepared the inputs to the MOVES2010a model and the vehicle miles traveled (VMT)/Speeds files for CONCEPT. The files were provided to LADCO and USEPA. LADCO performed the computer runs. MOVES2010a generates county emissions rates for every pollutant, road and vehicle type combination. CONCEPT uses MOVES2010a emissions rates, multiplies them with the VMT files and spatially/temporally allocates emissions in specified grid cells. Ohio EPA relied on 2008 VMT data generated by the Ohio Department of Transportation Office of Planning and Programming.

Off-road mobile source emissions were calculated using NMIM-NONROAD computer model and CONCEPT. Ohio EPA prepared the inputs to the NMIM model and provided them to LADCO and USEPA. LADCO performed the computer runs. NMIM generates emissions rates for the various off road equipment. The emissions rates are processed in CONCEPT and spatially/temporally allocated in specified grid cells. The NMIM model does not include emission estimates for aircraft, locomotives and commercial marine vessels. Aircraft emissions were calculated by USEPA using actual activity data (operations) for each airport. Emissions from locomotives were obtained from a study of the Eastern Regional Technical Advisory Committee (ERTAC). Commercial marine vessel emissions were grown from the 2005 inventory. The aircraft, locomotives and commercial marine vessels inventories are also processed in CONCEPT by LADCO.

To ensure this inventory is of the highest quality, Ohio EPA implemented quality assurance (QA) procedures and quality control (QC) checks throughout the inventory process. Ohio EPA specifically followed the procedures outlined in USEPA's guidance.

This document is comprised of 6 sections and it covers the reporting, development and analysis of the point, area and mobile source emissions inventory. The biogenic inventory is not discussed in this document because Ohio EPA did not participate in the generation of this inventory.

3 Emission Inventory Summaries

3.1 Background

Four basic steps were involved in the preparation of the emission inventory. The first step involved planning. As required by USEPA guidance, Ohio EPA outlined the methods by which the Ohio EPA would assemble the 2008 inventory and perform QA/QC checks. The QA/QC plans and procedures are presented in Section 6.0.

The second basic step was data collection. A major component of this step was to determine which source categories should be considered as point sources in the inventory and which should be considered area sources. This determination is important as fundamentally different data collection procedures are used for each of these two source types. Actual emissions data submitted in the facility annual reports are used for point sources, whereas county level information such as population or employment is generally used to estimate area source emissions. The data collected and maintained on point sources is more detailed than area sources. For inventory year 2008, Title V sources were included in the point source inventory. For mobile sources, Ohio EPA compiled the inputs to the mobile source models (MOVES2010a and NMIM) and provided them to USEPA and LADCO.

The third basic step in the inventory compilation effort involved analysis of data collected and the development of emission estimates for each source. Emissions were determined individually for each point source. Emissions were generally determined by overall source category for area sources. Reported emission data, material balances and emission factors were all used to calculate these estimates.

The fourth step was reporting. Initially, Ohio EPA identified the kinds of data and formats that would be needed for this inventory document to fulfill USEPA inventory requirements. Later, Ohio EPA identified additional reports and features that would be useful for future inventory needs and/or modeling requirements. These have been incorporated into this document.

A number of agencies provided data for use in developing the nonattainment area inventories. Ohio EPA is directly responsible for coordinating and supervising the completion of each segment of the inventory. Several other state and local agencies contributed information to Ohio EPA that was necessary for preparing emission estimates. The majority of the highway vehicle emission calculation information was provided by Ohio Department of Transportation (DOT). Ohio DOT used federally approved transportation planning methods to develop VMT estimates which were based on monitored traffic count data in selected key locations throughout the state. Certain other localized traffic data were obtained from metropolitan planning organizations (MPOs).

3.2 Methodology

A detailed emission inventory for a pollutant lists each source of that pollutant and the quantity of its emissions. The sources are usually categorized in two ways: (1) point, area or mobile sources or (2) industrial categories and subcategories.

Emissions from point sources are defined as those whose emissions are usually fairly well characterized and are generally discharged through stacks and which are required to possess an Ohio EPA issued permit. Fugitive emissions are not emitted from a discrete point but are emitted from numerous areas throughout a facility. Area sources are usually spread over wide

areas with no distinct discharge points or are comprised of a large number of small point sources that are difficult to describe separately (e.g., the heating furnaces in individual homes in a city) and whose emissions are not so well characterized. Other examples of area sources include architectural surface coating, automobile refueling, dry cleaning and automobile refinishing. Mobile sources are divided into two major categories – on-road and off-road. On-road mobile sources include cars, trucks, buses and motorcycles used for transportation of goods and passengers on roads and streets. Off-road mobile sources include other modes of powered transportation such as aircraft, locomotives, ships and motor vehicles used off-highway. This classification protocol has been utilized throughout this document.

A typical industrial plant may have different source types associated with it. For example, a refinery with numerous industrial processes would itself be a point source, the leaks from valves, pumps and fittings throughout the miles of piping would be a fugitive source and the switch engine that moves tank cars on the railroad siding would be a non-highway mobile source. Also, a plant may have more than one industrial classification associated with it. The refinery in the previous example is in one industrial category; its tank farm is in another. Quantities of emissions may be measured directly (at the stack); they may be calculated from engineering principles (e.g., mass balance); or they may be estimated (e.g., by assuming reasonable emission rates, times, etc.). Further, emissions can be expressed in terms of annual emissions, seasonal emissions or daily emissions. In the case of the pollutant ozone, precursor emissions are generally expressed in terms of typical daily emissions representative of the peak ozone season, or tons per day. LADCO has processed annual emissions data files previous inventory cycles using the CONCEPT model and calculated daily emissions in a robust, consistent and transparent manner.

Emission estimates generally followed the methodologies outlined in USEPA's emission inventory preparation guidance document, Volumes I-IV and USEPA's "Reporting Guidance for 1996 Periodic Emissions Inventories and National Emission Trends (NET) Inventories." LADCO spatially and temporally processed the emissions data in accordance with U.S EPA guidance: "Guidelines on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze", EPA-454/B07-002, April 2007.

3.3 Point Sources

Emissions and source specific data for Title V point sources were developed for the 2008 inventory by Ohio EPA. The source of data for point sources was facility reported annual emissions reports. These data are reported by the sources annually as part of the inventory process conducted by Ohio EPA and include emissions, process rates, operating schedules, and other relevant information. The data are stored in Ohio EPA's internal data management system called STARS2. The data were converted from STARS2 into the EIS XML file format via a tool developed by Ohio EPA's contractor, UNICON. The data were submitted to USEPA and LADCO. Daily emissions were computed by LADCO using CONCEPT and the original process data.

3.4 Area Sources

Area source emissions were typically estimated by multiplying an emission factor by a known indicator of activity for each source category and each county. Area source emissions for 2008 were based on data available for population, employment and commodities and were generally prepared following the procedures described in the Inventory Preparation Plans. For the 2008 inventory, state agencies and USEPA formed the ERTAC Committee. The committee defined

the categories to inventory, emissions factors, sources of activity data and contracted with Pechan to develop draft estimate of emissions. County level activity data were made available for all States. Ohio EPA accepted the majority of the estimates except in cases where Ohio had a better methodology, more accurate activity data and a point source subtraction needed to be applied on the estimate. Unfortunately, Ohio EPA or USEPA were not always able to use data representative of 2008 because the data was not available at the time of creating the inventory. In a number of cases, data was provided from national estimates and allocated to the State and county levels. In those cases, if data specific to Ohio was available, it was used by Ohio EPA. Emission estimates for 2008 emissions were developed using primarily 2008 category activity levels, where available, or projections of changes in activity from 2005 levels with a preference to data specific to Ohio. Emission controls were accounted for by using either adjusted emission factors or through the use of control factors. The data were processed in Microsoft Excel and Access applications, converted into the EIS XML file format via USEPA's EIS Bridge Application and provided to USEPA and LADCO. Daily emissions were computed by LADCO using CONCEPT and the original process data.

3.5 Mobile Sources

Statewide highway vehicle emissions were estimated by multiplying USEPA emission factors generated from the MOVES2010a computer model by daily VMT estimates by county for all counties. Ohio EPA relied on VMT data generated by the Ohio DOT Office of Planning and Programming and Metropolitan Planning Organizations (MPOs). Ohio DOT and MPOs used urban transportation planning methodologies approved by the Federal Highway Administration to generate the necessary VMT estimates. Ohio EPA constructed the MOVES2010a input files and provided them to LADCO. LADCO run the model and generated vehicle emission rates. LADCO used the CONCEPT model to spatially and temporally allocate emissions in a 4 km grid. For some parameters, however, sufficient resources were not available for Ohio EPA to develop area-specific values, so national average defaults contained in the model were used. A discussion of the inputs used in running MOVES2010a is included in Section 5.0.

Emissions were also estimated for non-road equipment. Ohio EPA and LADCO prepared emission estimates for railroad locomotives; commercial, military and civil aircraft; and commercial vessels using state and county specific activity factors and USEPA approved emission factors and data. Further discussion of off-road equipment emission estimation methodologies and actual estimates are contained in Section 5.2.

3.6 Results

The 2008 Emission Inventory summary of the emission estimates for the State of Ohio is shown in LADCO's Emissions Modeling and Emissions Inventory Page, http://www.ladco.org/tech/emis/
LADCO prepared a modeling protocol that explains the procedures used to generate emissions estimates:
http://www.ladco.org/tech/emis/baseb/Modeling_Protocol_New_SIP_Modeling_Version_3.0.pdf
For each inventory, LADCO provides detailed methodology, the responsible group and the status. The data are presented in multiple ways including:

- State total reports for each sector
- County total reports for each sector
- Unified SCC reports for all sectors
- Point source EGU and Non-EGU reports for summer weekday

- Point source advanced diagnostics
- Speciation reports
- Annual reports
- Graphics by pollutant

LADCO processed the data in multiple phases and identified each phase by a specific Base Case and letter. If after the completion of each phase, there is a need to revise essential information that changes the calculated values, a new inventory is posted with another letter. When viewing LADCO files, be certain that either the latest inventory or the desired phase inventory is being looked at the LADCO website.

4 Point Sources

Ohio is an industrialized State with a large number of operating permits. Under ideal conditions, a complete point source inventory should account for all permitted facilities in the State. There are roughly 13,000 operating permits in Ohio with the following permitting classifications: Title V (TV), Synthetic Minor (SMTV), Non-Title V (NTV) and Permit By Rule (PBR) facilities.

Out of the 13,000 operating permits, there are only approximately 1,500 TV and SMTV facilities. Only TV facilities are subject to annual emissions report. There are two emissions reports in the State: Fee Emissions Report (FER) and Emissions Inventory System (EIS) report. For calendar year 2008, only Title V facilities (around 600 facilities) were subject to an EIS report. The EIS contains sufficient reported detail to qualify for the point source inventory. For calendar year 2009 and beyond, SMTVs will be subjected to the same strict reporting requirements as with TVs. This change will result in a large inventory improvement for future years.

TV facilities submit their inventory reports through Ohio EPA's eBusiness Center which is a secure portal for online business services. The online service is designed to assist the regulated community in preparing and submitting a variety of electronic permit applications and reports to the Ohio EPA Division of Air Pollution Control (DAPC). The inventory information has to meet Ohio's quality assurance requirements before the application is considered complete. The facility inventory includes emissions, process rates, operating schedules, control data and other reporting requirements designed to meet the USEPA and Ohio EPA data requirements.

The online reports are stored in the Ohio EPA's Division Oracle database, STARS2. The files are reviewed by the local air agencies and Ohio EPA district and central office staff. After review, the emissions reports data are processed into USEPA's facility and point source emissions XML files. Starting with the 2008 inventory year, USEPA made significant changes with their repository system, National Emissions Inventory (NEI). The new NEI system allows only quality assured data. The XML files were quality assured in USEPA's QA environment and a number of corrections were needed to satisfy USEPA's QA checks. USEPA performs format and content checks on state-submitted files prior to accepting the files. Corrections were made to Ohio's data to meet US EPA's strict reporting requirements and data files were submitted to US EPA by the deadline. A complex Java application was developed to convert Ohio data form STARS2 into USEPA's NEI XML files. The State relies on this program to meet future reporting requirements and any minor change with NEI requires a significant State investment to modify the program to satisfy the change.

The same quality assured data was also submitted to LADCO for emissions processing through CONCEPT. There was an exception for the Electric Generating Units (EGUs). The State provided inventory for EGUs is replaced by LADCO with the federal EGU inventory. The EGU inventory is submitted by facilities to USEPA and it is compiled in USEPA's Acid Rain Program application. The EGU inventory is based on facility reported emissions as measured by continuous emissions monitors. In conclusion, the final point source inventory is a hybrid of the federal EGU inventory and the state provided non-EGU units.

A distinction exists in emissions inventories between point and area sources. In this inventory, point sources are sources for which individual records are maintained for that source. As discussed above, such records are maintained for all Ohio Title V facilities. The area source inventory accounts for facilities from non-Title V facilities and calculates emissions information using surrogate emissions factors based on energy usage, population, employment records, or

other reliable data. A more detailed discussion of the area source inventory is provided in Section 2. The point source inventory described herein is considered to be the most current and accurate source of emissions data available for 2008.

4.1 Source Identification and Data Collection

As explained above, the sources to be included in the 2008 base year inventory are identified using the STARS2 database. Title V facility and emissions reported data are included in this database. This information is based on 2008 facility-reported actual emissions reports.

4.2 Non-reactive VOC Emissions Adjustments

Along with all criteria pollutants, sources are required to identify emissions of photochemically non-reactive Volatile Organic Compounds (VOC). Based upon this information, those emissions have been specifically excluded from the 2008 base line inventory in accordance with U.S. EPA's "Recommended Policy on the Control of Volatile Organic Compounds." A complete list of the compounds that U.S. EPA has identified as being photochemically non-reactive, and therefore not included in the inventory, are listed below:

- Methane
- Ethane
- Methylene chloride
- Methyl chloroform
- Trichlorofluoromethane (CFC-11)
- Dichlorodifluoromethane (CFC-12)
- Chlorodifluoromethane (CFC-22)
- Trifluoromethane (HFC-23)
- Chlorofluoromethance (HCFC-31)
- Difluoromethane (HFC-32)
- Decafluoropentane (HFC-43-10mee)
- Ethylfluoride (HFC-161)
- Trichlorotrifluoroethane (CFC-113)
- Dichlorotetrafluoroethane (CFC-114)
- Chloropentafluoroethane (CFC-115)
- 2,2-Dichloro-1,1,1-trifluoroethane (HCFC-123)
- 1,1,2-Trifluoroethane (HCFC-123a)
- 2-Chloro-1,1,1,2-tetrafluoroethane (HCFC-124)
- Pentafluoroethane (HFC-125)
- 1,1,2,2,-Tetrafluoroethane (HFC-134)
- 1,1,1,2-Tetrafluoroethane (HFC-134a)
- 1,1-Dichloro-1-fluoroethane (HCFC-141b)
- 1-Chloro-1,1,-difluoroethane (HCFC-142b)
- 1,1,1-Trifluoroethane (HFC-143a)
- Fluoroethane (HCFC-151a)
- 1,1-Difluoroethane (HFC-152a)
- Pentafluoropropane (HFC-225ca)
- Pentafluoropropane (HFC-225cb)
- Hexafluoropropane (HFC-236ea)
- Hexafluoropropane (HFC-236fa)

- Pentafluoropropane (HFC-245ca)
- Pentafluoropropane (HFC-245ea)
- Pentafluoropropane (HFC-245eb)
- Pentafluoropropane (HFC-245fa)
- Pentafluorobutane (HFC-365mfc)
- Parachlorobenzotrifluoride (PCBTF)
- Methoxybutane
- Nonaflourobutane
- Heptafluoropropane ($(CF_3)_2CFCF_2OCH_3$)
- Heptafluoropropane ($(CF_3)CFCF_2OC_2H_5$)
- Perchloroethylene
- Cyclic, branched or linear completely methylated siloxanes
- Methyl acetate
- Volatile methyl siloxanes
- Acetone

In addition, the following four classes of perfluorocarbons (PFCs) have been excluded:

- Cyclic, branched or linear completely fluorinated alkanes
- Cyclic, branched or linear completely fluorinated ethers with no unsaturations
- Cyclic, branched or linear completely fluorinated tertiary amines with no unsaturations
- Sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine

4.3 Emissions Estimation Methodologies

Ohio EPA used TV emissions reports to compile the State's point source inventory. Facilities provided emissions and described their method of calculation. Among many methods, facilities have used emissions factors, stack test results, material balances, engineering judgment and other available methods to calculate emissions. The facility provided reports were reviewed for completeness by Ohio EPA. XML reports were generated by Ohio EPA and provided to LADCO and USEPA. LADCO imported and processed the files in CONCEPT and applied temporal and spatial profiles to calculate the daily emissions rates. The final point source inventory is split into two separate reports, the Electric Generating Units (EGU) which is the U.S. EPA inventory for electric generating units and the non-EGU which is the state inventory minus the EGU units. The emissions information can be found at LADCO web site.

http://www.ladco.org/tech/emis/current/index.php

4.4 References

Recommended Policy on the Control of Volatile Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, NC, Revised January 18, 1989.

Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I: General Guidance for Stationary Sources. EPA-450/4-91-016, Office of Air Quality Planning & Standards Research, Triangle Park, NC. May 1991.

Compilation of Air Pollution Emission Factors, Fourth Edition and Supplements, AP-42. U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1985.

Guidance for the Preparation of Quality Assurance Plans for O3/CO SIP Emission Inventories. EPA-450/4-88-023, U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Par, NC, December 1988.

Documentation for the 2002 Electric Generating Unit National Emissions Inventory (NEI). Eastern research group, Inc., 1600 Perimeter Park Drive, Morrisville, NC 27560 and E.H. Pechan and Associates, Inc., 5528–B Hempstead Way

http://www.epa.gov/ttn/chief/net/neip/

http://www.epa.gov/ttn/chief/publications.html

http://www.epa.gov/ttn/chief/efpac/index.html

http://www.epa.gov/ttn/chief/eiinformation.html

5 Area Sources

Area sources are sources which are typically small, individual, numerous, and have not been inventoried as specific point, mobile, or biogenic sources. For inventory purposes, they are grouped with other like sources into categories that allow emissions to be calculated collectively using one methodology. Since area sources are traditionally defined at the county level, most methods are designed to estimate area source emissions at the county level.

Ohio EPA has either used published Emission Inventory Improvement Program (EIIP) methodologies or selected other methodologies which are shared by other states and USEPA. The decision of which methodology to use was largely based on Ohio's data availability. Data which was not available on a county-level is estimated by assigning a percentage of the state's total activity to each county based on the state's population or employment information.

As a member of ERTAC, Ohio EPA actively participated in the generation of the Committee's 2008 area source methodologies and emissions factors. USEPA headed the ERTAC committee and contracted with Pechan consulting to estimate emissions for specific area source categories for all States. Ohio EPA reviewed those estimates to define a level of agreement. For most of those categories, Ohio EPA was in complete agreement with the estimates and adopted the ERTAC inventory estimates. For categories where Ohio had more refined data or methodology for an area source estimate, Ohio recalculated the inventory estimate.

5.1 Source Identification

Area source categories of emissions have been identified primarily through past experience with previous inventories and availability of data for new inventories. Most of the past inventories have followed previous guidance and have been found to be complete. As knowledge of emissions and emission sources grows, USEPA, through the ERTAC group, introduces new source categories for area sources. Ohio EPA reviewed the updated list and incorporated the new categories, as appropriate, added since the previous inventory.

Care is also taken when identifying potential area source categories. This means that some categories classified as area sources in other states are included solely in the point source inventory for Ohio EPA. The best example of this is coal combustion in industrial boilers. All boilers of this type are assumed to be permitted and therefore included in the point source inventory. In this and similar cases, Ohio EPA reported zero emissions for those categories to USEPA. Reporting zero emissions indicates that the category has been evaluated and not overlooked.

5.2 Source Category Descriptions and Emission Estimation Approach

ERTAC formed workgroups and subcommittees to define the list and a plan for each area source category. The entire list of area source categories is listed in Table 1. The table was constructed in cooperation with USEPA and other states through ERTAC. The Ohio EPA approach options for calculating emissions estimates for each SCC are explained below:

1. US EPA Calculated Emission Estimates - Ohio was in complete agreement with the ERTAC methodology and emissions factors. For some sources in this category, Ohio EPA used the US EPA/ERTAC estimate and applied a Point Source Subtraction. That means that either the area source activity or emissions were adjusted to account for activity or emissions reported to Ohio EPA that had already been included in the point

source inventory.

2. Point Source Subtraction Emissions Estimates - there was reason to deviate from ERTAC developed estimates. These area source emissions are estimated by modifying US EPA's files to allow Ohio EPA to subtract point source emissions or to use state-specific activity data.

3. Ohio EPA Produced Emissions Estimates - an inventory was not considered by ERTAC but deemed important to Ohio EPA. Ohio EPA used State specific activity data, methodology or emission factors.

4. Excluded SCCs - all known inventories that were not included in 2008, are provided in Category D and should be evaluated in future inventory years and possibly incorporated into the mainstream inventories.

Descriptions of the area source categories are provided in the following sections which have been grouped according to the Ohio EPA approach (Categories 1-4 described above) used to estimate emissions. The source categories have been organized within each section according to the source category code. Due to the number of sources discussed in this section, Table 1 shows a summary of the area sources and their corresponding pollutant emissions. As previously stated, all US EPA calculated emissions are developed in consultation with ERTAC. The methodology and emissions can be viewed on the US EPA 2008 National Emissions Inventory website at:
http://www.epa.gov/ttn/chief/net/2008inventory.html#inventorydoc.

Table 1 Area Sources and Respective Pollutants

Ref #	SCC	Area Source	VOC	NOX	SO2	PM-CON	PM 10-FIL	PM 2.5-FIL	PM 10-Pri	PM 25-Pri	CO	NH3	Hg
1	2401001000	Architectural Surface Coatings	■										
2	2501080050	Aviation Gasoline Distribution Stage 1	■										
3	2501080100	Aviation Gasoline Distribution Stage 2	■										
4	2401008000	Traffic Paints (or Pavement Markings)	■										
5	2465000000	Consumer Solvents	■										
6	2104004000	Residential Heating; Distillate Fuel	■	■	■	■	■	■			■	■	
7	2104006000	Residential Heating; Natural Gas	■	■	■	■	■	■			■	■	
8	2104007000	Residential Heating; Liquefied Petroleum Gas (LPG)	■	■	■	■	■	■			■	■	
9	Multiple	Residential Heating; Wood.	■	■	■				■	■	■	■	
10	2104011000	Residential Heating; Kerosene	■	■	■	■	■	■			■	■	
11	Multiple	Residential Heating; Coal	■	■	■	■	■	■	■	■	■	■	
			■	■	■	■	■	■	■	■	■	■	
12	2294000000	Paved Roads					■	■	■	■			
13	2296000000	Unpaved Roads					■	■	■	■			
14	Multiple	Commercial Cooking	■	■	■		■	■	■	■	■		
15	Multiple	Construction							■	■			
16	2461021000	Cutback Asphalt	■										
17	2461022000	Emulsified Asphalt	■										
18	Multiple	Open Burning – Yard Waste	■	■	■		■	■	■	■	■		
19	2610000500	Open Burning – Land Clearing Debris	■	■			■	■	■	■	■		

Ref #	SCC	Area Source	VOC	NOX	SO2	PM-CON	PM 10-FIL	PM 2.5-FIL	PM 10-Pri	PM 25-Pri	CO	NH3	Hg
20	2610030000	Open Burning – Residential Household Waste											
21	Multiple	Animal Husbandry											
22	Multiple	Fertilizer Application											
23	Multiple	Portable Fuel Containers											
24	Multiple	Fuel Combustion; Industrial, Commercial, & Institutional											
25	2401005000	Surface Coating - Auto Refinishing											
26	2401015000	Surface Coating - Factory Finished Wood: SIC 2426 thru 242											
27	2401020000	Surface Coating - Wood Furniture											
28	2401025000	Surface Coating - Metal Furniture: SIC 25											
29	2401030000	Surface Coating - Paper, foil, and film											
30	2401040000	Surface Coating - Metal Can Coating											
31	2401045000	Surface Coating - Sheet, strip, and coil											
32	2401055000	Surface Coating – Machinery & Equipment: SIC 35											
33	2401060000	Surface Coating - Large Appliances: SIC 363											
34	2401065000	Surface Coating – Electronic &other Electric Coatings											
35	2401070000	Surface Coating – Motor Vehicles											
36	2401075000	Surface Coating – Aircraft											
37	2401080000	Surface Coating – Marine											
38	2401085000	Surface Coating – Railroad											

Ref #	SCC	Area Source	VOC	NOX	SO2	PM-CON	PM 10-FIL	PM 2.5-FIL	PM 10-Pri	PM 25-Pri	CO	NH3	Hg
39	2401090000	Surface Coating – Misc	■										
40	2401100000	Industrial Maintenance Coatings	■										
41	2401200000	Other Special Purpose Coatings	■										
42	2415000000	Degreasing	■										
43	2425000000	Graphic Arts	■										
44	2420000000	Dry Cleaning	■										
45	2461850000	Agricultural Pesticide Application	■										
46	2630020000	Publicly Owned Treatment Works	■										
47	Multiple	Gas Distribution: Stage 1	■										
48	2501060100	Stage 2 Gasoline Refueling	■										
49	2810060200	Cremation:		■			■	■					
		Human											
50	2850000010	Hospital Sterilization	■										
51	2810030000	Structure Fires	■	■					■	■			
52	2810050000	Vehicle Fires		■					■	■	■		
53	2850001000	Dental Prep											■
54	Split into 57 & 58	Fluorescent Lamps											■
55	None Yet	Non-Fluorescent Lamps											■
56	2861000010	Lamp (Fluorescent) Recycling											■
57	2861000000	Lamp Breakage (Landfill emissions)											■
58	None Yet	Thermostats											■
59	None Yet	Auto Switches											■
60	None Yet	Switches & Relays											■

5.3 Area Source Category Descriptions and Emissions Estimate Methodology

Several methodologies have been used in estimating area source emissions.

- Emission factors
  - Standard (e.g., lb/person, lb/acre)
  - Formula (methods that may require multiple data values)
- Growth factors
- Data from inventories compiled by ERTAC

5.3.1 US EPA Calculated Emissions Estimates

1. **Architectural Surface Coatings (SCC 2401001000)**

Architectural Surface Coatings is typically considered to be a non-industrial category which homeowners and painting contractors use for coating the interior and exterior of houses, buildings, and other surfaces. Two types of paint are used to categorize this area source: water-based and solvent-based paint. Solvent-based paint typically contains substantially higher volatile solvent contents than water-based paint.

Ohio EPA adopted US EPA's estimate with a modification of applying a 10% reduction on factors and emissions due to Ohio's AIM rule.

Table 2 lists the emission factors used in calculating the VOC emissions which US EPA acquired from the ERTAC advisory panel based on the 2007 Freedonia Study.

Table 2 Architectural Surface Coatings VOC Emission Factors and Paint Usage Factors

Paint Type	VOC Emission Factor (lb/capita)
Solvent-Based Paint	3.09

The Emission Factor used is for states without AC rules (Ohio has no AC rules).

2. **Aviation Gasoline Distribution Stage 1 (SCC 2501080050)**

Aviation gasoline (also called "AvGas") is the only aviation fuel that contains tetraethyl lead (TEL) as a knock-out component for small reciprocating, piston-engine crafts in civil aviation.[1] Commercial and military aviation rarely use this fuel. AvGas is shipped to airports and is filled into bulk terminals, and then into tanker trucks. These processes fall under the definition of stage I, displacement vapors during the transfer of gasoline from tank trucks to storage tanks, and vice versa. These processes are subject to EPA's maximum available control technology (MACT) standards for gasoline distribution.[2]

The national-level emissions are calculated by multiplying AvGas (which is obtained from the Petroleum Supply Annual for designated Petroleum Administration Districts, or PADs[3]) consumption by the appropriate emission factors then allocated based on consumption reported

for PAD 2 (Midwestern states). That value is then allocated to the counties within PAD 2 based on 2008 Landing-Take Off (LTO) data for general aviation flights.[4] General aviation flights are used in this allocation because they are the primary consumers of AvGas. Table 3 lists the EFs used to calculate these emissions.

Table 3 AvGas Stage 1 VOC Emission Factors

Pollutant	Emission Source	Emission Factor	Emission Factor Units	Factor Reference
VOC	Aviation Gas Unloading/ Tank Filling - tank fill	0.009021383	lb/GAL AvGas	1
	Aviation Gas Unloading/ Tank Filling - Storage tank working	0.003605215		
	Aviation Gas Tank Truck Filling - Composite	0.010306575		
	Aviation Gas Storage Tank - Breathing losses	0.001694117		
	Aviation Gas - Fugitive from valves	0.573201882	lb/valve/day	
	Aviation Gas - Fugitive from pumps	5.952481079	lb/seal/day	

Ohio EPA accepted US EPA's estimates without any changes. This is a new non-point source for OEPA.

3. Aviation Gasoline Distribution Stage 2 (SCC 2501080100)

Stage II involves the transfer of fuel from the tanker trucks into general aviation aircraft. The activity data is collected same as Stage I and emissions are calculated same as above. Table 4 shows the EF used to calculate Stage II emissions.

Table 4 AvGas Stage 2VOC Emission Factor

Pollutant	Emission Source	Emission Factor	Emission Factor Units	Factor Reference
VOC	Fuel Transfer from Tanker Trucks to General Aviation Aircraft	0.0136	lb/GAL AvGas	1

Ohio EPA accepted US EPA's estimates without any changes. This is a new non-point source for OEPA.

4. **Traffic Paints (SCC 2401008000) also Pavement Markings**

Three types of activity data collected are population, road miles, and employment data. Employment data is listed by the North American Industrial Classification Standard (NAICS) code(s) that is used to determine county-level employment for the category.
The population data is collected from the U.S. Census Bureau's population estimates for July 1, 2008. The Federal Highway Administration provides county-level road miles as a part of their HPMS data. The most recent data set available at the time of compilation is 2006. The employment data is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation).[5]

Based on activity data available, either emission factor may be used to calculate emissions. Table 5 shows the EF used which were developed using the 2007 Freedonia data.

Table 5 Traffic Paint VOC Emission Factors

Pollutant	Emission Source	Emission Factor	Emission Factor
VOC	Traffic Markings	22.1 lbs/road mile	10.5 lbs/lane mile

Ohio EPA accepted US EPA's estimates without any changes. US EPA's estimate is 60% lower than that of Ohio EPA's due to improved methodology and activity data.

5. **Consumer Solvents (SCC 2465000000)**

This area source includes a wide array of products including personal care products, household cleaning products and household pesticides. The majority of VOC emitted into the air from this category is a result of evaporation of the solvent contained in the product or from the propellant released during use. Table 6 shows the sources contained in this category are listed below with their appropriate SCC and the ERTAC recommended VOC emissions factor.

Table 6 Consumer Solvent VOC Emission Factors

Consumer Solvent Sources	SCC	lbs/capita
C&C: Personal Care Products (Cosmetics and Toiletries)	2460100000	1.9
C&C: Household Products (Cleaning Products: Household)	2460200000	1.8
C&C: Automotive Aftermarket (Transportation: Motor Vehicles)	2460400000	1.36
C&C: Adhesives and Sealants	2460600000	0.57
C&C: FIFRA Regulated Products	2460800000	1.78
C&C: Coatings and Related Products	2460500000	0.95
C&C: Misc. Products	2460900000	0.07

Ohio EPA adopted USEPA's estimate and applied a 7.1% reduction on factors and emissions due to Consumer Products State rule.Residential Heating; Distillate Fuel (SCC 2104004000)
The state-level volume of distillate oil consumed by residential combustion in the USA is used to estimate emissions. Distillate oil consumption by energy use sector is presented in State Energy Data 2006 Consumption tables published by the Energy Information Administration (EIA).[6] Year 2006 consumption data are used as a surrogate for 2008 emissions because year 2006 data are the latest data available when this inventory is prepared.

State-level distillate oil consumption is allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[7] These data include the number of housing units using a specific type of fuel for residential heating. State distillate oil consumption is allocated to each county using the ratio of the number of houses burning distillate oil in each county to the total number of houses burning distillate oil in the State.

Criteria pollutant emission factors for distillate oil are from AP-42.[8] The distillate oil consumed is assumed to be No. 2 fuel oil with a heating value of 140,000 Btu per gallon and a sulfur content of 0.30%.[9] The ammonia emission factor is from US EPA's *Estimating Ammonia Emissions from Anthropogenic Sources, Draft Report.*[10]

Table 7 Residential Distillate Oil Emission Factors

Pollutant Code	Pollutant Code Description	LB/E3GAL
NH3	AMMONIA	1
CO	CARBON MONOXIDE	5
NOX	NITROGEN OXIDES	18
PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	1.08
PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	0.83
PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	1.3
SO2	SULFUR DIOXIDE	42.6
VOC	VOLATILE ORGANIC COMPOUNDS	0.7

Ohio EPA accepted US EPA's estimates without any changes

6. **Residential Heating; Natural Gas (SCC 2104006000)**

Residential Natural Gas (NG) Combustion is burned to heat residential housing as well as in grills, hot water heaters, and dryers.

The State NG Consumption from the EIA is allocated it to the county level using the methods described below. County level NG consumption is multiplied by the emission factors (EF) to calculate emissions. The State Energy Data 2006 Consumption tables published by the EIA[6] are used as a surrogate for 2008 emissions because these data are the latest available when this inventory was prepared.

State-level NG consumption is allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information. [7] These data include the number of housing units using a specific type of fuel for residential heating. State NG 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 NG in the State.

The criteria pollutant EF for Natural Gas are from AP-42.[8] The ammonia EF is from EPA's *Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report.*[11] According to AP-42, NG has a heat content of 1,050 million BTU per million cubic feet. This value was required to convert EF originally given in units "pounds per million Btu" to units "pounds per million cubic feet." The grains of sulfur per million cubic feet are assumed to be 2000.[12] Some EF are revised based on recommendations by ERTAC advisory panel composed of state and EPA personnel.

Table 8 Residential Natural Gas Emission Factors

Pollutant Code	Pollutant Code Description	lb/E6FT3
NH3	AMMONIA	20
CO	CARBON MONOXIDE	40
NOX	NITROGEN OXIDES	94
PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	0. 2
PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	0.11
PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	0.32
SO2	SULFUR DIOXIDE	0.6
VOC	VOLATILE ORGANIC COMPOUNDS	5.5

Ohio EPA accepted US EPA's estimates without any changes

7. Residential Heating; Liquefied Petroleum Gas (LPG) (2104007000)

Common uses for LPG fuel include space heating, water heating, and cooking.

Emissions are calculated by allocating the state LPG Consumption from the EIA and allocating it to the county level using methods described below. County level LPG consumption is multiplied by the emission factors to calculate emissions.

LPG combustion emissions were calculated using the volume of LPG consumed in the United States. State-level LPG consumption by sector is available from the Energy Information Administration (EIA).[6] Year 2006 consumption data were used as a surrogate for 2008 emissions because these were the latest data available when this inventory was prepared.

State-level LPG consumption is allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[7] These data include the number of housing units using a specific type of fuel for residential heating. 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.

Pollutant EFs for residential LPG are based on the residential natural gas emission factors.[8,9,12] For all counties in the United States, the natural gas consumed by residential combustion is assumed to have a heating value of 1,020 Btu per cubic foot and a sulfur content of 2,000 grains per million cubic feet[8] . The NG EF originally presented in units of "pounds per million cubic feet" were converted to energy-based units using the 1,020 Btu/cubic foot conversion factor. Then the NG EFs are converted to LPG EF by multiplying by 96,750 Btu/gallon. Some EFs are revised based on recommendations by an ERTAC advisory panel composed of state and EPA personnel.

Table 9 Residential LPG Emission Factors

Pollutant Code	Pollutant Code Description	lb/E3BBL
NH3	AMMONIA	1.95
CO	CARBON MONOXIDE	159.6
NOX	NITROGEN OXIDES	562.8
PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	0.796764706
PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	0.438220588
PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	1.274823529
SO2	SULFUR DIOXIDE	2.390294118
VOC	VOLATILE ORGANIC COMPOUNDS	21.91102941

Ohio EPA accepted US EPA's estimates without any changes

8. **Residential Heating; Wood**

Past inventories calculated emissions from this area source by estimating emissions from seven types of equipment that may be used for residential heating involving wood as shown below.

1) Fireplaces without inserts
2) Fireplaces with inserts catalytic (non-U.S. EPA certified)
3) Fireplaces with inserts non-catalytic
4) Fireplaces with inserts catalytic (U.S. EPA certified)
5) Wood stoves – Conventional
6) Woodstoves – Catalytic
7) Wood stoves – Non catalytic

The number of Ohio homes with fireplaces are adjusted for those that burn wood and a state consumption value is applied which is apportioned to each county based on a county's population. For the 2008 inventory, US EPA added the hydroponic heaters and outdoor burning devices to this category to include all burning wood equipment.

Tables 10-16 show the EF used for each of the different types of wood burners which make-up this category. Each table is pollutant specific and contains each EF for each wood burning device.

Table 10 Ammonia Emission Factors Used for Wood Burners

SCC	SCC_L4	code	lb/Ton	Data Source
2104008100	Fireplace: general	NH3	1.8	MARAMA
2104008210	Woodstove: fireplace inserts; non-EPA certified	NH3	1.7	MARAMA
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	NH3	0.9	MARAMA
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	NH3	0.9	MARAMA
2104008310	Woodstove: freestanding, non-EPA certified	NH3	1.7	MARAMA
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	NH3	0.9	MARAMA
2104008330	Woodstove: freestanding, EPA certified, catalytic	NH3	0.9	MARAMA
2104008400	Woodstove: pellet-fired, general	NH3	0.3	MARAMA
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	NH3	1.8	MARAMA
2104008610	Hydronic heater: outdoor	NH3	1.8	MARAMA
2104008700	Outdoor wood burning device, NEC	NH3	1.8	MARAMA

Ohio EPA accepted US EPA's estimates without any changes

Table 11 Carbon Monoxide Emission Factors Used for Wood Burners

SCC	SCC_L4	code	lb/Ton	Data Source
2104008100	Fireplace: general	CO	149	MARAMA
2104008210	Woodstove: fireplace inserts; non-EPA certified	CO	230.8	2002 NEI
2104008220	Woodstove: fireplace inserts; EPA certified; non-	CO	140.8	2002 NEI

SCC	SCC_L4	code	lb/Ton	Data Source
	catalytic			
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	CO	104.4	2002 NEI
2104008310	Woodstove: freestanding, non-EPA certified	CO	230.8	2002 NEI
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	CO	140.8	2002 NEI
2104008330	Woodstove: freestanding, EPA certified, catalytic	CO	104.4	2002 NEI
2104008400	Woodstove: pellet-fired, general	CO	15.9	MARAMA
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	CO	184	MARAMA
2104008610	Hydronic heater: outdoor	CO	184	MARAMA
2104008700	Outdoor wood burning device, NEC	CO	149	MARAMA
2104009000	Residential Fire log Total: All	CO	125.08	Content and emission characteristics of Artificial Wax Fire logs, Environment Canada

Ohio EPA accepted US EPA's estimates without any changes

Table 12 Primary PM – 10 Emission Factors Used for Wood Burners

SCC	SCC_L4	code	lb/Ton	Data Source
2104008100	Fireplace: general	PM10-PRI	23.6	2002 NEI
2104008210	Woodstove: fireplace inserts; non-EPA certified	PM10-PRI	30.6	2002 NEI
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	PM10-PRI	19.6	2002 NEI
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	PM10-PRI	20.4	2002 NEI

SCC	SCC_L4	code	lb/Ton	Data Source
2104008310	Woodstove: freestanding, non-EPA certified	PM10-PRI	30.6	2002 NEI
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	PM10-PRI	19.6	2002 NEI
2104008330	Woodstove: freestanding, EPA certified, catalytic	PM10-PRI	20.4	2002 NEI
2104008400	Woodstove: pellet-fired, general	PM10-PRI	3.06	MARAMA
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	PM10-PRI	27.6	MARAMA
2104008610	Hydronic heater: outdoor	PM10-PRI	27.6	MARAMA
2104008700	Outdoor wood burning device, NEC	PM10-PRI	23.6	2002 NEI
2104009000	Residential Fire log Total: All	PM10-PRI	29.32	Content and emission characteristics of Artificial Wax Fire logs, Environment Canada

Ohio EPA accepted US EPA's estimates without any changes

Table 13 Primary PM – 2.5 Emission Factors Used for Wood Burners

SCC	SCC_L4	code	lb/Ton	Data Source
2104008100	Fireplace: general	PM25-PRI	23.6	2002 NEI
2104008210	Woodstove: fireplace inserts; non-EPA certified	PM25-PRI	30.6	2002 NEI
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	PM25-PRI	19.6	2002 NEI
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	PM25-PRI	20.4	2002 NEI
2104008310	Woodstove: freestanding, non-EPA certified	PM25-PRI	30.6	2002 NEI
2104008320	Woodstove:	PM25-	19.6	2002 NEI

SCC	SCC_L4	code	lb/Ton	Data Source
	freestanding, EPA certified, non-catalytic	PRI		
2104008330	Woodstove: freestanding, EPA certified, catalytic	PM25-PRI	20.4	2002 NEI
2104008400	Woodstove: pellet-fired, general	PM25-PRI	3.06	MARAMA
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	PM25-PRI	27.6	MARAMA
2104008610	Hydronic heater: outdoor	PM25-PRI	27.6	MARAMA
2104008700	Outdoor wood burning device, NEC	PM25-PRI	23.6	2002 NEI
2104009000	Residential Fire log Total: All	PM25-PRI	28.4	Content and emission characteristics of Artificial Wax Fire logs, Environment Canada

Ohio EPA accepted US EPA's estimates without any changes

Table 14 Sulfur Dioxide Emission Factors Used for Wood Burners

SCC	SCC_L4	code	lb/Ton	Data Source
2104008100	Fireplace: general	SO2	0.4	2002 NEI
2104008210	Woodstove: fireplace inserts; non-EPA certified	SO2	0.4	2002 NEI
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	SO2	0.4	2002 NEI
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	SO2	0.4	2002 NEI
2104008310	Woodstove: freestanding, non-EPA certified	SO2	0.4	2002 NEI
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	SO2	0.4	2002 NEI
2104008330	Woodstove:	SO2	0.4	2002 NEI

SCC	SCC_L4	code	lb/Ton	Data Source
	freestanding, EPA certified, catalytic			
2104008400	Woodstove: pellet-fired, general	SO2	0.32	MARAMA
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	SO2	2.03	MARAMA
2104008610	Hydronic heater: outdoor	SO2	2.03	MARAMA
2104008700	Outdoor wood burning device, NEC	SO2	0.4	2002 NEI

Ohio EPA accepted US EPA's estimates without any changes

Table 15 Volatile Organic Compounds Emission Factors Used for Wood Burners

SCC	SCC_L4	code	lb/Ton	Data Source
2104008100	Fireplace: general	VOC	18.9	MARAMA
2104008210	Woodstove: fireplace inserts; non-EPA certified	VOC	53	2002 NEI
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	VOC	12	2002 NEI
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	VOC	15	2002 NEI
2104008310	Woodstove: freestanding, non-EPA certified	VOC	53	2002 NEI
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	VOC	12	2002 NEI
2104008330	Woodstove: freestanding, EPA certified, catalytic	VOC	15	2002 NEI
2104008400	Woodstove: pellet-fired, general	VOC	0.041	MARAMA
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	VOC	11.7	MARAMA

SCC	SCC_L4	code	lb/Ton	Data Source
2104008610	Hydronic heater: outdoor	VOC	11.7	MARAMA
2104008700	Outdoor wood burning device, NEC	VOC	18.9	MARAMA
2104009000	Residential Fire log Total: All	VOC	39.56	Content and emission characteristics of Artificial Wax Fire logs, Environment Canada

Ohio EPA accepted US EPA's estimates without any changes

Table 16 Nitrous Oxides Emission Factors Used for Wood Burners

SCC	SCC_L4	code	lb/Ton	Data Source
2104008100	Fireplace: general	NOX	2.6	2002 NEI
2104008210	Woodstove: fireplace inserts; non-EPA certified	NOX	2.8	2002 NEI
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	NOX	2.28	MARAMA
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	NOX	2	2002 NEI
2104008310	Woodstove: freestanding, non-EPA certified	NOX	2.8	2002 NEI
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	NOX	2.28	MARAMA
2104008330	Woodstove: freestanding, EPA certified, catalytic	NOX	2	2002 NEI
2104008400	Woodstove: pellet-fired, general	NOX	3.8	MARAMA
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	NOX	1.8	MARAMA
2104008610	Hydronic heater: outdoor	NOX	1.8	MARAMA
2104008700	Outdoor wood burning device, NEC	NOX	2.6	2002 NEI

SCC	SCC_L4	code	lb/Ton	Data Source
2104009000	Residential Fire log Total: All	NOX	7.684	Content and emission characteristics of Artificial Wax Fire logs, Environment Canada

Ohio EPA accepted US EPA's estimates without any changes

9. **Residential Heating; Kerosene (SCC 2104011000)**

Common uses for this fuel are space heating, water heating, cooking, and running a wide variety of other equipment.

The volume of kerosene consumed by residential combustion in the U.S. is used to estimate emissions. Kerosene consumption by energy use sector is presented in State Energy Data 2006 Consumption tables published by the Energy Information Administration (EIA).[6] Year 2006 consumption data is used as a surrogate for 2008 emissions because that is the latest data available when this inventory was prepared.

State-level kerosene consumption is allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[7] These data include the number of housing units using kerosene. State kerosene consumption is 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.

EF for distillate oil is used for kerosene, but the distillate oil EFs are 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).[8] The criteria pollutants EF, listed below in table 17, are from AP-42.[9] Distillate sulfur content (0.30%) is used for kerosene as well [9].

Table 17 Residential Kerosene Emission Factors

Pollutant Code	Pollutant Code Description	LB/E3BBL
NH3	AMMONIA	40.5
CO	CARBON MONOXIDE	202.5
NOX	NITROGEN OXIDES	729
PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	43.74
PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	33.615
PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	52.65
SO2	SULFUR DIOXIDE	1,725.3
VOC	VOLATILE ORGANIC COMPOUNDS	28.35

Ohio EPA accepted US EPA's estimates without any changes

10. **Residential Heating; Coal**

The mass of coal consumed by residential combustion in the U.S. is used to estimate emissions. Coal consumption by energy use sector is presented in State Energy Data 2006 Consumption tables published by the Energy Information Administration (EIA).[6] Year 2006 consumption data is used as a surrogate for 2008 emissions because this is latest data available when this inventory was prepared.

EIA data do not distinguish between anthracite and bituminous coal consumption estimates. The EIA table "Domestic Distribution of U.S. Coal by Destination State, Consumer, Origin and Method of Transportation," provides state-level residential coal distribution data for 2006 that is used to estimate anthracite and bituminous coal consumption. The amount of anthracite distributed to each state and the total coal delivered to each state were used to estimate the proportion of anthracite and bituminous coal consumption.[13] The 2006 ratio of anthracite (and bituminous) coal consumption to total coal consumption is used to distribute the EIA's total residential sector coal consumption data by coal type. The 2006 anthracite and bituminous coal ratios for Ohio are shown in Table 18.

Table 18 Anthracite/bituminous Coal Usage Ratios in Ohio

SCC	Source	Ratio of Consumption
2104001000	Anthracite Coal	0.1273
2104002000	Bituminous Coal	0.8727

State-level coal consumption was allocated to each county using the US Census Bureau's 2000 Census Detailed Housing Information.[7] These data include the number of housing units using a specific type of fuel for residential heating. State coal consumption was allocated to each county using the ratio of the number of houses burning coal in each county to the total number of houses burning coal in the State.

Where SO_2 and PM EFs are required, State-specific sulfur and ash contents of anthracite and bituminous coal were obtained from data compiled in preparing the 1999 residential coal combustion emissions estimates.[9] This study mostly relied on data obtained from USGS COALQUAL database. States not included in the database but had reported coal usage are assigned values based on their proximity to coal seams or using an average value for Pennsylvania. See Table 19 for SO_2 and PM EF.

Table 19 SO_2 and PM Emission Factors for Industrial Anthracite and Bituminous Coal Combustion

Pollutant	Emission Factor (lb/ton)	AP-42 Table
Anthracite Emission Factors (SCC 2104001000)		
PM-CON	0.08* % Ash	1.2-3
PM10-FIL	10	1.2-4
PM25-FIL	0.6 * % Ash	1.2-4
PM10-PRI	10 + 0.08* % Ash	1.2-3 and 1.2-4
PM25-PRI	0.6 * % Ash + 0.08* % Ash	1.2-3 and 1.2-4
Sulfur Dioxide	39 * % Sulfur	1.2-1
Bituminous Emission Factors (SCC 2104002000)		
PM-CON	.04	1.1-5
PM10-FIL	6.2	1.1-9
PM25-FIL	3.8	1.1-9
PM10-PRI	6.24	1.1-5 and 1.1-9
PM25-PRI	3.84	1.1-5 and 1.1-9
Sulfur Dioxide	31 * % Sulfur	1.1-3
NOTE: PM_{10}, $PM_{2.5}$, and condensable PM EFs for bituminous coal do not require ash content, nor does the condensable PM EF for anthracite coal.		

Table 20 presents the bituminous and anthracite coal sulfur content values used for Ohio. For anthracite coal, an ash content value of 13.38% and a sulfur content of 0.89% are applied. The remaining criteria pollutant emissions are calculated by multiplying the total coal consumed in each county per year by an EF. All EFs except ammonia are from AP-42[8]. The ammonia EF is from EPA's *Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report.*[11] Table 21 presents a summary of the EFs for residential anthracite coal combustion while Table 22 presents a summary of the EF for residential bituminous coal combustion.

Table 20 Ohio-Specific Sulfur and Ash Content for Coal

Coal Type	Percent Sulfur Content	Percent Ash Content
Bituminous	3.45	NA
Anthracite	0.89	13.38

Table 21 Emission Factors for Residential Anthracite Coal Combustion
(Not Adjusted for Point Source Fuel Consumption)

Pollutant	Code Description	lb/Ton
CO	CARBON MONOXIDE	275
NH3	AMMONIA	2
SO2	SULFUR DIOXIDE	34.71
PM10-PRI	PRIMARY PM10	11.0704
PM25-PRI	PRIMARY PM2.5	9.0984
PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	10
PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	8.028
PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	1.0704
NOX	NITROGEN OXIDES	3
VOC	VOLATILE ORGANIC COMPOUNDS	10

Table 22 Emission Factors for Residential Bituminous Coal Combustion
(Not Adjusted for Point Source Fuel Consumption)

Pollutant	Code Description	lb/Ton
CO	CARBON MONOXIDE	275
NH3	AMMONIA	2
SO2	SULFUR DIOXIDE	106.95
PM10-PRI	PRIMARY PM10	6.24
PM25-PRI	PRIMARY PM2.5	3.84
PM10-FIL	PRIMARY PM10, FILTERABLE PORTION ONLY	6.2
PM25-FIL	PRIMARY PM2.5, FILTERABLE PORTION ONLY	3.8
PM-CON	PRIMARY PM CONDENSIBLE PORTION ONLY (ALL LESS THAN 1 MICRON)	0.04
NOX	NITROGEN OXIDES	9.1
VOC	VOLATILE ORGANIC COMPOUNDS	10

Ohio EPA accepted US EPA's estimates without any changes

11. **Paved Roads (SCC 2294000000)**

Fugitive dust emissions from paved road traffic were estimated for PM10-PRI, PM10-FIL, PM25-PRI, and PM25-FIL. Since there are no PM-CON emissions for this category, PM10-PRI emissions are equal to PM10-FIL emissions and PM25-PRI emissions are equal to PM25-FIL. Uncontrolled paved road emissions are calculated at the State level by roadway class and

month by multiplying the State/roadway class VMT by the appropriate monthly temporal allocation factor and by the paved road EF. After the paved road dust emissions are calculated at the State/road class/monthly level of detail, the uncontrolled emissions are allocated to the county level using total VMT as a surrogate. Next, control factors are applied to the paved road emissions in PM_{10} nonattainment area counties. Emissions and VMT by roadway class are then totaled to the county level for reporting in the NEI. The following equation is used to estimate road dust emissions from AP-42:[14]

$$E = [k * (sL/2)^{0.65} * (W/3)^{1.5} - C] * [1 - P/(4*N)]$$

where: E = paved road dust emission factor (gram [g]/VMT)
k = particle size multiplier (7.3 g/VMT for PM10-PRI/-FIL and 1.1 g/VMT for PM25-PRI/-FIL)
sL = road surface silt loading (g/square meter [m^2])
W = average weight (tons) of all vehicles traveling the road
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear (0.2119 g/VMT for PM10-PRI/-FIL and 0.1617 g/VMT for PM 2.5-PRI/-FIL)
N = number of days in the month
P = number of days in the month with at least 0.01 inches of precipitation

Table 23 lists Ohio's uncontrolled PM10-PRI/-FIL and PM25-PRI/-FIL EF as provided in US EPA's file "Paved Roads PM Emission Factors.xls". EF's are specific to each state, roadway class, and month.Paved road silt loadings are assigned to each of the twelve functional roadway classes (six urban and six rural) based on the average annual traffic volume of each functional system by State[15]. The resulting paved road silt loadings calculated for Ohio from the average annual traffic volume data are shown in Table 24.

Table 23 Paved Roads PM10 Emissions Factors for Ohio

ROAD TYPE	ROAD TYPE	Month	Pollutant	g/VMT for PM10	g/VMT for PM25
Rural Interstate	110	Jan	PM 10 & PM25	0.1125428	0
Rural Interstate	110	Feb	PM 10 & PM25	0.108696	0
Rural Interstate	110	Mar	PM 10 & PM25	0.1085939	0
Rural Interstate	110	Apr	PM 10 & PM25	0.1111936	0
Rural Interstate	110	May	PM 10 & PM25	0.1076067	0
Rural Interstate	110	Jun	PM 10 & PM25	0.1101734	0
Rural Interstate	110	Jul	PM 10 & PM25	0.1115555	0
Rural Interstate	110	Aug	PM 10 & PM25	0.1174788	0
Rural Interstate	110	Sep	PM 10 & PM25	0.1173143	0
Rural Interstate	110	Oct	PM 10 & PM25	0.1224149	0
Rural Interstate	110	Nov	PM 10 & PM25	0.1122137	0
Rural Interstate	110	Dec	PM 10 & PM25	0.1066195	0
Rural Other Principal Arterial	130	Jan	PM 10 & PM25	0.5619831	0
Rural Other Principal Arterial	130	Feb	PM 10 & PM25	0.5427744	0
Rural Other Principal Arterial	130	Mar	PM 10 & PM25	0.5422644	0
Rural Other Principal Arterial	130	Apr	PM 10 & PM25	0.5552459	0
Rural Other Principal Arterial	130	May	PM 10 & PM25	0.5373348	0
Rural Other Principal Arterial	130	Jun	PM 10 & PM25	0.5501519	0
Rural Other Principal Arterial	130	Jul	PM 10 & PM25	0.5570535	0

ROAD TYPE	ROAD TYPE	Month	Pollutant	g/VMT for PM10	g/VMT for PM25
Rural Other Principal Arterial	130	Aug	PM 10 & PM25	0.5866315	0
Rural Other Principal Arterial	130	Sep	PM 10 & PM25	0.5858099	0
Rural Other Principal Arterial	130	Oct	PM 10 & PM25	0.6112799	0
Rural Other Principal Arterial	130	Nov	PM 10 & PM25	0.5603399	0
Rural Other Principal Arterial	130	Dec	PM 10 & PM25	0.5324051	0
Rural Minor Arterial	150	Jan	PM 10 & PM25	1.4603835	0.1007532
Rural Minor Arterial	150	Feb	PM 10 & PM25	1.4104672	0.0973095
Rural Minor Arterial	150	Mar	PM 10 & PM25	1.409142	0.097218
Rural Minor Arterial	150	Apr	PM 10 & PM25	1.442876	0.0995454
Rural Minor Arterial	150	May	PM 10 & PM25	1.3963316	0.0963342
Rural Minor Arterial	150	Jun	PM 10 & PM25	1.4296386	0.0986321
Rural Minor Arterial	150	Jul	PM 10 & PM25	1.4475731	0.0998694
Rural Minor Arterial	150	Aug	PM 10 & PM25	1.5244354	0.1051722
Rural Minor Arterial	150	Sep	PM 10 & PM25	1.5223003	0.1050249
Rural Minor Arterial	150	Oct	PM 10 & PM25	1.5884873	0.1095912
Rural Minor Arterial	150	Nov	PM 10 & PM25	1.4561134	0.1004586
Rural Minor Arterial	150	Dec	PM 10 & PM25	1.3835212	0.0954504
Rural Major Collector	170	Jan	PM 10 & PM25	1.4603835	0.1007532
Rural Major Collector	170	Feb	PM 10 & PM25	1.4104672	0.0973095
Rural Major Collector	170	Mar	PM 10 & PM25	1.409142	0.097218
Rural Major Collector	170	Apr	PM 10 & PM25	1.442876	0.0995454
Rural Major Collector	170	May	PM 10 & PM25	1.3963316	0.0963342
Rural Major Collector	170	Jun	PM 10 & PM25	1.4296386	0.0986321
Rural Major Collector	170	Jul	PM 10 & PM25	1.4475731	0.0998694
Rural Major Collector	170	Aug	PM 10 & PM25	1.5244354	0.1051722
Rural Major Collector	170	Sep	PM 10 & PM25	1.5223003	0.1050249
Rural Major Collector	170	Oct	PM 10 & PM25	1.5884873	0.1095912
Rural Major Collector	170	Nov	PM 10 & PM25	1.4561134	0.1004586
Rural Major Collector	170	Dec	PM 10 & PM25	1.3835212	0.0954504
Rural Minor Collector	190	Jan	PM 10 & PM25	1.4603835	0.1007532
Rural Minor Collector	190	Feb	PM 10 & PM25	1.4104672	0.0973095
Rural Minor Collector	190	Mar	PM 10 & PM25	1.409142	0.097218
Rural Minor Collector	190	Apr	PM 10 & PM25	1.442876	0.0995454
Rural Minor Collector	190	May	PM 10 & PM25	1.3963316	0.0963342
Rural Minor Collector	190	Jun	PM 10 & PM25	1.4296386	0.0986321
Rural Minor Collector	190	Jul	PM 10 & PM25	1.4475731	0.0998694
Rural Minor Collector	190	Aug	PM 10 & PM25	1.5244354	0.1051722
Rural Minor Collector	190	Sep	PM 10 & PM25	1.5223003	0.1050249
Rural Minor Collector	190	Oct	PM 10 & PM25	1.5884873	0.1095912
Rural Minor Collector	190	Nov	PM 10 & PM25	1.4561134	0.1004586
Rural Minor Collector	190	Dec	PM 10 & PM25	1.3835212	0.0954504
Rural Local	210	Jan	PM 10 & PM25	3.1856653	0.3607272
Rural Local	210	Feb	PM 10 & PM25	3.0767783	0.3483974

ROAD TYPE	ROAD TYPE	Month	Pollutant	g/VMT for PM10	g/VMT for PM25
Rural Local	210	Mar	PM 10 & PM25	3.0738875	0.3480701
Rural Local	210	Apr	PM 10 & PM25	3.1474745	0.3564027
Rural Local	210	May	PM 10 & PM25	3.0459431	0.3449058
Rural Local	210	Jun	PM 10 & PM25	3.1185986	0.3531329
Rural Local	210	Jul	PM 10 & PM25	3.1577208	0.3575629
Rural Local	210	Aug	PM 10 & PM25	3.3253874	0.3765486
Rural Local	210	Sep	PM 10 & PM25	3.32073	0.3760212
Rural Local	210	Oct	PM 10 & PM25	3.4651096	0.3923699
Rural Local	210	Nov	PM 10 & PM25	3.1763504	0.3596724
Rural Local	210	Dec	PM 10 & PM25	3.0179987	0.3417416
Urban Interstate	230	Jan	PM 10 & PM25	0.1125428	0
Urban Interstate	230	Feb	PM 10 & PM25	0.108696	0
Urban Interstate	230	Mar	PM 10 & PM25	0.1085939	0
Urban Interstate	230	Apr	PM 10 & PM25	0.1111936	0
Urban Interstate	230	May	PM 10 & PM25	0.1076067	0
Urban Interstate	230	Jun	PM 10 & PM25	0.1101734	0
Urban Interstate	230	Jul	PM 10 & PM25	0.1115555	0
Urban Interstate	230	Aug	PM 10 & PM25	0.1174788	0
Urban Interstate	230	Sep	PM 10 & PM25	0.1173143	0
Urban Interstate	230	Oct	PM 10 & PM25	0.1224149	0
Urban Interstate	230	Nov	PM 10 & PM25	0.1122137	0
Urban Interstate	230	Dec	PM 10 & PM25	0.1066195	0
Urban Other Freeways and Expressways	250	Jan	PM 10 & PM25	0.1125428	0
Urban Other Freeways and Expressways	250	Feb	PM 10 & PM25	0.108696	0
Urban Other Freeways and Expressways	250	Mar	PM 10 & PM25	0.1085939	0
Urban Other Freeways and Expressways	250	Apr	PM 10 & PM25	0.1111936	0
Urban Other Freeways and Expressways	250	May	PM 10 & PM25	0.1076067	0
Urban Other Freeways and Expressways	250	Jun	PM 10 & PM25	0.1101734	0
Urban Other Freeways and Expressways	250	Jul	PM 10 & PM25	0.1115555	0
Urban Other Freeways and Expressways	250	Aug	PM 10 & PM25	0.1174788	0
Urban Other Freeways and Expressways	250	Sep	PM 10 & PM25	0.1173143	0
Urban Other Freeways and Expressways	250	Oct	PM 10 & PM25	0.1224149	0
Urban Other Freeways and Expressways	250	Nov	PM 10 & PM25	0.1122137	0
Urban Other Freeways and	250	Dec	PM 10 & PM25	0.1066195	0

ROAD TYPE	ROAD TYPE	Month	Pollutant	g/VMT for PM10	g/VMT for PM25
Expressways					
Urban Other Principal Arterial	270	Jan	PM 10 & PM25	0.2874789	0
Urban Other Principal Arterial	270	Feb	PM 10 & PM25	0.2776528	0
Urban Other Principal Arterial	270	Mar	PM 10 & PM25	0.2773919	0
Urban Other Principal Arterial	270	Apr	PM 10 & PM25	0.2840325	0
Urban Other Principal Arterial	270	May	PM 10 & PM25	0.2748702	0
Urban Other Principal Arterial	270	Jun	PM 10 & PM25	0.2814267	0
Urban Other Principal Arterial	270	Jul	PM 10 & PM25	0.2849572	0
Urban Other Principal Arterial	270	Aug	PM 10 & PM25	0.3000876	0
Urban Other Principal Arterial	270	Sep	PM 10 & PM25	0.2996673	0
Urban Other Principal Arterial	270	Oct	PM 10 & PM25	0.3126963	0
Urban Other Principal Arterial	270	Nov	PM 10 & PM25	0.2866383	0
Urban Other Principal Arterial	270	Dec	PM 10 & PM25	0.2723484	0
Urban Minor Arterial	290	Jan	PM 10 & PM25	0.5619831	0
Urban Minor Arterial	290	Feb	PM 10 & PM25	0.5427744	0
Urban Minor Arterial	290	Mar	PM 10 & PM25	0.5422644	0
Urban Minor Arterial	290	Apr	PM 10 & PM25	0.5552459	0
Urban Minor Arterial	290	May	PM 10 & PM25	0.5373348	0
Urban Minor Arterial	290	Jun	PM 10 & PM25	0.5501519	0
Urban Minor Arterial	290	Jul	PM 10 & PM25	0.5570535	0
Urban Minor Arterial	290	Aug	PM 10 & PM25	0.5866315	0
Urban Minor Arterial	290	Sep	PM 10 & PM25	0.5858099	0
Urban Minor Arterial	290	Oct	PM 10 & PM25	0.6112799	0
Urban Minor Arterial	290	Nov	PM 10 & PM25	0.5603399	0
Urban Minor Arterial	290	Dec	PM 10 & PM25	0.5324051	0
Urban Collector	310	Jan	PM 10 & PM25	1.4603835	0.1007532
Urban Collector	310	Feb	PM 10 & PM25	1.4104672	0.0973095
Urban Collector	310	Mar	PM 10 & PM25	1.409142	0.097218
Urban Collector	310	Apr	PM 10 & PM25	1.442876	0.0995454
Urban Collector	310	May	PM 10 & PM25	1.3963316	0.0963342
Urban Collector	310	Jun	PM 10 & PM25	1.4296386	0.0986321
Urban Collector	310	Jul	PM 10 & PM25	1.4475731	0.0998694
Urban Collector	310	Aug	PM 10 & PM25	1.5244354	0.1051722
Urban Collector	310	Sep	PM 10 & PM25	1.5223003	0.1050249
Urban Collector	310	Oct	PM 10 & PM25	1.5884873	0.1095912
Urban Collector	310	Nov	PM 10 & PM25	1.4561134	0.1004586
Urban Collector	310	Dec	PM 10 & PM25	1.3835212	0.0954504
Urban Local	330	Jan	PM 10 & PM25	1.4603835	0.1007532
Urban Local	330	Feb	PM 10 & PM25	1.4104672	0.0973095
Urban Local	330	Mar	PM 10 & PM25	1.409142	0.097218
Urban Local	330	Apr	PM 10 & PM25	1.442876	0.0995454
Urban Local	330	May	PM 10 & PM25	1.3963316	0.0963342
Urban Local	330	Jun	PM 10 & PM25	1.4296386	0.0986321
Urban Local	330	Jul	PM 10 & PM25	1.4475731	0.0998694

ROAD TYPE	ROAD TYPE	Month	Pollutant	g/VMT for PM10	g/VMT for PM25
Urban Local	330	Aug	PM 10 & PM25	1.5244354	0.1051722
Urban Local	330	Sep	PM 10 & PM25	1.5223003	0.1050249
Urban Local	330	Oct	PM 10 & PM25	1.5884873	0.1095912
Urban Local	330	Nov	PM 10 & PM25	1.4561134	0.1004586
Urban Local	330	Dec	PM 10 & PM25	1.3835212	0.0954504

Table 24 2008 Silt Loadings for Ohio by Roadway Class Modeled

Paved Road Emission Factors (g/m^2)												
	Rural Roadway Classes						**Urban Roadway Classes**					
State	Inter-State	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Inter-state	Freeways & Express-ways	Other Principal Arterial	Minor Arterial	Collector	Local
Ohio	0.015	0.03	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2

The AP-42 equation listed above (used to estimate road dust emissions) includes a correction factor to adjust for the number of days with measurable precipitation in each month. The factor of “4" in the precipitation adjustment accounts for the fact that paved roads dry more quickly than unpaved roads and that precipitation may not occur over the entire 24-hour day period. The number of days with at least 0.01 inches of precipitation in each month by State was obtained from the National Climatic Data Center.[16] Data is collected from a meteorological station selected to be representative of urban areas within each state. Whenever the EF calculated using the equation above is negative due to the subtraction of the C term that accounts for vehicle exhaust, brake wear, and tire wear, the EF is reset to zero, assuming that the emissions have been accounted for in the on-road emission inventory.

The paved road VMT estimates by state/roadway class are first temporally allocated by season using the National Acid Precipitation Assessment Program (NAPAP) Inventory seasonal temporal allocations factors for VMT.[17] These seasonal VMT values are multiplied by the ratio of the number of days in a month to the number of days in a season to adjust to monthly VMT. The EFs are then applied to estimate emissions by month. The paved road activity and emissions are spatially allocated to counties according to the fraction of total VMT in each county for the specific roadway class. Due to differences in methodologies used to calculate total and unpaved road VMT, there are rural counties with unpaved road VMT higher than total VMT. Those cases are treating by reducing the unpaved VMT to total VMT and paved road VMT is assigned a zero.

Paved road dust controls are applied by county to urban and rural roads in serious PM_{10} nonattainment areas and to urban roads in moderate PM_{10} nonattainment areas. The assumed control measure is vacuum sweeping of paved roads twice per month. A control efficiency of 79 % is assumed for this control measure.[18] The assumed rule penetration varies by roadway class and PM_{10} nonattainment area classification (serious or moderate). The rule penetration rates are shown in Table 25.

Rule effectiveness was assumed to be 100% for all counties where this control was applied.

The controls are applied at the county/roadway class level, and they differ by roadway class.

Table 25 Penetration Rate of Paved Road Vacuum Sweeping

PM_{10} Nonattainment Status	Roadway Class	Vacuum Sweeping Penetration Rate
Moderate	Urban Interstate	0.42
Moderate	Urban Freeway &	0.67
Moderate	Urban Other Principal	0.90
Moderate	Urban Minor Arterial	0.67
Moderate	Urban Collector	0.64
Moderate	Urban Local	0.88
Serious	Rural Interstate	0.55
Serious	Rural Other Principal Arterial	0.37
Serious	Rural Minor Arterial	0.71
Serious	Rural Major Collector	0.83
Serious	Rural Minor Collector	0.59
Serious	Rural Local	0.35
Serious	Urban Interstate	0.42
Serious	Urban Freeway &	0.67
Serious	Urban Other Principal	0.90
Serious	Urban Minor Arterial	0.67
Serious	Urban Collector	0.64
Serious	Urban Local	0.88

Ohio EPA accepted US EPA's estimates without any changes

12. Unpaved Roads (SCC 2296000000)

Fugitive dust emissions from unpaved road traffic are estimated for PM10-PRI, PM10-FIL, PM25-PRI, and PM25-FIL. Since there are no PM-CON emissions for this category, PM10-PRI emissions are equal to PM10-FIL emissions and PM25-PRI emissions are equal to PM25-FIL.

Uncontrolled unpaved road emissions are calculated at the State level by roadway class and month by multiplying the State/roadway class unpaved roadway VMT by the appropriate monthly temporal allocation factor and by the monthly unpaved road EF then allocated to the county level using 1990 rural population data as a surrogate. Next, control factors are applied to the unpaved road emissions in PM_{10} nonattainment area counties. Emissions and VMT by roadway class are totaled to the county level. The following provides further details on the emission factor equation, temporal and spatial allocation procedures, and controls.
Re-entrained road dust emissions for unpaved roads are estimated using unpaved road VMT and the EF equation from AP-42:[19]

$$E = [k * (s/12)^{1} * (SPD/30)^{0.5}] / (M/0.5)^{0.2} - C$$

where k, and C are empirical constants as identified in Table 14-1
k = particle size multiplier (lb/VMT)
E = size specific emission factor (lb/VMT)
s = surface material silt content (%)
SPD = mean vehicle speed (mph)

M = surface material moisture content (%)
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear (lb/VMT)

Table 26 Constants for Unpaved Roads Re-entrained Dust Emission Factor Equation

Constant	PM25-PRI/ PM25-FIL[22]	PM10-PRI/ PM10-FIL[22]
k (lb/VMT)	0.18	1.8
C	0.00036	0.00047

The uncontrolled EFs are provided for Ohio by roadway class and month in Table 27.

Table 27 Unpaved Roads PM Emissions Factors for Ohio

ROAD TYPE	ROAD TYPE	Month	Pollutant	g/VMT for PM10	g/VMT for PM25
Rural Minor Arterial	150	Jan	PM 10 & PM25	139.51	13.87
Rural Minor Arterial	150	Feb	PM 10 & PM25	107.71	10.71
Rural Minor Arterial	150	Mar	PM 10 & PM25	124.01	12.33
Rural Minor Arterial	150	Apr	PM 10 & PM25	144.16	14.33
Rural Minor Arterial	150	May	PM 10 & PM25	108.51	10.79
Rural Minor Arterial	150	Jun	PM 10 & PM25	120.14	11.94
Rural Minor Arterial	150	Jul	PM 10 & PM25	170.52	16.95
Rural Minor Arterial	150	Aug	PM 10 & PM25	201.52	20.03
Rural Minor Arterial	150	Sep	PM 10 & PM25	168.19	16.72
Rural Minor Arterial	150	Oct	PM 10 & PM25	217.02	21.57
Rural Minor Arterial	150	Nov	PM 10 & PM25	160.18	15.92
Rural Minor Arterial	150	Dec	PM 10 & PM25	108.51	10.79
Rural Major Collector	170	Jan	PM 10 & PM25	130.25	12.94
Rural Major Collector	170	Feb	PM 10 & PM25	100.56	9.99
Rural Major Collector	170	Mar	PM 10 & PM25	115.78	11.5
Rural Major Collector	170	Apr	PM 10 & PM25	134.6	13.37
Rural Major Collector	170	May	PM 10 & PM25	101.31	10.07
Rural Major Collector	170	Jun	PM 10 & PM25	112.16	11.15
Rural Major Collector	170	Jul	PM 10 & PM25	159.2	15.82
Rural Major Collector	170	Aug	PM 10 & PM25	188.15	18.7
Rural Major Collector	170	Sep	PM 10 & PM25	157.03	15.6
Rural Major Collector	170	Oct	PM 10 & PM25	202.62	20.13
Rural Major Collector	170	Nov	PM 10 & PM25	149.55	14.86
Rural Major Collector	170	Dec	PM 10 & PM25	101.31	10.07
Rural Minor Collector	190	Jan	PM 10 & PM25	122.35	12.15
Rural Minor Collector	190	Feb	PM 10 & PM25	94.45	9.38
Rural Minor Collector	190	Mar	PM 10 & PM25	108.75	10.8
Rural Minor Collector	190	Apr	PM 10 & PM25	126.42	12.56
Rural Minor Collector	190	May	PM 10 & PM25	95.16	9.45
Rural Minor Collector	190	Jun	PM 10 & PM25	105.35	10.46
Rural Minor Collector	190	Jul	PM 10 & PM25	149.53	14.85

ROAD TYPE	ROAD TYPE	Month	Pollutant	g/VMT for PM10	g/VMT for PM25
Rural Minor Collector	190	Aug	PM 10 & PM25	176.72	17.55
Rural Minor Collector	190	Sep	PM 10 & PM25	147.49	14.65
Rural Minor Collector	190	Oct	PM 10 & PM25	190.32	18.9
Rural Minor Collector	190	Nov	PM 10 & PM25	140.47	13.95
Rural Minor Collector	190	Dec	PM 10 & PM25	95.16	9.45
Rural Local	210	Jan	PM 10 & PM25	122.35	12.15
Rural Local	210	Feb	PM 10 & PM25	94.45	9.38
Rural Local	210	Mar	PM 10 & PM25	108.75	10.8
Rural Local	210	Apr	PM 10 & PM25	126.42	12.56
Rural Local	210	May	PM 10 & PM25	95.16	9.45
Rural Local	210	Jun	PM 10 & PM25	105.35	10.46
Rural Local	210	Jul	PM 10 & PM25	149.53	14.85
Rural Local	210	Aug	PM 10 & PM25	176.72	17.55
Rural Local	210	Sep	PM 10 & PM25	147.49	14.65
Rural Local	210	Oct	PM 10 & PM25	190.32	18.9
Rural Local	210	Nov	PM 10 & PM25	140.47	13.95
Rural Local	210	Dec	PM 10 & PM25	95.16	9.45
Urban Other Principal Arterial	270	Jan	PM 10 & PM25	99.87	9.9
Urban Other Principal Arterial	270	Feb	PM 10 & PM25	77.1	7.65
Urban Other Principal Arterial	270	Mar	PM 10 & PM25	88.78	8.8
Urban Other Principal Arterial	270	Apr	PM 10 & PM25	103.2	10.23
Urban Other Principal Arterial	270	May	PM 10 & PM25	77.68	7.7
Urban Other Principal Arterial	270	Jun	PM 10 & PM25	86	8.53
Urban Other Principal Arterial	270	Jul	PM 10 & PM25	122.07	12.11
Urban Other Principal Arterial	270	Aug	PM 10 & PM25	144.26	14.31
Urban Other Principal Arterial	270	Sep	PM 10 & PM25	120.4	11.94
Urban Other Principal Arterial	270	Oct	PM 10 & PM25	155.36	15.41
Urban Other Principal Arterial	270	Nov	PM 10 & PM25	114.67	11.37
Urban Other Principal Arterial	270	Dec	PM 10 & PM25	77.68	7.7
Urban Minor Arterial	290	Jan	PM 10 & PM25	99.87	9.9
Urban Minor Arterial	290	Feb	PM 10 & PM25	77.1	7.65
Urban Minor Arterial	290	Mar	PM 10 & PM25	88.78	8.8
Urban Minor Arterial	290	Apr	PM 10 & PM25	103.2	10.23
Urban Minor Arterial	290	May	PM 10 & PM25	77.68	7.7
Urban Minor Arterial	290	Jun	PM 10 & PM25	86	8.53
Urban Minor Arterial	290	Jul	PM 10 & PM25	122.07	12.11
Urban Minor Arterial	290	Aug	PM 10 & PM25	144.26	14.31
Urban Minor Arterial	290	Sep	PM 10 & PM25	120.4	11.94
Urban Minor Arterial	290	Oct	PM 10 & PM25	155.36	15.41
Urban Minor Arterial	290	Nov	PM 10 & PM25	114.67	11.37
Urban Minor Arterial	290	Dec	PM 10 & PM25	77.68	7.7
Urban Collector	310	Jan	PM 10 & PM25	99.87	9.9
Urban Collector	310	Feb	PM 10 & PM25	77.1	7.65
Urban Collector	310	Mar	PM 10 & PM25	88.78	8.8
Urban Collector	310	Apr	PM 10 & PM25	103.2	10.23
Urban Collector	310	May	PM 10 & PM25	77.68	7.7

ROAD TYPE	ROAD TYPE	Month	Pollutant	g/VMT for PM10	g/VMT for PM25
Urban Collector	310	Jun	PM 10 & PM25	86	8.53
Urban Collector	310	Jul	PM 10 & PM25	122.07	12.11
Urban Collector	310	Aug	PM 10 & PM25	144.26	14.31
Urban Collector	310	Sep	PM 10 & PM25	120.4	11.94
Urban Collector	310	Oct	PM 10 & PM25	155.36	15.41
Urban Collector	310	Nov	PM 10 & PM25	114.67	11.37
Urban Collector	310	Dec	PM 10 & PM25	77.68	7.7
Urban Local	330	Jan	PM 10 & PM25	99.87	9.9
Urban Local	330	Feb	PM 10 & PM25	77.1	7.65
Urban Local	330	Mar	PM 10 & PM25	88.78	8.8
Urban Local	330	Apr	PM 10 & PM25	103.2	10.23
Urban Local	330	May	PM 10 & PM25	77.68	7.7
Urban Local	330	Jun	PM 10 & PM25	86	8.53
Urban Local	330	Jul	PM 10 & PM25	122.07	12.11
Urban Local	330	Aug	PM 10 & PM25	144.26	14.31
Urban Local	330	Sep	PM 10 & PM25	120.4	11.94
Urban Local	330	Oct	PM 10 & PM25	155.36	15.41
Urban Local	330	Nov	PM 10 & PM25	114.67	11.37
Urban Local	330	Dec	PM 10 & PM25	77.68	7.7

Average State-level unpaved road silt content values, developed as part of the 1985 NAPAP Inventory, are obtained from the Illinois State Water Survey.[20] Silt contents of over 200 unpaved roads from over 30 States are obtained. Average silt contents of unpaved roads are calculated for each state that had three or more samples for that State. For States that did not have three or more samples, the average for all samples from all States is used as a default value.

Correction factors are applied to the EFs to account for the number of days with a sufficient amount of precipitation to prevent road dust re-suspension. Monthly corrected EFs by State and roadway classification are calculated using the following equation:

$E_{corr} = E * [(D-p)/D]$

where:

E_{corr} = unpaved road dust emission factor corrected for precipitation effects
E = uncorrected emission factor
D = number of days in the month
p = number of days in the month with at least 0.01 inches of precipitation
The number of days with at least 0.01 inches of precipitation in each month is obtained from the National Climatic Data Center.[16] Data are collected from a meteorological station selected to be representative of rural areas within the State.

The controls assumed for unpaved roads varied by PM_{10} nonattainment area classification and by urban and rural areas. On urban unpaved roads in moderate PM_{10} nonattainment areas, paving of the unpaved road is assumed, and a control efficiency of 96% and a rule penetration of 50% is applied. Chemical stabilization with a control efficiency of 75% and a rule penetration

of 50% is assumed for rural areas in serious PM_{10} nonattainment areas. A combination of paving and chemical stabilization, with a control efficiency of 90% and a rule penetration of 75%, is assumed for urban unpaved roads in serious PM_{10} nonattainment areas.[18]

Ohio EPA accepted US EPA's estimates without any changes

13. **Commercial Cooking (SCC 2302002100, 2302002200, 2302003000, 2302003100, 2302003200)**

Commercial Cooking emissions are generated from the preparation of food for human consumption at eating establishments. Restaurant equipment that contributes to these emissions includes char-broilers, griddles, and deep fat fryers. Char-broilers can either be conveyors or under-fire. While both types generally use natural gas, however, under-fire char-broilers may use solid fuels, such as charcoal or wood. Deep-fat fryers may be either gas-fired or electric to heat the cooking oil used to fry the food. Griddles use an exposed metal plate, heated by either gas or electricity.

Emissions estimates are for all types of meat cooked using a particular piece of equipment. Deep fat frying of french fries is also included. The commercial cooking SCCs are shown in Table 28.

Table 28 Commercial Cooking SCCs

Source Classification Code	Type of Cooking	Type of Equipment
2302002100	Commercial Cooking - Charbroiling	Conveyor Charbroiling
2302002200	Commercial Cooking - Charbroiling	Under-fire Charbroiling
2302003000	Commercial Cooking - Frying	Deep Fat Frying
2302003100	Commercial Cooking - Frying	Flat Griddle Frying
2302003200	Commercial Cooking - Frying	Clamshell Griddle Frying

Activity data is collected from the US Census Bureau's county level population estimates for July 1, 2008.[21] No controls are assumed for this category.

The Emission Factors listed in Table 29 are developed and reviewed by an ERTAC advisory panel composed of state and EPA personnel. The EFs are created by dividing the 2002 emissions in the NEI by the 2002 population to develop per capita.

Table 29 Commercial Cooking Emission Factors Developed by ERTAC

SCC	Equipment Type	Pollutant	lb/Each
2302002100	Conveyor Charbroiling	CO	4.245E-02
2302002200	Under-fired Charbroiling	CO	1.350E-01
2302003000	Deep Fat Flying	CO	0.000E+00
2302003100	Flat Griddle Frying	CO	1.269E-02
2302003200	Clamshell Griddle Frying	CO	0.000E+00
2302002200	Under-fired Charbroiling	NOX	0.000E+00
2302002100	Conveyor Charbroiling	PM10-FIL	1.648E-04
2302002200	Under-fired Charbroiling	PM10-FIL	1.048E-03
2302003100	Flat Griddle Frying	PM10-FIL	2.727E-04
2302003200	Clamshell Griddle Frying	PM10-FIL	1.981E-05
2302002100	Conveyor Charbroiling	PM10-PRI	4.980E-02
2302002200	Under-fired Charbroiling	PM10-PRI	3.528E-01
2302003000	Deep Fat Flying	PM10-PRI	0.000E+00
2302003100	Flat Griddle Frying	PM10-PRI	1.031E-01
2302003200	Clamshell Griddle Frying	PM10-PRI	6.994E-03
2302002100	Conveyor Charbroiling	PM25-FIL	1.597E-04
2302002200	Under-fired Charbroiling	PM25-FIL	1.013E-03
2302003100	Flat Griddle Frying	PM25-FIL	2.074E-04
2302003200	Clamshell Griddle Frying	PM25-FIL	1.685E-05
2302002100	Conveyor Charbroiling	PM25-PRI	4.827E-02
2302002200	Under-fired Charbroiling	PM25-PRI	3.415E-01
2302003000	Deep Fat Flying	PM25-PRI	0.000E+00
2302003100	Flat Griddle Frying	PM25-PRI	7.834E-02
2302003200	Clamshell Griddle Frying	PM25-PRI	5.910E-03
2302002200	Under-fired Charbroiling	SO2	0.000E+00
2302002100	Conveyor Charbroiling	VOC	1.206E-02
2302002200	Under-fired Charbroiling	VOC	4.148E-02
2302003000	Deep Fat Flying	VOC	1.261E-02
2302003100	Flat Griddle Frying	VOC	5.943E-03
2302003200	Clamshell Griddle Frying	VOC	2.316E-04

Ohio EPA accepted US EPA's estimates without any changes

14. **Construction (Residential, Road & Commercial/Industrial/Institutional) (2311010000, 2311020000, 2311030000)**

RESIDENTIAL (2311010000)

Emissions from residential construction activity are calculated based on the acres of surface soil disturbed and the volume of soil excavated for basements. Residential construction activity is developed from data obtained from the U.S. Department of Commerce (DOC)'s Bureau of the Census.

To calculate the emissions from the disturbed surface soil, the US Census Bureau is consulted to obtain the 2008 data for *Housing Starts - New Privately Owned Housing Units Started*[22] which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. The 2002 Census Bureau gives a breakdown of approximately 1/3 of the housing starts

being for 2 unit structures, and 2/3 being for 3 and 4 unit structures. The 5 or more unit category may be made up of more than one structure. The *New Privately Owned Housing Units Authorized Unadjusted Units*[23] gives a conversion factor to determine the ratio of structures to units in the 5 or more unit category. Structures started by category are then calculated at a regional level. The table *Annual Housing Units Authorized by Building Permit*[24] has 2007 data at the county level to allocate regional housing starts to the county level by number of units. The assumed disturbed surface soil surface areas for each unit type are presented in Table 30.

Table 30 Surface Soil removed per unit type

1-Unit	1/4 acre/structure
2-Unit	1/3 acre/structure
Apartment	1/2 acre/structure

The 3-4 unit category is considered to be an apartment. Multiplication of housing starts to soil removed results in number of acres disturbed for each unit category.

To calculate basement soil removal, the 2007 *Characteristics of New Houses*[25] is used to estimate the percentage of 1 unit structures that have a basement (on the regional level). The county level estimate of number of 1 unit starts is multiplied by the percent of 1 unit houses in the region that have a basement to get the number of basements in a county. Basement volume is calculated by assuming a 2000 square foot house has a basement dug to a depth of 8 feet (making 1600 ft^3 per basement). An additional 10% is added for peripheral dirt bringing the total to 1760 ft^3 per basement.

Initial PM_{10} emissions from construction of single family, two family, and apartment structures are calculated using the emission factors given in Table 31. The duration of construction activity for houses is assumed to be 6 months and the duration of construction for apartments is assumed to be 12 months.

Table 31 PM_{10} Emission Factors for Residential Construction

Type of Structure	Tons/acre-month	Duration of Construction
Apartments	0.11	12 months
2-Unit Structures	0.032	6 months
1-Unit Structures w/o Basements	0.032	6 months
1-unit Structures with Basements	0.011	6 months

Regional variances in construction emissions are corrected using soil moisture level, silt content, and control efficiency. These correction parameters are applied to initial PM_{10} emissions from residential construction to develop the final emissions inventory.
To account for the soil moisture level, the PM_{10} emissions are weighted using the precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation

values for each State were estimated based on PE values for specific climatic divisions within a state. These values range from 7 to 41.

To account for the silt content, thePM_{10} emissions are weighted using average silt content for each county. A correction factor developed by the California Air Resources Board is applied to convert wet silt values to dry silt values. PM_{25} emissions are 20% of the adjusted PM_{10} emissions.

NON-RESIDENTIAL (2311020000)

Emissions from non-residential construction activity are a function of the acreage disturbed. The *Annual Value of Construction Put in Place in the U.S.*[26] has the 2008 National Value of Non-residential construction (in millions of dollars) and is allocated to counties using county-level non-residential construction (NAICS Code 2362) employment data obtained from *County Business Patterns*[27] *(CBP)*. If county employment data is withheld due to privacy concerns, the following procedure is adopted:

1. State totals for known county level employees are subtracted from the number of employees reported in the state level version of CBP. This results in the total number of withheld employees in the state.
2. A starting guess of the midpoint of the range code is used and a state total of the withheld counties is computed.
3. A ratio of guessed employees (Step 2) to withheld employees (Step 1) is used to adjust the county level guesses up or down so the state total of adjusted guesses should match state total of withheld employees (Step 1)

Initial PM_{10} emissions from construction of non-residential buildings are calculated using an EF of 0.19 tons/acre/month and the duration of construction activity is assumed to be 11 months. Regional variances in construction emissions are corrected using soil moisture level and silt content. These correction parameters are applied to initial PM_{10} emissions from non-residential construction to develop the final emissions inventory.

To account for the soil moisture level, the PM_{10} emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite's PE Index
(Ohio's PE value is 103.9). Average precipitation evaporation values for each state are estimated based on PE values for specific climatic divisions within a State. These values range from 7 to 41.

To account for the silt content, thePM_{10} emissions are weighted using average silt content for each county. A correction factor developed by the California Air Resources Board is applied to convert wet silt values to dry silt values. PM_{25} emissions are 10% of the adjusted PM_{10} emissions.

ROAD (2311030000)

Emissions from road construction activity are a function of the acreage disturbed. Road construction activity is developed from data obtained from the Federal Highway Administration (FHWA).[28]

The Federal Highway Administration's 2006 data outlines spending by state in several different categories. For this SCC, the following data is used: New Construction, Relocation, Added

Capacity, Major and Minor Widening and differentiated according to the following six classifications:

1. Interstate, urban
2. Interstate, rural
3. Other arterial, urban
4. Other arterial, rural
5. Collectors, urban
6. Collectors, rural

The state expenditure data is converted to new miles of road constructed using $/mile conversions obtained from the North Carolina Department of Transportation (NCDOT) in 2000. A conversion of $4 million/mile is applied to the interstate expenditures. For expenditures on other arterial and collectors, a conversion factor of $1.9 million/mile is applied, which corresponds to all other projects.

The new miles-of-road constructed is used to estimate the acreage disturbed due to road construction. The total area disturbed in each state is calculated by converting the new miles of road constructed to acres using an acres disturbed/mile conversion factor for each road type as given in table 32 below:

Table 32 Spending per mile and acres disturbed per mile by highway type

Road Type	Thousand Dollars per mile	Acres Disturbed per mile
URBAN AREAS, INTERSTATE	4000	15.2
RURAL AREAS, INTERSTATE	4000	15.2
URBAN AREAS, OTHER ARTERIALS	1900	15.2
RURAL AREAS, OTHER ARTERIALS	1900	12.7
URBAN AREAS, COLLECTORS	1900	9.8
RURAL AREAS, COLLECTORS	1900	7.9

Residential building starts[24] are used to allocate the state-level acres disturbed by road construction to the county. A ratio of the number of building starts in each county to the total number of building starts in each state is applied to the state-level acres disturbed to estimate the total number of acres disturbed by road construction in each county.

Initial PM_{10} emissions from construction of roads are calculated using an EF 0.42 tons/acre/month. Since most road construction consists of land grading and leveling, the higher EF more accurately reflects the high level of cut and fill activity that occurs at road construction sites. The duration of construction activity for road construction is assumed to be 12 months.

Regional variances in construction emissions are corrected using soil moisture level, silt

content, and control efficiency. These correction parameters are applied to initial PM_{10} emissions from non-residential construction to develop the final emissions inventory.
To account for the soil moisture level, the PM_{10} emissions are weighted using the precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each state are estimated based on PE values for specific climatic divisions within a state. These values range from 7 to 41. To account for the silt content, the PM_{10} emissions are weighted using average silt content for each county. A correction factor developed by the California Air Resources Board is applied to convert wet silt values to dry silt values.

PM_{25} emissions are 20% of the adjusted PM_{10} emissions.
Ohio EPA accepted US EPA's estimates without any changes

15. **Cutback Asphalt (SCC 2461021000)**

Asphalt concrete is a composite material comprised of a binder and a mineral aggregate. The binder, referred to as asphalt cement, is a byproduct of petroleum refining and contains the semi-solid residual material left after the more volatile chemical fractions have been distilled off.[29] Asphalt paving is the process of applying asphalt concrete to seal or repair the surface of roads, parking lots, driveways, walkways, or airport runways.

Asphalt cements thinned with petroleum distillates are known as cutback asphalts. The primary uses of cutback asphalt include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick. Cut-back asphalt is produced by thinning the binder with a diluent containing 25 to 45% petroleum distillates by volume prior to mixing with the aggregate. This reduces the viscosity of the asphalt making it easier to work with the mixture.

Emissions from cutback asphalt result from the evaporation of VOCs after the mixture is laid applied. Of all asphalt types, cutback asphalt has the highest diluent content and, thus, emits the highest levels of VOCs per ton used. The timeframe and quantity of VOC emissions depend on the type and the quantity of organic solvent used as a diluent.

To calculating emissions from cutback asphalt paving, the estimated county-level cutback asphalt usage is multiplied by VOC EF. The State-level cutback asphalt usage in 2008 is obtained from the Asphalt Institute's *2008 Asphalt Usage Survey.*[30] State-level data are allocated to county-level according to the fraction of paved road vehicle miles traveled (VMT) in each county.

Total annual VMT estimates by state and roadway class were obtained from the Federal Highway Administration's (FHWA) annual Highway Statistics report.[31] Paved road VMT is calculated by subtracting the state/roadway class unpaved road VMT from total state/roadway class VMT. State-level paved road VMT is spatially allocated to counties according to the fraction of total VMT in each county for the specific roadway class.

The VOC EF for cutback asphalt usage is 88 lbs/barrel and is obtained from the *Technical Report Series* produced by the U.S. EPA's Emission Inventory Improvement Program.[29] To convert tons of asphalt reported in the *2008 Asphalt Usage Survey* to barrels, it is assumed that the density of asphalt is similar to that of water, 8.34 lbs/gal, and that one barrel of asphalt equals 42 gallons and weighs 350 pounds.

Ohio adopted US EPA's emissions estimate. Better activity data than State methodology.

16. **Emulsified Asphalt (SCC 2461022000)**

Asphalt paving is the process of applying asphalt concrete to seal or repair the surface of roads, parking lots, driveways, walkways, or airport runways. Asphalt concrete is a composite material comprised of a binder and a mineral aggregate. The binder, referred to as asphalt cement, is a byproduct of petroleum refining and contains the semi-solid residual material left after the more volatile chemical fractions have been distilled off.[29]

Asphalt cements thinned with water and an emulsifying agent are known as emulsified asphalts. This thinning reduces the viscosity of the asphalt making it easier to apply the mixture. The primary uses of emulsified asphalt include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick.

Emulsified asphalt may contain up to 12% organic solvents by volume.[29] Emissions from emulsified asphalt result from the evaporation of VOCs after the mixture is applied. Compared to cutback asphalt, emulsified asphalt has lower VOCs emissions per ton used.
The state-level emulsified asphalt usage in 2008 is obtained from the Asphalt Institute's *2008 Asphalt Usage Survey.*[30] State-level data are allocated to county-level according to the fraction of paved road vehicle miles traveled (VMT) in each county.
Total annual VMT estimates by state and roadway class are obtained from the Federal Highway Administration's (FHWA) annual Highway Statistics report.[31] Paved road VMT is calculated by subtracting the State/roadway class unpaved road VMT from total State/roadway class VMT. State-level paved road VMT is spatially allocated to counties according to the fraction of total VMT in each county for the specific roadway class.

The VOC EF for emulsified asphalt usage is 9.2 lbs/barrel and is obtained from the *Technical Report Series* produced by the U.S. EPA's Emission Inventory Improvement Program.[29] To convert tons of asphalt reported in the *2008 Asphalt Usage Survey* to barrels, it is assumed that the density of asphalt is similar to that of water, 8.34 lbs/gal, and that one barrel of asphalt equals 42 gallons and weighs 350 pounds.

Ohio Adopted US EPA's emissions estimate. Better activity data than State methodology.

17. **Open Burning – Yard Waste (SCC 2610000100, 2610000400)**

Open burning of yard waste is the purposeful burning of leaf and brush species in outdoor areas. Criteria Air Pollutant (CAP) emission estimates for leaf and brush waste burning are a function of the amount of waste burned per year. Table 33 lists the SCCs for yard waste open burning.

Table 33 SCC for Yard Waste Type

SCC	Type of Yard Waste
2610000100	Leaf
2610000400	Brush

The amount of leaf and brush waste burned is estimated using data from EPA's report *Municipal Solid Waste in the United States: 2007 Facts and Figures.*[32] The report presents the total mass of yard waste generated in the United States by type of waste for the calendar year 2007. This

data is used to calculate a daily estimate of the per capita yard waste, 0.59 lbs/person/day. Of the total amount of yard waste generated, the yard waste composition is assumed to be 25% leaves, 25% brush, and 50% grass by weight.[33]

Open burning of grass clippings is not typically practiced by homeowners, and as such only estimates for leaf burning and brush burning were developed. Approximately 25 to 32% of all waste that is subject to open burning is actually burned.[33] A median value of 28% is assumed to be burned in all counties in the United States.

The per capita estimate is multiplied by the 2008 population in each county that is expected to burn waste. Since open burning is generally not practiced in urban areas, only the rural population is assumed to practice open burning. The ratio of urban to rural population is obtained from 2000 U.S. Census data[34] and is multiplied by the 2008 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2008[35].

The percentage of forested acres from Version 2 of BELD2 within BEIS is used to adjust for variations in vegetation. To better account for native vegetation that would likely occur in the residential yards of farming states, agricultural land acreage is subtracted before calculating the percentage of forested acres. Table 34 presents the ranges that are used to make adjustments to the amount of yard waste that is assumed to be generated per county.

Table 34 Adjustment for Percentage of Forested Acres

Percent Forested Acres per County	Adjustment for Yard Waste Generated
< 10%	0% generated
>= 10%, and < 50%	50% generated
>= 50%	100% generated

Controls for yard waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that are more than 80% urban are assumed to not practice any open burning and emissions from these counties are zero.

EFs, which are developed by U.S. EPA in consultation with the Eastern Regional Technical Advisory Committee[36], are specific to yard waste type and are reported in Tables 35 and 36 below. County-level emissions are calculated by multiplying the total amount of yard waste (either leaf or brush) burned per year by an EF.

Table 35 Emission Factors for Open Burning of Leaf Species (SCC 2610000100)

Pollutant	Pollutant Code	Emission Factor (lb/ton)
Carbon Monoxide	CO	112
Nitrogen Oxides	NOX	6.2
PM10-FIL	PM10-FIL	22
PM10-PRI	PM10-PRI	22
PM25-FIL	PM25-FIL	22
PM25-PRI	PM25-PRI	22
Sulfur Dioxide	SO2	0.76
VOC	VOC	28

Table 36 Emission Factors for Open Burning of Brush Species (SCC 2610000400)

Pollutant	Pollutant Code	Emission Factor (lb/ton)
Carbon Monoxide	CO	140
Nitrogen Oxides	NOX	5
PM10-PRI	PM10-PRI	19.73
PM10-FIL	PM10-FIL	19.73
PM25-PRI	PM25-PRI	15.21
PM25-FIL	PM25-FIL	15.21
Sulfur Dioxide	SO2	1.66
VOC	VOC	19

Ohio EPA accepted US EPA's estimates without any changes

18. **Open Burning – Land Clearing Debris (SCC 2610000500)**

Open burning of land clearing debris is the purposeful burning of debris, such as trees, shrubs, and brush, from the clearing of land for the construction of new buildings and highways. Emission estimates from open burning of land clearing debris are a function of the amount of material or fuel subject to burning per year.

The amount of material burned is estimated using the county-level total number of acres disturbed by residential, non-residential, and road construction. County-level weighted loading factors are applied to the total number of construction acres to convert acres to tons of available fuel.

Residential Construction

The US Census Bureau has 2008 data for *Housing Starts - New Privately Owned Housing Units Started*[22] which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. The Census Bureau in 2002 gives a breakdown of approximately 1/3 of the housing starts being for 2 unit structures, and 2/3 being for 3 and 4 unit structures. To

determine the number of structures for each grouping, the 1 unit category is divided by 1, the 2 unit category is divided by 2, and the 3-4 unit category is divided by 3.5. The 5 or more unit category may be made up of more than one structure. *New Privately Owned Housing Units Authorized Unadjusted Units*[23] gives a conversion factor to determine the ratio of structures to units in the 5 or more unit category. The table *Annual Housing Units Authorized by Building Permit*[24] has 2007 data at the county level to allocate regional housing starts to the county level. This results in county level housing starts by number of units. Table 37 includes the surface areas are assumed disturbed for each unit type.

Table 37 Surface Acres Disturbed per Unit Type

1-Unit	1/4 acre/structure
2-Unit	1/3 acre/structure
Apartment	1/2 acre/structure

Non-Residential Construction

The Annual Value of Construction Put in Place in the U.S[26] has the 2008 National Value of Non-residential construction which is allocated to counties using county-level non-residential construction (NAICS Code 2362) employment data obtained from *County Business* Patterns[27] *(CBP)*. Because some counties employment data is withheld due to privacy concerns, the following procedure is adopted:

1. State totals for the known county level employees are subtracted from the number of employees reported in the state level version of CBP. This results in the total number of withheld employees in the state.

2. A starting guess of the midpoint of the range code is used (so for instance in the 1-19 employees range, a guess of 10 employees would be used) and a state total of the withheld counties is computed.

3. A ratio of guessed employees (Step 2) to withheld employees (Step 1) is used to adjust the county level guesses up or down so the state total of adjusted guesses matches state total of withheld employees (Step 1).

Road Construction

The Federal Highway Administration has *Highway Statistics, Section IV - Highway Finance, Table SF-12A, The State Highway Agency Capital* Outlay[28] for 2006 which outlines spending by state in several different categories. The following categories are used to calculate acres disturbed: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening and are also differentiated as follows:

1. Interstate, urban
2. Interstate, rural
3. Other arterial, urban
4. Other arterial, rural
5. Collectors, urban
6. Collectors, rural

The State expenditure data are converted to new miles of road constructed using $/mile

conversions obtained from the North Carolina Department of Transportation (NCDOT) in 2000. A conversion of $4 million/mile is applied to the interstate expenditures. For expenditures on other arterial and collectors, a conversion factor of $1.9 million/mile is applied.

The new miles of road constructed are used to estimate the acreage disturbed due to road construction. The total area disturbed in each state is calculated by converting the new miles of road constructed to acres using an acres disturbed/mile conversion factor for each road type as given in Table 38 below:

Table 38 Spending per Mile and Acres Disturbed per Mile by Highway Type

Road Type	Thousand Dollars per mile	Acres Disturbed per mile
Urban Areas, Interstate	4000	15.2
Rural Areas, Interstate	4000	15.2
Urban Areas, Other Arterials	1900	15.2
Rural Areas, Other Arterials	1900	12.7
Urban Areas, Collectors	1900	9.8
Rural Areas, Collectors	1900	7.9

Residential building starts are used to allocate the state-level acres disturbed by road construction to the county.[24] A ratio of the number of building starts in each county to the total number of building starts in each state is applied to the state-level acres disturbed to estimate the total number of acres disturbed by road construction in each county.

Converting Acres Disturbed to Tons of Land Clearing Debris Burned

Version 2 of the Biogenic Emissions Land cover Database (BELD2) within EPA's Biogenic Emission Inventory System (BEIS) is used to identify the acres of hardwoods, softwoods, and grasses in each county. Table 39 presents the average fuel loading factors by vegetation type. The average loading factors for slash hardwood and slash softwood are adjusted by a factor of 1.5 to account for the mass of tree that is below the soil surface that would be subject to burning once the land is cleared.[37] Weighted average county-level loading factors are calculated by multiplying the average loading factors by the percent contribution of each type of vegetation class to the total land area for each county.

Table 39 Fuel Loading Factors by Vegetation Type

Vegetation Type	Unadjusted Average Fuel Loading Factor (Ton/acre)	Adjusted Average Fuel Loading Factor (Ton/acre)
Hardwood	66	99
Softwood	38	57
Grass	4.5	Not Applicable

The total acres disturbed by all construction types is calculated by summing the acres disturbed from residential, non-residential, and road construction and multiplied by the weighted average

loading factor to derive tons of land clearing debris.

Controls for land clearing debris burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that are more than 80% urban are assumed to not practice any open burning and therefore, have zero emissions.

EFs are reported in Table 40 and are developed by U.S. EPA in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report.[38,39]

Table 40 Emission Factors for Open Burning of Land Clearing Debris

Pollutant	Pollutant Code	Emission Factor (lb/ton)
Carbon Monoxide	CO	1.69E+02
Nitrogen Oxides	NOX	5.00E+00
PM10-PRI	PM10-PRI	1.70E+01
PM10-FIL	PM10-FIL	1.70E+01
PM25-PRI	PM25-PRI	1.70E+01
PM25-FIL	PM25-FIL	1.70E+01
VOC	VOC	1.16E+01

Ohio EPA accepted US EPA's estimates without any changes

19. **Open Burning – Residential Household Waste (SCC 2610030000)**

Open burning of residential municipal solid waste (MSW) is the purposeful burning of MSW in outdoor areas. Emission estimates for MSW burning are a function of the amount of waste burned per year.

The amount of household MSW burned is estimated using data from EPA's report *Municipal Solid Waste in the United States: 2007 Facts and Figures.*[40] The report presents the total mass of waste generated in the United States by type of waste for the calendar year 2007. This data is used to calculate a daily estimate of the per capita household waste subject to burning, 3.40 lbs/person/day. Non-combustible waste, such as glass and metals, is not considered to be waste subject to burning. Since 25 to 32% of all waste that is subject to open burning is actually burned[41], a median value of 28% was used.

(Burning of yard waste is included in SCC 2610000100 and SCC 2610000400; therefore, it is not part of residential MSW)

Since open burning is generally not practiced in urban areas, only the rural population of each county is assumed to practice open burning. The ratio of urban to rural population is obtained from 2000 U.S. Census data.[34] This ratio is multiplied by the 2008 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2008.[42] The county-level rural population is multiplied by the per capita household waste subject to burning to determine the amount of rural household MSW generated in each county in 2008.

Controls for residential MSW burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that are more than 80% urban are assumed to not practice any open burning and therefore, have zero emissions

EFs are reported in Table 41 and are developed by U.S. EPA in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report.[38,39]

Table 41 Emission Factors for Open Burning of Residential MSW

Pollutant	Pollutant Code	Emission Factor (lb/ton)
Carbon Monoxide	CO	8.50E+01
Nitrogen Oxides	NOX	6.00E+00
PM10-PRI	PM10-PRI	3.80E+01
PM10-FIL	PM10-FIL	3.80E+01
PM25-PRI	PM25-PRI	3.48E+01
PM25-FIL	PM25-FIL	3.48E+01
VOC	VOC	8.56E+00
Sulfur Dioxide	SO2	1.00E+00

Ohio EPA accepted US EPA's estimates without any changes

20. **Animal Husbandry (SCC see Table 42)**

Agriculture production livestock refers to domesticated animals reared for food, fiber, and other goods or for the use of their labor. This category includes beef cattle, dairy cattle, ducks, geese, goats, horses, poultry, sheep, and swine.

Table 42 Agricultural Production Livestock SCC

SCC	Description Level 1	Description Level 2
2805001100	Beef cattle - finishing operations on feedlots (dry lots)	Confinement
2805001200	Beef cattle – finishing operations on feedlots (dry lots)	Manure handling and storage
2805001300	Beef cattle – finishing operations on feedlots (dry lots)	Land application of manure
2805002000	Beef cattle production composite	Not Elsewhere Classified
2805003100	Beef cattle - finishing operations on pasture/range	Confinement
2805007100	Poultry production - layers with dry manure management systems	Confinement
2805007300	Poultry production - layers	Land application of manure

SCC	Description Level 1	Description Level 2
	with dry manure management systems	
2805008100	Poultry production - layers with wet manure management systems	Confinement
2805008200	Poultry production - layers with wet manure management systems	Manure handling and storage
2805008300	Poultry production - layers with wet manure management systems	Land application of manure
2805009100	Poultry production - broilers	Confinement
2805009200	Poultry production - broilers	Manure handling and storage
2805009300	Poultry production - broilers	Land application of manure
2805010100	Poultry production - turkeys	Confinement
2805010200	Poultry production - turkeys	Manure handling and storage
2805010300	Poultry production - turkeys	Land application of manure
2805018000	Dairy cattle composite	Not Elsewhere Classified
2805019100	Dairy cattle - flush dairy	Confinement
2805019200	Dairy cattle - flush dairy	Manure handling and storage
2805019300	Dairy cattle - flush dairy	Land application of manure
2805021100	Dairy cattle - scrape dairy	Confinement
2805021200	Dairy cattle - scrape dairy	Manure handling and storage
2805021300	Dairy cattle - scrape dairy	Land application of manure
2805022100	Dairy cattle - deep pit dairy	Confinement
2805022200	Dairy cattle - deep pit dairy	Manure handling and storage
2805022300	Dairy cattle - deep pit dairy	Land application of manure
2805023100	Dairy cattle – dry lot/pasture dairy	Confinement
2805023200	Dairy cattle – dry lot/pasture dairy	Manure handling and storage
2805023300	Dairy cattle – dry lot/pasture dairy	Land application of manure
2805025000	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)
2805030000	Poultry Waste Emissions	Not Elsewhere Classified (see also 28-05-007, -008, -009)
2805030007	Poultry Waste Emissions	Ducks
2805030008	Poultry Waste Emissions	Geese
2805035000	Horses and Ponies Waste Emissions	Not Elsewhere Classified
2805039100	Swine production - operations with lagoons (unspecified animal age)	Confinement
2805039200	Swine production - operations	Manure handling and storage

SCC	Description Level 1	Description Level 2
	with lagoons (unspecified animal age)	
2805039300	Swine production - operations with lagoons (unspecified animal age)	Land application of manure
2805040000	Sheep and Lambs Waste Emissions	Total
2805045000	Goats Waste Emissions	Not Elsewhere Classified
2805047100	Swine production - deep-pit house operations (unspecified animal age)	Confinement
2805047300	Swine production - deep-pit house operations (unspecified animal age)	Land application of manure
2805053100	Swine production - outdoor operations (unspecified animal age)	Confinement

To calculate emissions, the steps below are followed:

1. Determine 2007 county-level population of animals.

2. For beef, dairy, poultry, and swine, apportion animal populations to a Manure Management Train (MMT) for each county. Animal populations for ducks, geese, goats, horses, and sheep are not apportioned to MMTs.

3. Modify the EF files provided with the CMU Ammonia Model v. 3.6 to ensure that every county has an assigned EF.[43]

4. Use the CMU Ammonia Model v. 3.6 to calculate ammonia emissions based on the updated county-level animal populations and EFs.

The 2007 county-level animal numbers are obtained from the U.S. Department of Agriculture's 2007 Census of Agriculture report[44]. Although some counties and states' census data is withheld the total national-level animal numbers and most state-level animal numbers for each livestock type reported in the Census include those animal numbers not disclosed at the county-level. When available, state-level animal numbers from the USDA NASS online database is used for states with undisclosed animal numbers in the 2007 Census of Agriculture.[45] If the state-level data is undisclosed and not available in the NASS database, then national animal numbers are used to determine undisclosed state numbers and allocated to those counties reporting undisclosed data based on the number of farms raising that livestock in each county.

County-level animal numbers are apportioned to manure management trains. A MMT consists of an animal confinement area (e.g., dry lot, pasture, flush, scrape); components used to store, process, or stabilize the manure (e.g., anaerobic lagoons, deep pits); and a land application site where manure is used as a fertilizer source.[46] The apportionment is based on county-level

MMT percentages derived from the CMU Ammonia Model. In cases where the county-level numbers are zero in the 2002 CMU Ammonia Model input files, the county is assigned state-level MMT percentages.

Cattle reported as "Other Cattle" in the 2007 Census of Agriculture is divided between dairy cattle and beef cattle at the county-level using percent allocations derived from county-level dairy and beef cattle reported in the 2007 Census of Agriculture and corrected for undisclosed data. The animal numbers from "Other Cattle" apportioned to dairy and beef cattle are used to create the Dairy Cattle – Composite and Beef Cattle – Composite activity input files for the CMU Ammonia Model.

County-level pullet numbers reported in the 2007 Census of Agriculture are used to create the Poultry – Composite activity input file for the CMU Ammonia Model.

The EF for the poultry composite categories is obtained from an US EPA report and is reported in Table 43.[46] The county-level EFs for the beef composite and dairy composite categories are developed using beef and dairy cattle EFs provided with the 2002 CMU Model. Specifically, weighted average EFs are calculated based on the number of beef or dairy cattle in each MMT from the 2002 CMU Model activity files and the EF assigned to each MMT. All other EFs are provided with the CMU Ammonia Model v.3.6. If the EFs for any county in the CMU Ammonia Model files are zero, then the input files provided with the CMU Ammonia Model are modified to ensure that all counties with animal populations are assigned EFs. For all counties with an EF of zero, it is replaced with the state average EF. If all counties in the state have EFs of zero, then the county EF is replaced with the national average EF.

Table 43 Livestock Emissions Factors

Description	Pollutant Code	Emission Factor	Emission Factor Unit
Beef Cattle - Composite	NH3	county-specific	kg NH_3/cow/month
Beef Cattle – Dry lot Operation - Confinement	NH3	9.45E-01	kg NH_3/cow/month
Beef Cattle – Dry lot Operation - Land Application	NH3	state-specific	kg NH_3/cow/month
Beef Cattle – Dry lot Operation - Manure Storage	NH3	3.78E-04	kg NH_3/cow/month
Beef Cattle - Pasture Operation - Confinement	NH3	county-specific	kg NH_3/cow/month
Dairy Cattle - Composite	NH3	county-specific	kg NH_3/cow/month
Dairy Cattle - Deep Pit Dairy Confinement	NH3	2.42E+00	kg NH_3/cow/month
Dairy Cattle - Deep Pit Dairy Land Application	NH3	state-specific	kg NH_3/cow/month
Dairy Cattle - Deep Pit Dairy Manure Storage	NH3	1.13E-01	kg NH_3/cow/month

Description	Pollutant Code	Emission Factor	Emission Factor Unit
Dairy Cattle – Dry lot Dairy Confinement	NH3	state-specific	kg NH_3/cow/month
Dairy Cattle – Dry lot Dairy Land Application	NH3	state-specific	kg NH_3/cow/month
Dairy Cattle – Dry lot Dairy Manure Storage	NH3	state-specific	kg NH_3/cow/month
Dairy Cattle - Flush Dairy Confinement	NH3	2.00E+00	kg NH_3/cow/month
Dairy Cattle - Flush Dairy Land Application	NH3	state-specific	kg NH_3/cow/month
Dairy Cattle - Flush Dairy Manure Storage	NH3	state-specific	kg NH_3/cow/month
Dairy Cattle - Scrape Dairy Confinement	NH3	state-specific	kg NH_3/cow/month
Dairy Cattle - Scrape Dairy Land Application	NH3	state-specific	kg NH_3/cow/month
Dairy Cattle - Scrape Dairy Manure Storage	NH3	state-specific	kg NH_3/cow/month
Ducks	NH3	7.67E-02	kg NH_3/duck/month
Geese	NH3	7.67E-02	kg NH_3/goose/month
Goats	NH3	5.29E-01	kg NH_3/goat/month
Horses	NH3	1.02E+00	kg NH_3/horse/month
Poultry - Broiler Operation - Confinement	NH3	8.32E-03	kg NH_3/bird/month
Poultry - Broiler Operation - Land Application	NH3	6.80E-03	kg NH_3/bird/month
Poultry - Broiler Operation - Manure Storage	NH3	1.51E-03	kg NH_3/bird/month
Poultry - Composite	NH3	2.00E-02	kg NH_3/bird/month
Poultry - Layers - Dry Manure Operation - Confinement	NH3	3.36E-02	kg NH_3/bird/month
Poultry - Layers - Dry Manure Operation - Land Application	NH3	county-specific	kg NH_3/bird/month
Poultry - Layers - Wet Manure Operation - Confinement	NH3	9.45E-03	kg NH_3/bird/month
Poultry - Layers - Wet Manure Operation - Land Application	NH3	county-specific	kg NH_3/bird/month
Poultry - Layers - Wet Manure Operation - Manure	NH3	county-specific	kg NH_3/bird/month

Description	Pollutant Code	Emission Factor	Emission Factor Unit
Storage			
Poultry - Turkey Operation - Confinement	NH3	3.78E-02	kg NH_3/bird/month
Poultry - Turkey Operation - Land Application	NH3	3.40E-02	kg NH_3/bird/month
Poultry - Turkey Operation - Storage	NH3	6.80E-03	kg NH_3/bird/month
Sheep	NH3	2.65E-01	kg NH_3/sheep/month
Swine - Composite	NH3	county-specific	kg NH_3/pig/month
Swine - Deep Pit Operation - Confinement	NH3	2.65E-01	kg NH_3/pig/month
Swine - Deep Pit Operation - Land Application	NH3	county-specific	kg NH_3/pig/month
Swine - Lagoon Operation - Confinement	NH3	2.27E-01	kg NH_3/pig/month
Swine - Lagoon Operation - Land Application	NH3	county-specific	kg NH_3/pig/month
Swine - Lagoon Operation - Manure Storage	NH3	county-specific	kg NH_3/pig/month
Swine - Outdoor Operation - Confinement	NH3	county-specific	kg NH_3/pig/month

Ohio EPA accepted US EPA's estimates without any changes

21. **Fertilizer Application (SCC see Table 44)**

Fertilizer in this category refers to any nitrogen-based compound, or mixture containing such a compound, that is applied to land to improve plant fitness.

Table 44 Fertilizer Application SCC

SCC	Fertilizer
2801700001	Anhydrous Ammonia
2801700002	Aqueous Ammonia
2801700003	Nitrogen Solutions
2801700004	Urea
2801700005	Ammonium Nitrate

SCC	Fertilizer
2801700006	Ammonium Sulfate
2801700007	Ammonium Thiosulfate
2801700010	N-P-K (multi-grade nutrient fertilizers)
2801700011	Calcium Ammonium Nitrate
2801700012	Potassium Nitrate
2801700013	Diammonium Phosphate
2801700014	Monoammonium Phosphate
2801700015	Liquid Ammonium Polyphosphate
2801700099	Miscellaneous Fertilizers

To calculate emissions for the fertilizer application, the steps below are followed:

1. Calculate the percent change in county-level fertilizer quantities applied between 2002 and 2007.

2. Use the percent change in applied fertilizer quantity to grow the fertilizer activity files provided with the CMU Ammonia Model v.3.6.[43]

3. Run the CMU Ammonia Model to calculate ammonia emissions based on the updated county-level fertilizer quantities.

County-level fertilizer consumption data for 2002 and 2007 are obtained from the Fertilizer Institute's Commercial Fertilizers 2002 and 2007 reports.[54] For any state in 2002 reporting fertilizer quantities from unknown counties, the quantities are apportioned to every county in the state based on cropland area obtained from the U.S. Department of Agriculture's 2002 Census of Agriculture.[48] Similarly for 2007, fertilizer quantities from unknown counties are apportioned based on cropland area reported in the 2007 Census of Agriculture.[44]

To make the fertilizer types listed in the Commercial Fertilizers reports match the activity input files from the CMU Ammonia Model, the fertilizer types are grouped and for each fertilizer group, the percent difference in fertilizer consumption between 2002 and 2007 is calculated for each county and are used to grow the 2002 county-level nitrogen quantities from the fertilizer activity files provided with the CMU Ammonia Model v.3.6.

The average nitrogen content for each fertilizer group, reported in Table 45, is calculated by

summing the county-level fertilizer quantities for all counties from the CMU Ammonia Model activity files to generate total nitrogen applied. For each fertilizer group, the total nitrogen applied is divided by the 2002 fertilizer consumption data from the 2002 Commercial Fertilizers report to obtain the percent nitrogen content for each fertilizer group. For any county with fertilizer consumption in 2007, but not in 2002, the fertilizer quantity obtained from the 2007 Commercial Fertilizer's report is multiplied by the percent nitrogen content of each fertilizer group to determine tons of nitrogen. The state-level percentage is calculated using data in the CMU Ammonia Model input files.

Table 45 Fertilizer Nitrogen Content

Fertilizer	Nitrogen Content (percent)
Ammonium Nitrate	36
Ammonium Sulfate	22
Ammonium Thiosulfate	12
Anhydrous Ammonia	82
Aqueous Ammonia	21
Calcium Ammonium Nitrate	17
Di-ammonium Phosphate	18
Liquid Ammonium Polyphosphate	10
Miscellaneous	8
Mix	12
Mono-ammonium Phosphate	11
Nitrogen Solutions	29
Potassium Nitrate	14
Urea	46

Emission factors for each fertilizer group are provided with the CMU Ammonia Model and are reported in Table 46 below.[43]

Table 46 Fertilizer Emission Factors

Fertilizer Description	Pollutant Code	Emission Factor (varies by county for some fertilizers)			Emission Factor Unit
		Min	Max	Average	
Ammonium Nitrate	NH3	1.0	3.0	1.91	% N volatilized as NH3
Ammonium Sulfate	NH3	5.0	15.0	9.53	% N volatilized as NH3
Ammonium Thiosulfate	NH3	2.5	2.5	2.5	% N volatilized as NH3
Anhydrous Ammonia	NH3	4.0	4.0	4.0	% N volatilized as NH3

Fertilizer Description	Pollutant Code	Emission Factor (varies by county for some fertilizers)			Emission Factor Unit
		Min	Max	Average	
Aqueous Ammonia	NH3	4.0	4.0	4.0	% N volatilized as NH3
Calcium Ammonium Nitrate	NH3	1.0	3.0	1.91	% N volatilized as NH3
Diammonium Phosphate	NH3	5.0	5.0	5.0	% N volatilized as NH3
Liquid Ammonium Polyphosphate	NH3	5.0	5.0	5.0	% N volatilized as NH3
Miscellaneous Fertilizers	NH3	6.0	8.0	6.59	% N volatilized as NH3
Monoammonium Phosphate	NH3	5.0	5.0	5.0	% N volatilized as NH3
Nitrogen Solutions	NH3	8.0	8.0	8.0	% N volatilized as NH3
N-P-K (multi-grade nutrient fertilizers)	NH3	1.0	3.0	1.91	% N volatilized as NH3
Potassium Nitrate	NH3	2.0	2.0	2.0	% N volatilized as NH3
Urea	NH3	15.0	20.0	15.8	% N volatilized as NH3

Ohio EPA accepted US EPA's estimates without any changes

22. **Portable Fuel Containers (SCC see Table 47)**

Portable fuel containers (PFCs, or gas cans) are consumer products used to refuel a wide variety of gasoline-powered equipment. Although an individual gas can is a relatively modest emission source, the cumulative VOC emissions from an estimated population of 80 million gas cans are quite significant. Gasoline is highly volatile and evaporates easily from containers that are not sealed or closed properly. Left uncontrolled, the evaporative emissions from a gas can are up to 60 times the VOC of a new Tier 2 vehicle evaporative control system. VOC emissions estimated for this source are related to gasoline only, PFCs used for either kerosene or diesel fuels are not considered here.

Gas can emissions are primarily of three types:

1. Evaporative emissions from unsealed or open containers; permeation emissions from gasoline passing.
2. Through the walls of the plastic containers; and evaporative emissions from gasoline spillage.
3. During use.

This methodology is California's Air Resources Board (CARB) proposed method to estimate

annual emissions from portable fuel containers (PFCs).

For most of these sources, the daily emission rates depend on the following four factors:

1. Composition of the PFC (plastic versus metal),
2. Whether the PFC is stored open or closed (i.e., a PFC is considered “open” if the vent or spout is uncapped),
3. Average size/capacity of the PFC, and
4. Frequency the PFC is refilled.

CARB found that those four factors depend upon whether the PFC is used for residential or commercial use. Therefore, SCCs are divided based on residential or commercial use as shown in Table 47.

Table 47 Portable Fuel Containers SCC

SCC	Description Level 1	Description Level 2
2501011011	Residential Portable Gas Cans	Permeation
2501011012	Residential Portable Gas Cans	Evaporation (includes Diurnal losses)
2501011013	Residential Portable Gas Cans	Spillage During Transport
2501011014	Residential Portable Gas Cans	Refilling at the Pump – Vapor Displacement
2501011015	Residential Portable Gas Cans	Refilling at the Pump - Spillage
2501012011	Commercial Portable Gas Cans	Permeation
2501012012	Commercial Portable Gas Cans	Evaporation (includes Diurnal losses)
2501012013	Commercial Portable Gas Cans	Spillage During Transport
2501012014	Commercial Portable Gas Cans	Refilling at the Pump - Vapor Displacement
2501012015	Commercial Portable Gas Cans	Refilling at the Pump - Spillage

Rather than assume the numbers of PFCs per household and per business are consistent across the country, US EPA used its non-road emissions model (NONROAD2005*) to estimate the seasonal (non-road) consumption of gasoline by source category classification (SCC) code for each state. Each SCC code has a unique usage (commercial versus residential), a unique ratio of the percent of fuel dispensed from PFCs. Activity data for the 2002 and 2010 inventories are developed using US EPA’s Non-road Model which uses a variety of variables like equipment size, equipment population, equipment age, RVP, and air temperature to estimate activity.

There are at least 15 states which have enacted or are considering rules for PFCs. Due to the complexities in calculating emissions, these rules have already been accounted for in the emissions. Ohio has rule OAC 3745-21-17 which became effective 6/21/07.

US EPA's modification produced the following list of seven emissions sources:

Emissions associated with filling the gas can (PFC) at the gas pump

1) Displacement of the vapor within the can
2) Spillage of gasoline while filling the can

Emissions associated with transporting the gas can to the non-road equipment

3) Spillage of gasoline during transport

Emissions associated with using the gas can to refuel the non-road equipment (these emissions are already accounted for in EPA's NONROAD model.)

4) Spillage of gasoline while filling the non-road equipment
5) Displacement of the vapor within the non-road equipment

Emissions (adjusted for changes in ambient temperature) associated with storage of gasoline in the PFCs

6) Emissions due to evaporation (i.e., diurnal emissions)
7) Emissions due to permeation, Table 48 lists the EFs EPA used for each of the activities associated with PFCs.

Table 48 details the EFs US EPA used for each of the activities associated with PFCs[49].

Table 48 HC Emissions Factors for PFCs

SOURCE	FACTOR	UNIT
Vapor Displacement a function of the ambient temperature (in degrees Fahrenheit) and the Reid Vapor Pressure (RVP in psi) of the fuel	exp(-1.2798 + 0.0203*Temperature + 0.1315*RVP)	F- psi
Spillage at Pump	0.3128	grams / gallon pumped
Spillage During Transport	Residential Open: 13.889	grams / gallon
	Residential Closed: 9.829	
	Commercial Open: 9.475	
	Commercial Closed: 6.706	
Spillage During Refueling Non-Road Equipment equipment fuel tank capacity dependent	See Table 24-3 for Residential See Table 24-4 for Commercial	grams / gallon
Permeation evaporative emissions far exceeds the permeation	Residential closed Plastic: 1.80016	grams / container
	Residential closed Metal: 0	

SOURCE	FACTOR	UNIT
permeation rate is the same whether the PFC is completely filled with liquid gasoline or with saturated vapor. Thus, the total permeation emission is a function of total number of PFCs (in use) rather than of the total amount of gasoline.	Commercial closed Plastic: 2.63870	
	Commercial closed Metal: 0	
Evaporation/Diurnal	Residential closed Plastic: 1.6	grams / container
	Residential closed Metal: 0.6	
Assuming an average daily fill level of 49 percent	Commercial closed Plastic: 2.3	
	Commercial closed Metal: 0.8	

Table 49 Residential Equipment using Fuel from PFCs

Classification	SCC	Equipment	2/4 Stroke	Spillage (gr/gal)
Lawn & Garden Equipment	2260004015	Rotary Tillers < 6 HP	2	56.667
	2260004020	Chain Saws < 6 HP	2	201.422
	2260004025	Trimmers/Edger/Brush Cutter	2	85.000
	2260004030	Leaf blowers/Vacuums	2	24.286
	2265004010	Lawn mowers	4	42.500
	2265004015	Rotary Tillers < 6 HP	4	56.667
	2265004025	Trimmers/Edger/Brush Cutter	4	85.000
	2265004030	Leaf blowers/Vacuums	4	24.286
	2265004035	Snow blowers	4	24.286
	2265004040	Rear Engine Riding Mowers	4	6.953
	2265004055	Lawn & Garden Tractors	4	6.526
	2265004075	Other Lawn & Garden Eqp.	4	5.155
Pleasure Craft	2282005010	Outboard	2	5.963
	2282010005	Inboard/Stern drive	4	7.194
Recreational Equipment	2260001010	Motorcycles: Off-Road	2	6.538
	2260001030	ATVs	2	6.538
	2265001010	Motorcycles: Off-Road	4	6.538

Table 50 Commercial Equipment using Fuel from PFCs

Classification	SCC	Equipment	2/4 Stroke	%Fuel from PFC	Spillage (gr/gal)
Commercial Equipment	2260006005	Generator Sets	2	100	21.250
	2260006010	Pumps	2	98.459	21.250
	2260006015	Air Compressors	2	100	15.455
	2265006005	Generator Sets	4	52.297	7.275
	2265006010	Pumps	4	76.737	12.798
	2265006015	Air Compressors	4	57.208	8.437
	2265006025	Welders	4	10.290	11.333
	2265006030	Pressure Washers	4	77.253	12.448
Industrial Equipment	2265003030	Sweepers/Scrubbers	2	100	26.123
	2265003040	Other General Industrial Eqp	2	100	16.308
	2265003010	Aerial Lifts	4	1.587	5.862
	2265003030	Sweepers/Scrubbers	4	18.803	4.375
	2265003040	Other General Industrial Eqp	4	63.058	6.741
	2265003050	Other Material Handling Eqp	4	0.156	11.111
Lawn & Garden Equipment	2260004016	Rotary Tillers < 6 HP	2	100	56.667
	2260004021	Chain Saws < 6 HP	2	100	122.324
	2260004026	Trimmers/Edger/Brush Cutter	2	100	85.000
	2260004031	Leaf blowers/Vacuums	2	100	24.286
	2260004071	Commercial Turf Equipment	2	100	6.800
	2260004011	Lawn mowers	4	100	42.500
	2260004016	Rotary Tillers < 6 HP	4	100	56.667
	2260004026	Trimmers/Edger/Brush Cutter	4	100	85.000
	2260004031	Leaf blowers/Vacuums	4	100	24.286
	2260004036	Snow blowers	4	100	24.286
	2265004041	Rear Engine Riding Mowers	4	100	6.954
	2265004046	Front Mowers	4	100	6.987
	2265004051	Shredders < 6 HP	4	100	54.839
	2265004056	Lawn & Garden Tractors	4	100	6.526
	2265004066	Chippers/Stump Grinders	4	100	1.478
	2265004071	Commercial Turf Equipment	4	100	3.290
	2265004076	Other Lawn & Garden Eqp.	4	100	5.141
Logging Equipment	2260007005	Chain Saws > 6 HP	2	100	62.408
Recreational Equipment	2265001060	Specialty Vehicles/Carts	4	0.021	4.722

Ohio EPA accepted US EPA's estimates without any changes

5.3.2 Point Source Subtraction Emissions Estimates

The following area source emissions are estimated by modifying US EPA's files to allow Ohio EPA to subtract point source emissions or to use state-specific activity data.

23. Fuel Combustion; Industrial, Commercial, & Institutional (SCC's see Table 51)

INDUSTRIAL

This subsector includes emissions from fuel combustion at stationary area sources within the industrial sector (i.e., sources that are not reported in the point source inventory because their emissions are too small). Industrial fuel combustion emissions are calculated for the following fuel types: coal, distillate oil, residual oil, natural gas, liquefied petroleum gas (LPG), kerosene, and wood. Motor gasoline is not inventoried as an area source because gasoline combustion is included in the non-road inventory. Most of the fuel types that are included in the industrial combustion sector also have a non-fuel use component. Therefore, it is necessary to exclude this component in calculating area source industrial fuel combustion activity/emissions.

Table 51 Non-point Source Industrial Fuel Combustion SCCs

SCC	Fuel Type
2102001000	Anthracite Coal
2102002000	Bituminous/Sub-bituminous Coal
2102004000	Distillate Oil
2102005000	Residual Oil
2102006000	Natural Gas
2102007000	Liquefied Petroleum Gas LPG)
2102008000	Wood
2102011000	Kerosene

Total state-level industrial sector energy consumption data are available from the Energy Information Administration (EIA)'s State Energy Data System (SEDS), and are used for most source categories.[50] The 2006 SEDS data are used to estimate the 2008 emissions because they are the latest consumption data available at the time this estimate is being calculated in 2009.

A number of adjustments are made to the SEDS data for Coal, Distillate Oil and LPG to obtain fuel-specific activity data as explained below.

Coal - for industrial coal combustion, it is necessary to compile data representing a sub-set of total sector coal consumption. Data representing *non-coke plant* consumption is compiled from EIA because coal consumed by coke plants is accounted for in the point source inventory. The SEDS data do not provide coal consumption estimates by type of coal (i.e., anthracite versus bituminous/sub-bituminous). Therefore, US EPA used state-level industrial coal distribution data for 2006 from the EIA table "Domestic and Foreign Distribution of U.S. Coal by State of Origin, 2006," to allocate coal consumption between the two types of coal. The 2006 ratio of anthracite (and bituminous) coal consumption to total coal consumption is used for this allocation procedure.

Table 52 presents the 2006 anthracite and bituminous coal ratio for Ohio.

Table 52 Proportion of 2006 Industrial Sector Coal Consumption by Type of Coal

State	% Anthracite	% Bituminous/ Sub-bituminous
Ohio	0.0%	100.0%

Distillate Oil and LPG - the SEDS industrial sector distillate oil and LPG consumption data include consumption estimates for equipment that US EPA includes in the non-road sector inventory. In particular, SEDS considers the following non-road source category activities to be part of the industrial sector: farming, logging, mining, and construction. To avoid double-counting of LPG consumption, US EPA ran the National Mobile Inventory Model (NMIM) for 2006 and calculated the national volume of non-road LPG consumption from agriculture, logging, mining, and construction source categories. This estimate is divided into the SEDS total industrial sector LPG consumption estimate to yield the proportion of total industrial sector LPG consumption attributable to the non-road sector in that year (approximately 9%). To estimate the volume of industrial sector LPG consumption that should not be included in the area source industrial fuel combustion category, US EPA subtracted 9% from Ohio's industrial sector LPG consumption estimate reported in SEDS.

To avoid double-counting of distillate oil consumption between the area and non-road sector emissions inventories, more detailed distillate oil consumption estimates reported in EIA's *Fuel Oil and Kerosene Sales* were used, and assumptions used in the regulatory impact analysis (RIA) for EPA's non-road diesel emissions rulemaking.[51,52]

Some industrial sector energy is consumed for non-fuel purposes such as LPG and is used to create intermediate products to make plastics. To estimate the volume of fuel that is associated with industrial combustion, it is necessary to subtract the volume of fuel consumption for non-energy uses from the volume of total fuel consumption. The US EPA's State Greenhouse Gas Inventory Tool (SIT) provides national defaults representing the percentage of total industrial fuel consumption from non-energy uses.

These default values represent the EIA's definition of the industrial sector, which includes fuel consumption from industrial, farm, mining, and construction sectors that is accounted for in the non-road inventory. In calculating the emission activity for industrial fuel combustion, all SEDS were excluded fuel types for which EIA assumes 100 percent of consumption is non-fuel use.

Because the point source inventory also includes industrial fuel combustion categories, Ohio EPA modified US EPA's estimates by subtracting the point source inventory fuel use for this sector. Ohio EPA used a crosswalk between industrial fuel combustion area SCCs and the associated point SCCs supplied by US EPA to ensure an accurate subtraction procedure.

US EPA has compiled EFs for area source industrial fuel combustion categories[53] where, in most cases, they are the same as those used in the 2002 area source NEI.[54] The Industrial LPG and wood combustion EFs are obtained from an ICI fuel combustion study being performed for the Central Regional Air Planning Association (CENRAP).[55] Table 53 lists the EFs used to calculate emissions from the Industrial Fuel sources.

Table 53 Emission Factors for Industrial Fuel Combustion

Fuel Type	Pollutant CODE	Pollutant NAME	Emission Factor	
Bituminous/Sub-bituminous Coal	VOC	Volatile Organic Compounds	0.05	
	NOX	Nitrogen Oxides	11	
Sulfur Content	CO	Carbon Monoxide	5	

Fuel Type	Pollutant CODE	Pollutant NAME	Emission Factor	
3.45% Heat Content 26 MMBTU/lb Ohio's Point Source Contribution: 1,820,130.05 Tons	SO2	Sulfur Dioxide	38*S	lb/Ton
	PM25-FIL	Primary PM2.5, Filterable Portion Only	1.4	
	PM10-FIL	Primary PM10, Filterable Portion Only	12	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.04	
	NH3	Ammonia	0.03	
Distillate Oil Sulfur Content 0.6% Heat Content 140 MMBTU/E3Gal Ohio's Point Source Contribution: 4337 E3Gal	VOC	Volatile Organic Compounds	0.34	lb/E3Gal
	NOX	Nitrogen Oxides	20	
	CO	Carbon Monoxide	5	
	SO2	Sulfur Dioxide	85.2	
	PM25-FIL	Primary PM2.5, Filterable Portion Only	0.83	
	PM10-FIL	Primary PM10, Filterable Portion Only	1.08	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	1.3	
	NH3	Ammonia	0.8	
Residual Oil Sulfur Content 2.25% Heat Content 150 MMBTU/E3Gal Ohio's Point Source Contribution: 18300.74 E3Gal	VOC	Volatile Organic Compounds	1.13	lb/E3Gal
	NOX	Nitrogen Oxides	55	
	CO	Carbon Monoxide	5	
	SO2	Sulfur Dioxide	353.25	
	PM25-FIL	Primary PM2.5, Filterable Portion Only	13.4963	
	PM10-FIL	Primary PM10, Filterable Portion Only	20.7213	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	1.5	
	NH3	Ammonia	0.8	
Natural Gas Ohio's Point Source Contribution:	VOC	Volatile Organic Compounds	5.5	
	NOX	Nitrogen Oxides	100	
	CO	Carbon Monoxide	84	

Fuel Type	Pollutant CODE	Pollutant NAME	Emission Factor	
79187.03 MMCF	SO2	Sulfur Dioxide	0.6	lb/MMCF
	PM25-FIL	Primary PM2.5, Filterable Portion Only	0.11	
	PM10-FIL	Primary PM10, Filterable Portion Only	0.2	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.32	
	NH3	Ammonia	0.49	
Liquefied Petroleum Gas (LPG) Heat Content 94 MMBTU/E3Gal Ohio's Point Source Contribution: 21.71 E3Gal	VOC	Volatile Organic Compounds	0.52	lb/E3Gal
	NOX	Nitrogen Oxides	9.49	
	CO	Carbon Monoxide	11.95	
	SO2	Sulfur Dioxide	0.06	
	PM25-FIL	Primary PM2.5, Filterable Portion Only	0.01	
	PM10-FIL	Primary PM10, Filterable Portion Only	0.02	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.03	
	NH3	Ammonia	0.05	
Wood Sulfur Content 2% Heat Content 8000 BTU/lb Ohio's Point Source Contribution: 553,837.44 Tons	VOC	Volatile Organic Compounds	0.272	lb/Tons
	NOX	Nitrogen Oxides	3.52	
	CO	Carbon Monoxide	9.6	
	SO2	Sulfur Dioxide	0.4	
	PM25-FIL	Primary PM2.5, Filterable Portion Only	6.88	
	PM10-FIL	Primary PM10, Filterable Portion Only	7.152	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.272	
	NH3	Ammonia	0.0862	
Kerosene Sulfur Content 0.035%	VOC	Volatile Organic Compounds	0.33	
	NOX	Nitrogen Oxides	19.3	
	CO	Carbon Monoxide	4.8	
	SO2	Sulfur Dioxide	4.97	

Fuel Type	Pollutant CODE	Pollutant NAME	Emission Factor	
Heat Content 135 MMBTU/E3Gal Ohio's Point Source Contribution: 0 E3Gal	PM25-FIL	Primary PM2.5, Filterable Portion Only	0.8	lb/E3Gal
	PM10-FIL	Primary PM10, Filterable Portion Only	1.04	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	1.3	
	NH3	Ammonia	0.8	

COMMERCIAL/INSTITUTIONAL

This subsector covers emissions from fuel combustion at stationary area sources within the commercial/institutional sector. The fuel types included in the inventory for the commercial/institutional area source subsector are: anthracite coal, bituminous/sub-bituminous coal, distillate oil, residual oil, natural gas, LPG, wood, and kerosene. Motor gasoline is not included as an area source because it is expected that all area gasoline combustion in this sector to be included in the non-road inventory. Table 54 lists the area SCCs associated with commercial/institutional fuel combustion.

Table 54 Non-point Source Commercial/Institutional Fuel Combustion SCCs

SCC	Fuel Type
2103001000	Anthracite Coal
2103002000	Bituminous/Sub-bituminous Coal
2103004000	Distillate Oil
2103005000	Residual Oil
2103006000	Natural Gas
2103007000	Liquefied Petroleum Gas (LPG)
2102008000	Wood
2102011000	Kerosene

Total state-level commercial sector energy consumption data are available from the Energy Information Administration (EIA)'s State Energy Data System (SEDS), and are used for most source categories.[50] However, a number of adjustments are made to the SEDS data, and a separate EIA data source is used for distillate oil. The 2006 SEDS data are used to estimate the 2008 emissions because they are the latest year consumption data available at the time this work was performed in 2009.

Coal - for commercial/institutional coal combustion, SEDS data do not provide coal consumption estimates by type of coal (i.e., anthracite versus bituminous/sub-bituminous).

Therefore, US EPA used state-level commercial/residential coal distribution data for 2006 from the EIA table "Domestic and Foreign Distribution of U.S. Coal by State of Origin, 2006," to allocate coal consumption between the two types of coal. The 2006 ratio of anthracite (and bituminous) coal consumption to total coal consumption is used for this allocation procedure. Table 55 presents the 2006 anthracite and bituminous coal ratio for Ohio.

Table 55 Proportion of 2006 Commercial/Institutional Sector Coal Consumption by Type of Coal

State	% Anthracite	% Bituminous/Sub-bituminous
Ohio	12.7%	87.3%

Distillate Oil and LPG - the SEDS commercial/institutional sector distillate oil and LPG consumption data include consumption estimates for equipment that was included in the non-road sector inventory. To avoid double-counting of LPG consumption, the National Mobile Inventory Model (NMIM) for 2006 and calculated the national volume of non-road LPG consumption from commercial sector source categories. This estimate is divided into the SEDS total industrial sector LPG consumption estimate to yield the proportion of total commercial/institutional sector LPG consumption attributable to the non-road sector in that year (approximately 18%) which is subtracted from Ohio's commercial sector LPG consumption estimate reported in SEDS to estimate the volume of commercial/institutional sector LPG consumption that should not be included in the area source inventory.

To avoid double-counting the distillate oil consumption between the area and non-road sector emission inventories, Ohio EPA used more detailed distillate oil consumption estimates reported in EIA's *Fuel Oil and Kerosene Sales*, and assumptions from the regulatory impact analysis (RIA) for EPA's non-road diesel emissions rulemaking.[51,52]

Because the point source inventory includes commercial/institutional fuel combustion categories, Ohio EPA modified US EPA's estimates by subtracting the point source inventory fuel use for this sector. Ohio EPA used a crosswalk between commercial/institutional fuel combustion area SCCs and the associated point SCCs supplied by US EPA to ensure an accurate subtraction procedure.

US EPA compiled 2006 estimates of commercial sector (NAICS codes 42 through 81) employment from the Bureau of Census' *County Business Patterns 2006* for use in this inventory[56] and developed 2006 county-level estimates of institutional sector (NAICS code 92) employment from 2007 local government employment data in the 2007 *Census of Governments* and adjustments reflecting each state's 2006/2007 local government employment ratio[57]. State-level commercial/institutional fuel combustion by fuel type is 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.

The EPA has compiled EFs for area source commercial/institutional fuel combustion categories.[53] In most cases, these are the same EFs that are used in preparing the 2002 area source NEI.[54] Commercial/institutional wood combustion EFs are obtained from an ICI fuel combustion study performed for the Central Regional Air Planning Association (CENRAP).[55] Table 56 lists the EFs used to calculate emissions from the Industrial Fuel sources.

Table 56 Emission Factors for Commercial/Institutional Fuel Combustion

Fuel Type	Pollutant CODE	Pollutant NAME	Emission Factor	
Anthracite Coal Ash Content 0.89% Sulfur Content 13.38% Heat Content 13 MMBTU/lb Ohio's Point Source Contribution: 0 Tons	VOC	Volatile Organic Compounds	0.3	lb/Ton
	NOX	Nitrogen Oxides	9	
	CO	Carbon Monoxide	0.6	
	SO2	Sulfur Dioxide	5.2182	
	PM25-FIL	Primary PM2.5, Filterable Portion Only	0.00356	
	PM10-FIL	Primary PM10, Filterable Portion Only	0.00979	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.000712	
	NH3	Ammonia	0.03	
Bituminous/Sub-bituminous Coal Sulfur Content 3.45% Heat Content 26 MMBTU/lb Ohio's Point Source Contribution: 151837 Tons	VOC	Volatile Organic Compounds	0.05	lb/Ton
	NOX	Nitrogen Oxides	11	
	CO	Carbon Monoxide	5	
	SO2	Sulfur Dioxide	38*S	
	PM25-FIL	Primary PM2.5, Filterable Portion Only	1.4	
	PM10-FIL	Primary PM10, Filterable Portion Only	12	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.04	
	NH3	Ammonia	0.03	
Distillate Oil Sulfur Content 0.6% Heat Content 140 MMBTU/E3Gal Ohio's Point Source Contribution: 253.23 E3Gal	VOC	Volatile Organic Compounds	0.34	lb/E3Gal
	NOX	Nitrogen Oxides	20	
	CO	Carbon Monoxide	5	
	SO2	Sulfur Dioxide	85.2	
	PM25-FIL	Primary PM2.5, Filterable Portion Only	0.83	
	PM10-FIL	Primary PM10, Filterable Portion Only	1.08	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	1.3	
	NH3	Ammonia	0.8	
	VOC	Volatile Organic	1.13	

Fuel Type	Pollutant CODE	Pollutant NAME	Emission Factor	
Residual Oil		Compounds		
	NOX	Nitrogen Oxides	55	
	CO	Carbon Monoxide	5	
Sulfur Content 2.25%	SO2	Sulfur Dioxide	353.25	
Heat Content 150 MMBTU/E3Gal	PM25-FIL	Primary PM2.5, Filterable Portion Only	13.4963	lb/E3Gal
	PM10-FIL	Primary PM10, Filterable Portion Only	20.7213	
Ohio's Point Source Contribution: 1176.72 E3Gal	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	1.5	
	NH3	Ammonia	0.8	
	VOC	Volatile Organic Compounds	5.5	
	NOX	Nitrogen Oxides	100	
	CO	Carbon Monoxide	84	
	SO2	Sulfur Dioxide	0.6	
Natural Gas	PM25-FIL	Primary PM2.5, Filterable Portion Only	0.11	lb/MMCF
Ohio's Point Source Contribution: 24878.61 MMCF	PM10-FIL	Primary PM10, Filterable Portion Only	0.2	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.32	
	NH3	Ammonia	0.49	
	VOC	Volatile Organic Compounds	0.52	
	NOX	Nitrogen Oxides	9.49	
	CO	Carbon Monoxide	11.95	lb/E3Gal
	SO2	Sulfur Dioxide	0.06	
Liquefied Petroleum Gas (LPG)	PM25-FIL	Primary PM2.5, Filterable Portion Only	0.01	
Heat Content 94 MMBTU/E3Gal	PM10-FIL	Primary PM10, Filterable Portion Only	0.02	
Ohio's Point Source Contribution: 0 E3Gal	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.03	
	NH3	Ammonia	0.05	
Wood	VOC	Volatile Organic Compounds	0.272	
Sulfur Content 2%	NOX	Nitrogen Oxides	3.52	

Fuel Type	Pollutant CODE	Pollutant NAME	Emission Factor	
Heat Content 8000 BTU/lb Ohio's Point Source Contribution: 1487 Tons	CO	Carbon Monoxide	9.6	lb/Tons
	SO2	Sulfur Dioxide	0.4	
	PM25-FIL	Primary PM2.5, Filterable Portion Only	6.88	
	PM10-FIL	Primary PM10, Filterable Portion Only	7.152	
	PM-CON	PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	0.272	
	NH3	Ammonia	0.0862	
Kerosene Sulfur Content 0.035% Heat Content 135 MMBTU/E3Gal Ohio's Point Source Contribution: 0 E3Gal	VOC NOX CO SO2 PM25-FIL PM10-FIL PM-CON NH3	Volatile Organic Compounds	0.33	lb/E3Gal
		Nitrogen Oxides	19.3	
		Carbon Monoxide	4.8	
		Sulfur Dioxide	4.97	
		Primary PM2.5, Filterable Portion Only	0.8	
		Primary PM10, Filterable Portion Only	1.04	
		PE-Primary PM Condensable Portion Only (All Less Than 1 Micron)	1.3	
		Ammonia	0.8	

Ohio accepted US EPA's estimate with a modification of subtracting Ohio's point source contribution from total emissions.

SURFACE COATING OPERATIONS

Surface coating covers a wide range of categories and emissions. Surface coating operations include aerospace, auto refinishing, furniture finishing, metal can coating, and paper coating. Emissions depend on the type of surface coating operation and the material used for coating. Surface coating is the application of a thin layer of coating to an object for decorative or protective purposes which include coatings that are applied during the manufacturing of the products by Original Equipment Manufacturers (OEMs). The VOC Emissions result from the evaporation of paint solvent during coating operation, any additional solvent used to thin the coating, the use of solvents in cleaning the surface prior to coating, and cleaning coating equipment after use.[64]

Table A summarizes SCC, VOC EF, and point source contribution details of solvent emissions from surface coating operations while Table B provides similar details but for non-coating operations. Both tables can be found at the end of the surface coating discussion.

24. Surface Coating - Auto Refinishing (SCC 2401005000)

The repairing of damaged vehicles to any coating applications which occur after those applied at the original manufacturers' assembly plant are included in this category (only auto repair shops not coating of new cars). This area source includes paint and thinning solvents used as well as for surface preparation and clean-up. Since auto body repair shops may also be point sources, the area source emissions estimate will have to be adjusted by removing the total point source emissions. However, in Ohio, there are no point sources identified for this category so no such adjustment is made.

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 89 lb/employee. Ohio EPA accepted US EPA's estimate without modification because there is no point source adjustment for Ohio.

25. Surface Coating - Factory Finished Wood: SIC 2426 thru 242 (SCC 401015000)

The VOC emissions from this source category result from the evaporation of the solvent used in the gluing and coating process[59] of the wood products.

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 43 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 584.41 Tons point source adjustment for Ohio.

26. Surface Coating - Wood Furniture (SCC 2401020000)

This source category includes establishments engaged in the manufacture of wood home or office furniture. VOC emissions result from the evaporation of solvents used in the finish coats and cleanup procedures.[59]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 244 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 165.46 Tons point source adjustment for Ohio.

27. **Surface Coating - Metal Furniture: SIC 25 (SCC 2401025000)**

This source category includes manufacturing metal household and office furniture, such as beds, cabinets, desks, bookcases, and chairs.[59]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 772 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 155.76 Tons point source adjustment for Ohio.

28. **Surface Coating - Paper, foil, and film (SCC 2401030000)**

The paper and other web coating source category includes any coating of paper, plastic, film, metallic foil, and other web surfaces. A web is defined as a continuous substrate (e.g., paper, plastic film, foil) that is capable of being rolled at any point during the coating process. These coating processes apply a uniform layer of material (coating) across essentially the entire length and/or width of a continuous substrate (web) to provide a covering, finish, or a functional/protective layer to a substrate, to saturate a substrate or to provide adhesion between two substrates for lamination. This definition distinguishes this source category from the printing and publishing source category, which can be described as processes that apply words, designs or pictures to a substrate. Web coating is done in the manufacture of some major products such as pressure sensitive tapes and labels, photographic film, industrial and decorative laminates, flexible vinyl products, flexible packaging, abrasive products and folding paperboard boxes.[60]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS, the same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 735 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 679.80 Tons point source adjustment for Ohio.

29. Surface Coating - Metal Can Coating (SCC 2401040000)

This source category includes the manufacturing of metal cans, barrels, drums, kegs, and pails.[66]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 2326 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 7036.29 Tons point source adjustment for Ohio.

30. Surface Coating - Sheet, strip, and coil (SCC 2401045000)

Metal coil surface coating is the linear process by which protective or decorative organic coatings are applied to flat metal sheet or strip packaged in rolls or coils. Generally, a metal strip is uncoiled at the entry to a coating line and is passed through a wet section, where the metal is thoroughly cleaned and is given a chemical treatment to inhibit rust and to promote coatings adhesion to the metal surface. In some installations, the wet section contains an electro-galvanizing operation. Then the metal strip is dried and sent through a coating application station, where rollers coat one or both sides of the metal strip. The strip then passes through an oven where the coatings are dried and cured. As the strip exits the oven, it is cooled by a water spray and again dried.[61]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 2877 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 12,948.45 Tons point source adjustment for Ohio.

31. Surface Coating - Machinery and Equipment: SIC 35 (SCC 2401055000)

The VOC emissions from this source category result from the evaporation of the solvent used in the coating process in manufacturing facilities, such as engines, turbines, farm and garden equipment, computers, and office machinery.[59]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is

estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 109 lb/employee. Ohio EPA accepted US EPA's estimate without modification because there is no point source adjustment for Ohio.

32. **Surface Coating - Large Appliances: SIC 363 (SCC 2401060000)**

The VOC emissions from this source category result from the evaporation of the solvent used in the coating process in the manufacture of electrical appliances such as refrigerators, freezers, laundry equipment, and electric house wares.[59]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 249 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 401 Tons point source adjustment for Ohio.

33. **Surface Coating - Electronic and other Electric Coatings (SCC 2401065000)**

The VOC emissions from this source category result from the evaporation of the solvent used in the insulation coatings applied to wires and cables.[59] The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 24.7 lb/employee. Ohio EPA accepted US EPA's estimate without modification because there is no point source adjustment for Ohio.

34. **Surface Coating - Motor Vehicles (SCC 2401070000)**

Motor Vehicle Surface Coating is the spray application of coatings to any assembled self-propelled vehicle including automobiles, light duty trucks, golf carts, vans, and motorcycles[62].

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is

performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 164 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 16,220 Tons point source adjustment for Ohio.

35. **Surface Coating - Aircraft (SCC 2401075000)**

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 15 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 2 Tons point source adjustment for Ohio.

36. **Surface Coating - Marine (SCC 2401080000)**

This source category includes ship and boat building and repairing.The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 198 lb/employee. Ohio EPA accepted US EPA's estimate without modification because there is no point source adjustment for Ohio.

37. **Surface Coating - Railroad (SCC 2401085000)**

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 222 lb/employee. Ohio EPA accepted US EPA's estimate without modification because there is no point source adjustment for Ohio.

38. **Surface Coating - Miscellaneous Manufacturing (SCC 2401090000)**

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 136 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 5417 Tons point source adjustment for Ohio.

39. **Industrial Maintenance Coatings (SCC 2401100000)**

Industrial coatings are designed to provide protective rather than aesthetic properties, although they can provide both. The most common use of industrial coatings is for corrosion control of steel or concrete. Other functions include coatings for fire resistance[64]. Emissions for this category are estimated using a per capita emission factor and U.S. Bureau of the Census population data.

The methodology is based on the population data which is collected from the U.S. Census Bureau's population estimates for July 1, 2008.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 1.1 lb/capita (EF for states without IM rules). Ohio EPA accepted US EPA's estimate without modification since it is population based and there is not an available point source adjustment method.

40. **Other Special Purpose Coatings (SCC 2401200000)**

This category includes special purpose coatings used for applications such as maintenance operations at industrial and other facilities, auto refinishing, traffic paints, marine finishes, and aerosol sprays. This category covers those specific coating processes not already included in other source categories (e.g., High Performance Industrial Maintenance Coatings). Emissions for this category are estimated using a per capita emission factor and U.S. Bureau of the Census population data. The methodology is based on the population data which is collected from the U.S. Census Bureau's population estimates for July 1, 2008.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 0.007 lb/capita. Ohio EPA accepted US EPA's estimate without modification since it is population based and there's no way to apply a point source adjustment.

41. Degreasing (SCC 2415000000)

This area source (also known as "Solvent Cleaning") includes two classifications:

SCC Description	SCC
Solvent Cleaning	
Cold Cleaning for Automobile Repair	2415360000
Cold Cleaning for Manufacturing	2415345000
Vapor/in-line Cleaning for Electronics & Electrical	2415230000
Vapor/in-line Cleaning for Other	2415245000
Solvent Cleanup	
Wipe Cleaning of External Surfaces	

The solvent cleaning or conditioning of metal surfaces and parts, fabricated plastics, electronic and electrical components and other nonporous substrates is designed to remove foreign material, such as oils, grease, waxes and moisture, usually in the preparation for further treatment, such as painting, electroplating, galvanizing, anodizing or applying conversion coatings. The VOC emissions result from the evaporation of solvents used in these processes.[59]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 30.5 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 479 Tons point source adjustment for Ohio.

42. Graphic Arts (SCC 2425000000)

Graphic arts include operations that are involved in the printing of newspapers, magazines, books, and other printed material. Emissions of VOCs result from evaporation of solvents used in inks and cleaning.[59]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

The EFs are developed and reviewed by an ERTAC advisory panel composed of state and US EPA personnel. The VOC EF is 1482 lb/employee. Ohio EPA accepted US EPA's emissions estimate with the modification of subtracting 11,619 Tons point source adjustment for Ohio.

43. **Dry Cleaning (SCC 2420000000)**

Three types of dry cleaning operations are used:

1) Coin-operated facilities using Perchloroethylene (Perc);
2) Commercial/industrial facilities using Perc; and
3) Commercial/industrial facilities using VOC solvents.

Since PERC is not a VOC (PERC is a HAP which is not included in these estimates), US EPA only considered the commercial/industrial facilities using VOC solvents for the area source inventory which means that the first two categories are not included in the baseline inventory but they are retained for use in the modeling inventory as required by US EPA guidance.[59]

The methodology is based on the employment data which is obtained from the North American Industrial Classification Standard (NAICS) code(s) and is allocated to each county using *County Business Patterns* employment data for 2006 (the most recent data available at the time of compilation). Whenever data is withheld, the number of employees in a withheld county is estimated.[58] For SCCs associated with multiple NAICS. The same allocation procedure is performed for each individual NAICS.

US EPA's inventory estimates 423 Tons of VOCs for Ohio's Butler and Hamilton counties in 2008 while Ohio's own point source inventory shows only 71.39 tons of actual emissions for the 100 dry cleaners in these two counties. US EPA's over estimation may be due to an outdated EF which is obtained from Freedonia or based on uncontrolled factor which doesn't take into account the controls required to be installed per the MACT standard.

In light of the questionable values obtained from US EPA, Ohio did not use the EF provided by ERTAC but calculated own EF based on the assumption that no more than 10% of solvent is other than PERC. Ohio's PERC EF is based on employment data for NAICS codes 81232 and 81233 and actual PERC emissions from Butler and Hamilton counties.

Therefore the EFs used to estimate the dry cleaning emissions are 90.3 lb/employee for PERC and 9 lb/employee for VOC. US EPA's emissions estimate are modified by using Ohio's EF as explained above and by subtracting 18.19 Tons of PERC point source adjustment.

44. **Agricultural Pesticide Application (SCC 2461850000)**

Pesticides, which contain petroleum solvents and synthetic organic ingredients, are used to kill or retard the growth of insects, rodents, fungi, weeds, or microorganisms. The bulk of pesticide application is associated with agriculture and, therefore, occurs in rural areas. Although many crops are sprayed by Ohio farmers, corn and soybean are the main crops so they are the only crops included in the inventory. The corn total planted acreage consists of silage and grain.

The VOC emissions for each county are estimated using an EF based on the number of harvested acres. Harvested acreage data are obtained from the U.S. Department of Agriculture's National Agricultural Statistics Service.[65]

Because Indiana uses real data to calculate a new EF for every inventory cycle and that state's agricultural activity is similar to Ohio's, Ohio EPA opted to use Indiana's EF for VOC rather than US EPA's which is designed for the entire country where some agricultural activities are quite

different than those performed in Ohio. Therefore the EF used to estimate the pesticide application VOC emissions is 2.32 lb/acre for both crops. No point sources contribution from this category.

45. **Publicly Owned Treatment Works (POTW) (SCC 2630020000)**

Publicly Owned Treatment Works (POTW) may be operated by a state, municipality, city, town, special sewer district, or other publicly owned and financed entity as opposed to a privately (industrial) owned treatment facility. The definition includes intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment. The wastewater treated by these POTWs is generated by industrial, commercial, and domestic sources.[66]

Ohio EPA obtained Ohio's estimated POTW discharge volumes for each county from the OEPA Division of Surface Water. The flow data estimates are based on data that is reported May through October. The VOC EF used is 0.85 lb/E6Gal per the 2002 NEI and no point source contribution from this category.

Table 57 Summary of Surface Coating Operations

CATEGORY	SCC	Ohio's Point Source Contribution	VOC EF
Auto Refinishing	2401005000	None	89 lb/employee
Factory Finished Wood SIC 2426 thru 242	2401015000	584.41 Tons	43 lb/employee
Wood Furniture	2401020000	165.46 Tons	244 lb/employee
Metal Furniture: SIC 25	2401025000	155.76 Tons	772 lb/employee
Paper, foil, and film	2401030000	679.80 Tons	735 lb/employee
Metal Can Coating	2401040000	7036.29 Tons	2326 lb/employee
Sheet, Strip and Coil	2401045000	12,948.45 Tons	2877 lb/employee
Machinery and Equipment: SIC 35	2401055000	None	109 lb/employee
Large Appliances: SIC 363	2401060000	401 Tons	249 lb/employee
Electronic and other Electric Coatings	2401065000	None	24.7 lb/employee
Motor Vehicles	2401070000	16,220 Tons	164 lb/employee
Aircraft	2401075000	2 Tons	15 lb/employee
Marine	2401080000	None	198 lb/employee
Railroad	2401085000	None	222 lb/employee
Miscellaneous Manufacturing	2401090000	5417 Tons	136 lb/employee
Industrial Maintenance Coatings	2401100000	None	1.1 lb/capita (No IM Rules)
Other Special Purpose Coatings	2401200000	None	0.007 lb/capita

Table 58 Summary of Additional VOC Sources (Non Coating Operations)

CATEGORY	SCC	Ohio's Point Source Contribution	VOC EF
Degreasing	2415000000	479 Tons	30.5 lb/employee
Graphic Arts	2425000000	11,649 Tons	1482 lb/employee
Dry Cleaning	2420000000	18 tons of PERC	9 lb/employee VOC 90.3 lb/employee PERC
Agricultural Pesticide	2461850000	None	2.32 lb/acre (Corn & Soybean)
POTW	2630020000	None	0.85 b/E6Gal

46. **Gasoline Distribution: Stage I**

Stage I gasoline distribution includes the following gasoline emission points: 1) bulk terminals; 2) pipeline facilities; 3) bulk plants; 4) tank trucks; and 5) service stations. Emissions from Stage I gasoline distribution occur as gasoline vapors are released into the atmosphere. Table 59 lists all the SCCs involved in Stage I gasoline distribution.

Table 59 Stage I Gasoline Distribution SCCs

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

2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline
2505040120	Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline	Gasoline

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. Breathing losses are the expulsion of vapor from a tank vapor space that has expanded or contracted because of daily changes in temperature and barometric pressure; these emissions occur in the absence of any liquid level change in the tank. Emptying losses occur when the air that is drawn into the tank during liquid removal saturates with hydrocarbon vapor and expands, thus exceeding the fixed capacity of the vapor space and overflowing through the pressure vacuum valve.[67]

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.[68] Pipeline emissions result from the valves and pumps found at pipeline pumping stations and from the valves, pumps, and storage tanks at pipeline breakout stations. Stage I gasoline distribution emissions also occur when gasoline vapors are displaced from storage tanks during unloading of gasoline from tank trucks at service stations (Gasoline Service Station Unloading) and from gasoline vapors evaporating from service station storage tanks and from the lines going to the pumps (Underground Storage Tank Breathing and Emptying).

BULK TERMINALS AND PIPELINES

There are no generally accepted activities based VOC EF for the pipelines and bulk terminals sectors because they are generally treated as point sources where the emissions are estimated using site specific information. For bulk terminals and pipelines, US EPA's 2008 national VOC emissions estimates are obtained by multiplying 1998 national estimates developed in support of the Gasoline Distribution MACT standard[69] by the 2008 to 1998 ratio of the national volume of wholesale gasoline supplied. The gasoline supply information is obtained from Table 2 in Volume I of Petroleum Supply Annual 2008.[70]

Therefore, Ohio EPA accepted US EPA's estimate for the pipelines and the bulk terminals. Because all bulk terminals are either SMTV's or TV facilities in Ohio, the inventory is zeroed by equating the throughput and emissions of these sources to zero.

BULK PLANTS

US EPA calculated VOC emissions from bulk plants by developing an average EF from the bulk plant motor gasoline VOC emissions and throughput data developed in support of the Gasoline Distribution MACT standards.[67,69] To estimate the 2008 national VOC emissions, the VOC EF (8.62 pounds of VOC per 1,000 gallons) is applied to the estimated national volume of gasoline passing through bulk plants in 2008. The volume of bulk plant gasoline throughput is assumed

to be 9% of total gasoline consumption.[71] Total gasoline consumption for 2008 is assumed to be the same as the volume of finished motor gasoline supplied as reported on the U.S. Energy Information Administration's Petroleum Navigator website.[72] The resulting national VOC emission estimate is then allocated to counties based on employment data for NAICS code 42471 (Petroleum Bulk Stations and Terminals).

Ohio's permitting regulation exempts bulk plants from obtaining a permit, therefore, these facilities are excluded for the point source inventory and the federal estimates are adopted for this category.

TANK TRUCKS IN TRANSIT

US EPA calculated VOC emissions from Tank Trucks in Transit by multiplying county level tank truck gasoline throughput by a 0.06 lb of VOC per 1,000 gallon EF which is the sum of the individual emission factors reported in the Gasoline Distribution EIIP guidance document for gasoline-filled trucks (traveling to service station/bulk plant for delivery) and vapor-filled trucks (traveling to bulk terminal/plant for reloading).[68] County-level gasoline consumption is estimated by summing county-level on road and nonroad estimates. County-level on road consumption is estimated by subtracting the NMIM-derived national non road consumption from the EIA's estimate of finished motor gasoline supplied and then allocating to counties using NMIM-derived on road county-level CO_2 emissions.[72,73] County-level non road consumption is estimated by allocating NMIM-derived state/SCC-level non road gasoline consumption to the county-level based on nonroad county/SCC-level CO_2 emissions.[73] Gasoline throughput for tank trucks is computed by multiplying the county-level gasoline consumption estimates by a factor of 1.09 to account for gasoline that is transported more than once in a given area (i.e., transported from bulk terminal to bulk plant and then from bulk plant to service station).[71] Ohio accepted US EPA's emission estimate.

UNDERGROUND STORAGE TANK (UST) BREATHING AND EMPTYING

US EPA calculated VOC emissions from UST breathing and emptying by multiplying county-level total gasoline consumption, calculated as described above in the Tank Trucks in Transit section, by the 1.0 lb/1,000 gallons EF recommended by the Gasoline Distribution EIIP guidance document.[74] Ohio accepted US EPA's emission estimate.

GASOLINE SERVICE STATION UNLOADING

US EPA estimated uncontrolled VOC emissions from unloading of gasoline into service station tanks from county-level total gasoline consumption estimates, calculated as described above in the Tank Trucks in Transit section, and the following AP-42 equation:

$$L = (12.46 \times S \times P \times M)/T$$

where:

L	=	uncontrolled loading loss of liquid loaded (in lb/1,000 gallons);
S	=	saturation factor;
P	=	true vapor pressure of liquid loaded (pounds per square inch absolute);
M	=	molecular weight of vapors (lbs per lb/mole)
T	=	temperature of liquid loaded (Rankine).[75]

This equation requires geographic-specific information. This information includes the saturation factor, which differs by method of loading (e.g., submerged filling), Reid vapor pressure (RVP), temperature, and true vapor pressure of gasoline.

Gasoline RVP values are obtained from the NMIM 2008 database. Because NMIM[73] is a county level database that reports RVP values by month, EPA developed county level monthly gasoline consumption estimates by multiplying annual county gasoline consumption by monthly allocation factors. State-level monthly allocation factors are developed from monthly gasoline sales data reported in the Federal Highway Administration's Highway Statistics 2008.[76] Geographic specific information on the temperature of gasoline and the method of loading are obtained from a Stage I and II gasoline emission inventory study prepared for the EIIP.[77]

Although US EPA incorporated the effect of Stage I Gasoline Service Station vapor balancing controls based on the county level control efficiency values (either 90 or 95%) that are compiled for the EIIP study,[77] Ohio requested that a 95% of gasoline is balance submerged and 5% is splashed for all counties to be applied and USEPA revised as requested.

Emissions are reported by SCC based on the filling methods used in each county as determined from the EIIP study:

SCC 2501060051 (Submerged Filling);
SCC 2501060052 (Splash Filling);
SCC 2501060053 (Balanced Submerged Filling).

Ohio accepted US EPA's estimate since this category's point source adjustment is negligible.

47. **Stage 2 Gasoline Refueling (SCC 2501060100)**

Stage II gasoline distribution emissions are the refueling emissions that occur during the transfer of gasoline from storage tanks at service stations to vehicle fuel tanks. This SCC is only used in the NEI to report emissions for on road gasoline vehicle refueling (Estimates for Stage II non road equipment gasoline refueling are included in the nonroad source inventory).

The VOC emission estimates are generated via the 2008 NMIM model using county-specific fuel parameters, temperature, humidity, Reid vapor pressure, and other relevant inputs.[73]

Ohio accepted US EPA's estimate since this category's point source adjustment is negligible.

5.3.3 Ohio EPA Produced Emissions Estimates

These are the area emission sources for which Ohio EPA Calculated Emissions Estimates, but US EPA did not estimate due to resource constraints. The sources were deemed significant by OEPA. US EPA's lack of emissions estimated for these categories does not preclude Ohio from submitting emissions if they are deemed significant. Ohio estimated the following emissions based on State specific activities.

48. **Cremation: Human (SCC 2810060200)**

Not all Ohio counties possess a crematory, therefore, only those counties with crematories are used to calculate the number of cremations and their resulting emissions. The 2008 cremation data is obtained from the Ohio Department of Health, Vital Statistics.[78] The methodology does not offer an EF for NOx for this category. Therefore, through its Permits-to-Install for human cremation, Ohio EPA selected a NOx EF of 10.13 lb/ton cremated to calculate emissions for this area source. The remaining criteria pollutants emissions are calculated using EF obtained from California Air Resources Board (CARB) such as PM10-Fil EF of 0.07 lb/ton cremated and PM25-Fil EF of 0.0637 lb/ton cremated.

49. **Hospital Sterilization (SCC 2850000010)**

Small amounts of Ethylene Oxide (EO) are used in sterilization of hospital surgical equipment and plastic devices that cannot be sterilized by steam. EO is used as a sterilizer because of its potency and effectiveness in destroying pathogens without damaging the integrity of the device. The methodology used to calculate EO emissions required the number of beds in each hospital size to use the appropriate EF.

National estimates of emissions of ethylene oxide (EO) from hospital sterilization are estimated using EF provided by US EPA for large, medium, and small hospitals. The American Hospital Association Guide 2008 edition provided data on the number of hospital beds in large, medium, and small hospitals in Ohio.

50. **Structure Fires (SCC 2810030000)**

The Structure Fires category includes residential and commercial fires resulting from unintentional actions. Intentional fires, forest and wildfires, agricultural, and vehicle burning are not included in this area source. The State Fire Marshall Office, Fire Prevention Bureau[81] provided data on the number of structure fires per county in 2008.This area source is considered a combustion source for NO_X emissions which are calculated using EF 1.4 lb/Ton burned. The residential and commercial structures fires for each county are tabulated and a fuel loading of 1.15 Ton/fire is applied. This source also emits PM, PM_{10}, and $PM_{2.5}$ emissions which are calculated using EF 10.8 lb/Ton.

51. **Vehicle Fires (SCC 2810050000)**

This area source category reports the emissions caused by accidental vehicle fires. These vehicles may be any commercial or private mode of transportation that is authorized for use on public roads in Ohio. Emission factors are available for open burning of automobile components including upholstery, belts, hoses, and tires (AP-42, Section 2.5 Open Burning) (EPA, 1996). The amount of vehicle material burned (the fuel loading) in a vehicle fire must be estimated to use these factors. It is assumed that an average on road vehicle has 500 pounds of components that can burn in a fire, based on a 3,700 pound average vehicle weight (CARB, 1995).[79]

It is assumed that tires are burned in 60% of all vehicle fires. Therefore, composite EFs are calculated as a weighted average of the EFs listed in AP-42 are presented in Table 60.

Table 60 Vehicle Fires Weighted composite Emissions factors to include car components

Pollutant	lbs/Fire
NOx	0.7
CO	21.25
Methane	7.21
PM	17
PM10	17
PM2.5	17

The number of on-road vehicles burned on Ohio highways is obtained from the State Fire Marshall, Fire Prevention Bureau.[81] This data was available at the county level.

52. **Dental Preparation and Use (SCC 2850001000)**

US EPA employed Barr Engineering to create a flow model[86] which calculates mercury emissions for several products that utilize mercury. For each product, the model offers a flow diagram, which is linked to a calculations table, and a sheet which contains the supporting documentation. The supporting documents sheet is where all data is revised, added or deleted.

Ohio EPA entered available state specific values for 2008. Any data which could not be specifically obtained for Ohio, US EPA's data is used and apportioned by population for the inventory year with the exception of Dental Amalgam which is apportioned by the number of licensed practicing dentists in Ohio for the inventory year.

Amalgam is one of the most commonly used tooth fillings which can release small amounts of mercury vapor over time. Patients can absorb these vapors by inhaling or ingesting them.[82] Although US EPA's data is dated, in some instances as old as 2000, it was the best available at the time the inventory was created.

To calculate dental amalgam mercury emissions, the Model makes several estimates and assumptions using a trend from 1990-2000. The Model estimates mercury emissions from several sources specific to dental amalgam use such as amalgam placement and removal of old fillings, consumer exhalation, waste elimination and cremation, amalgam scrap waste and modes of storage and transportation of waste containing mercury, and whether the dental office is externally vented.

Barr estimates that the use of amalgams will decrease due to improved dental health and that newer Hg amalgams last much longer than older ones. Amalgams can last from 8 to 30 years. Once all emissions are calculated, the Model estimates that per the Mercury Mass Balance, 20% of Output is released to Atmosphere

53. **Fluorescent Lamps (Split into 57 & 58 Below)**

A fluorescent lamp is a gas-discharge lamp that uses electricity to excite mercury vapor. The excited mercury atoms produce short-wave ultraviolet light that causes a phosphor to fluoresce,

producing visible light.[83] The Model uses the premise that lamp sales have been steady since 1996 at around 620,000,000 units nationally. Since there has been zero growth and no direct Ohio data available, Ohio sales for 2008 is calculated based on population ratio multiplied by US sales from 1996.

Based on the amount of Hg present per lamp and the rate of recycling nationally, the Model calculated the amount of Hg in discarded lamps which is released to the air via recycling, breakage, land filling and incineration. The Mercury Flow Model offers ratios of loss of Hg to the air and wastewater due to consumer breakage as well distribution of recycling vs. MSW disposal. As of 2005, less lamps were being recycled than disposed in landfills (ratio being 25% recycling to 75% to MSW). Based on projected recycling trends, the Model estimates that during 2005-2010, 0.3 lb Hg will be released to the air per year.

54. **Non-Fluorescent Lamps (No SCC yet)**

These lamps operate on same principle as fluorescent lamps but are generally considered to be more natural lighting that provides consistent light levels and enables users with light sensitivity to work more productively in some industrial and office settings. Non-Fluorescent lamps are recycled at a higher rate than fluorescent lamps because they tend to be owned by government entities and large institutions that recycle more readily than small businesses. The recycling rate is assumed to be 25% higher. The Flow Model assigned a value of 50% recycling and 50% disposing as MSW. The same ratios are calculated for these lamps as for the fluorescent type.

55. **Lamp (Fluorescent) Recycling (SCC 2861000010)**

US EPA's Mercury Flow Model includes calculations which account for recycling emissions for both types of lamps, fluorescent and non-fluorescent.

56. **Lamp Breakage (Landfill emissions) (SCC 2861000000)**

US EPA's Mercury Flow Model includes calculations which account for breakage emissions for both types of lamps, fluorescent and non-fluorescent. Two types of breakage emissions are considered, en route from manufacturer to retail stores and consumer breakage at home.

57. **Thermostats (No SCC yet)**

Thermostats use mercury switches to sense and control room temperature through communication with heating, ventilating, and air conditioning (HVAC) equipment. Thermostats contain bimetal coils that contract and expand with room temperature. When the coil contracts or expands, it activates the mercury switch, which opens or closes a circuit to make the furnace, heat pump, or air conditioner turn on or off. [84] The Model estimates 10 million thermostats are installed each year either as replacement or for new construction. Based on population percentage, Ohio installed 380,000 units and 157, 000 of those contain mercury in 1990. Based on Model projections, for the 2005-2010 period, these numbers will decrease and Ohio will only install about 87,000 thermostats containing Hg as consumer discards will be replaced by non-mercury thermostats. The Model shows that while recycling is on the increase, majority of these units are still being disposed of in MSW facility.

58. **Auto Switches (No SCC yet)**

The Model accounts for total vehicles scrapped which Ohio estimated through population apportionment. The Model calculates emissions based on final disposition of the products such as steel shredded or number of cars. Mercury percentages are preset in the Model to calculate the portions being emitted to air, water, or land.

59. **Switches & Relays (No SCC yet)**

Electrical switches are devices utilized to manually control electric current flow. Relays are remote control electrical switches and tend to be used throughout the automobile industry to control a horn switch or a computer as in a power train control module.[85]

The Hg FLOW Model used data that averages values from 1993 to 1997 and then assumes a 4% reduction annually after 1997 in Hg going into switches and relays and
a 1% annual reduction in Hg retained in these products.

No Ohio specific data could be found regarding these products so US EPA's data was used. The Model calculates emissions using the number of items of this product type sold and discarded nationally. Taking into account the consumers' recycling rate for switches other than for auto, the Model calculates the rate at which waste is sent to MSW, to the landfill, and to the air.

5.3.4 Excluded SCCs - No Emissions Estimates from Ohio EPA or US EPA

1. Chrome Plating
2. Cotton Ginning
3. Drum and Barrel Reclamation
4. General Laboratory Services
5. Grain Elevators
6. Mining and Quarrying
7. Open Burning Scrap Tires
8. Swimming Pools
9. Cremation Animals (No data)
10. Agricultural Tiling
11. Wood Combustion, Industrial/Commercial/Institutional

5.4 Sources of Data

Various sources have been used to determine activity/commodity level data and emission information for area source inventory purposes. Among these are the USEPA's AP-42, USEPA's FIRE emission factor database, and data from federal and state agencies including USEPA's Office of Air Quality Planning and Standards, the US Department of Energy, US Bureau of Labor Statistics, Ohio Department of Transportation, Ohio Department of Agriculture, and so on.

5.5 Rule Effectiveness and Rule Penetration

For area sources subject to a VOC control equipment regulation, a rule effectiveness (RE) factor has been applied to the control efficiency when determining the emission rates. The RE adjustment reflects the assumption that regulations typically are not 100 percent effective at all sources at all times. For example, if a RE factor of 95 percent has been assumed, a value of 0.95 is multiplied against the control efficiency before subtracting the efficiency from unity.

In cases where a control regulation is applied to an area source category, a rule penetration (RP) adjustment may be required. The RP factor takes into account the fact that, due to exemptions within the rule, all sources within the category may not be regulated. Ohio EPA has used best judgment in the development and application of such factors.

Due to the use of emission factors, rather than the independent calculation of uncontrolled emissions and subsequent control efficiencies, the use of RE and RP factors is limited. In addition, a number of rules regulating area source emissions deal with operational behavior (e.g., keeping the lid closed on a cold-cleaner) rather than the addition of control equipment.

5.6 Double Counting of Emissions

A major concern in the development of an area source inventory is the possibility of double-counting emissions. Because some area source methodologies estimate emissions from all sources within a category, emissions already contained in the point source inventory may also be included in the area source estimate. In these instances, the point source emissions must be subtracted from the gross area source estimate to determine the net area source estimate. Commonly affected area source categories are:

- Dry Cleaning
- Fuel Combustion
- Graphic Arts
- Incineration
- Solvent Cleaning

5.7 Area Source Emission Summary

The 2008 Ohio Emissions Summary can be seen on LADCO's website at:
http://www.ladco.org/tech/emis/current/index.php

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6 Mobile Sources

A mobile source of air pollution is a self-propelled or portable emitter of air pollutants, and mobile source emissions are those generated by the engines or motors that power such sources. Most mobile sources, except jet or turboprop aircraft, are powered by internal combustion (IC) piston engines, and nearly all use liquid fuels.

Gaseous fuels, such as compressed natural gas (CNG) or liquefied petroleum gas (LPG), had only a very small fraction of the motor fuel market in Ohio in 2008. Solid fuels have not been used by mobile sources in significant amounts since railroads retired their coal-powered steam locomotives in the 1950s.

For inventory and planning purposes, mobile sources are divided into two major categories:

1) On-highway mobile sources, i.e., motor vehicles such as cars, vans, trucks, buses and motorcycles used for transportation of goods and passengers on roads and streets.

2) Off-highway (usually referred to as non-road) mobile sources including:

   a) Modes of powered transportation that do not use roads, such as aircraft, trains, ships and boats, and motor vehicles used off-road.

   b) Self-propelled or portable motorized machines or equipment not used for transportation, ranging from construction equipment and farm tractors to lawnmowers and hand-held power weed choppers.

The mobile source emissions are divided into three categories:

1) *Exhaust or tailpipe emissions*, which result from the combustion of fuel in the source's engine. These emissions occur when the engine is running.

2) *Evaporative emissions*, which result from evaporation of fuel from the engine or its fuel system.

3) Refueling emissions which result during the process of fueling the gas tank.

6.1 On-Road Mobile Source Inventory

6.1.1 Emission Inventories Development

The 2008 on-road inventory was ultimately developed using the Motor Vehicles Emission Simulator 2010b (MOVES 2010b). Ohio EPA provided state specific input data for the MOBILE6 program to US EPA. The data inputs were later reformatted for use with MOVES 2010a and later MOVES2010b.

MOBILE6 Overview:

MOBILE6 is a computer program that estimates hydrocarbon (HC), carbon monoxide (CO),

oxides of nitrogen (NO_x), exhaust particulate matter (which consists of several components), tire wear particulate matter, brake wear particulate matter, sulfur dioxide (SO_2), ammonia (NH_3), six hazardous air pollutant (HAP), and carbon dioxide (CO_2) emission factors for gasoline-fueled and diesel highway motor vehicles, and for certain specialized vehicles such as natural-gas-fueled or electric vehicles that may replace them. The program uses the calculation procedures presented in technical reports posted on EPA's MOBILE6 Web page http://www.epa.gov/otaq/models.htm.

MOBILE6 emission factor estimates depend on various conditions, such as ambient temperatures, travel speeds, operating modes, fuel volatility, and mileage accrual rates. Many of the variables affecting vehicle emissions can be specified by the user. MOBILE6 will estimate emission factors for any calendar year between 1952 and 2050. Vehicles from the 25 most recent model years are considered to be in operation in each calendar year.

6.1.2 MOBILE6 Defaults:

MOBILE6 includes default values for a wide range of conditions that affect emissions. These defaults are designed to represent “national average” input data values. Users who desire a more precise estimate of local emissions can substitute information that more specifically reflects local conditions. Use of local input data will be particularly common when the local emission inventory is to be constructed from separate estimates of roadways, geographic areas, or times of day, in which fleet or traffic conditions vary considerably.

A list of MOBILE6 input parameters is provided below. Most of these inputs are optional because the model will supply default values unless **alternate data** are provided.

6.1.3 MOBILE6 Input Parameters

- Calendar year
- Month (January, July)
- Hourly Temperature
- Altitude (high, low)
- Weekend/weekday
- Fuel characteristics (Reid vapor pressure, sulfur content, oxygenate content, etc.)
- Humidity and solar load
- Registration (age) distribution by vehicle class
- Annual mileage accumulation by vehicle class
- Diesel sales fractions by vehicle class and model year
- Average speed distribution by hour and roadway
- Distribution of vehicle miles traveled by roadway type
- Engine starts per day by vehicle class and distribution by hour
- Engine start soak time distribution by hour
- Trip end distribution by hour
- Average trip length distribution
- Hot soak duration
- Distribution of vehicle miles traveled by vehicle class
- Full, partial, and multiple diurnal distribution by hour

- Inspection and maintenance (I/M) program description
- Anti-tampering inspection program description
- Stage II refueling emissions inspection program description
- Natural gas vehicle fractions
- HC species output
- Particle size cutoff
- Emissions factors for PM and HAP
- Output format specifications and selections

6.1.4 MOBILE6 References

The following publications provide much of the guidance for the preparation of the on-highway inventory.

1. EPA-450/4-81-026d (Revised), now EPA/450-R-92-009, *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, December 1992. Hereafter, "Procedures Vol. IV". The 1992 version is still the definitive document on inventories. If a previous edition is referred to, the fact will be noted as, for example, "the 1989 Procedures Vol. IV" or "Volume IV, 1989 edition".

2. EPA420-R-03-010, *User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model*, August 2003. This is the User's Guide for the official MOBILE6.2.03 on-highway mobile source emission factor model and will usually be referred to as the M6.2 (or simply M6) User's Guide (UG). The M6 model in its various versions was developed and published by Assessment & Modeling Division (AMD) of the National Vehicle & Fuels Emissions Laboratory (NVFEL) in Ann Arbor, Michigan. The NVFEL is part of USEPA Office of Transportation & Air Quality (OTAQ), formerly the Office of Mobile Sources (OMS).

3. Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, August 2004. Hereafter, the M6 "Technical Guidance [Document]" or "TGD". The TGD is the primary source of guidance on M6 inputs and an invaluable adjunct to the M6 User's Guide.

4. USEPA document "Frequently Asked Questions on MOBILE6", 16 January 2002. Hereafter, [M6] "FAQ". This document was published along with the M6 TGD.

5. USEPA memo, "Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity", dated 18 January 2002, from John Seitz, Director of OAQPS, and Margo Oge, Director of OTAQ, to Regional Air Division Directors.

6.1.5 Ohio's Alternate Data for MOBILE6

Alternative data is state-specific data that is used in the Mobile6 runs. Using local data is preferred to using the default data in Mobile6. Efforts are made to collect as much local data as possible.

6.1.6 Vehicle Registration Distribution by Age

The vehicle age distribution determines the fraction of vehicles operating within each emissions control requirement standard and the deterioration of the emission control technology.

Emission rates vary widely between new and older vehicles. Thus, even small changes in fleet age, particularly for older vehicles, may result in large changes in emission totals.

The MOBILE6 model requires estimates of a distribution of registered vehicles by age and vehicle category for current and future years. MOBILE6 default values were developed using national level vehicle registration data by age and class for July 1, 1996. US EPA developed a methodology to convert the July 1, 1996 registration profile into a general registration distribution by age and by vehicle category for some 6 composite (gasoline and diesel) vehicle types plus motorcycles. To project future changes, general sales growth and vehicle scrappage trends were evaluated for the total light-duty vehicle in-use fleet and the total heavy-duty vehicle in-use fleet, and made minor adjustments, where possible, to reflect some of the differences between vehicle categories.

Description: The MOBILE6 model requires estimates of a distribution of registered vehicles by age and vehicle category for current and future years. OEPA chose to use local vehicle registration data provided by the Ohio Bureau of Motor Vehicles (BMV) to LADCO to develop these inputs.

Method Applicability: This approach is most applicable in areas where there are significant differences in the local vehicle fleet age distribution relative to the national average.

Data Sources and Procedures: This approach involves using local vehicle registration data. This is typically available at the county level, but may also be applied using statewide data from the state motor vehicle registration office. The fleet age should be representative of the vehicle fleet over the small urban or rural area under question.

Advantages:

- Uses locally specific registration data, which is likely more representative of the local area than the national default.
- Requires minimal additional resources, particularly if data is readily available at the county or local level from the state department of motor vehicle registration.
- Recommended by US EPA and generally is encouraged as a preferred approach over the national default approach.

6.1.7 Daily Vehicle Miles Traveled (DVMT)

In coordination with Ohio Metropolitan Planning Organizations (MPOs), the Ohio Department of Transportation (ODOT) provided Daily Vehicle Miles Traveled (DVMT) data and travel demand model (TDM) data. TDM data will be covered in another section. Because TDM results are used by the state and MPOs to forecast traffic for a multitude of purposes, undergo rigorous calibration and validation checks, and are sensitive to roadway capacity/travel time improvements, the TDMs are considered the best tool for emissions forecasting. Therefore, the

DVMT data discussed in this section is not used directly for all areas of Ohio. In counties where it is not used directly it is used for making rough emissions estimates where models do not exist or where time prohibits the use of TDMs. DVMT is a simple mechanism to measure how much traffic is flowing along a roadway during an average 24 hour period. This simple formula multiplies Average Annual Daily Traffic (AADT) by the length of the roadway. For example, if a roadway is 2 miles in length and the AADT is 4000 vehicles per day the DVMT would be computed by multiplying 2*4,000=8,000 or 8,000 DVMT.

County-By-County DVMT is computed using the State of Ohio, Department of Transportation's Roadway Information Files and the annual Highway Performance Monitoring System (HPMS) Summary Reports. DVMTs are computed for all of the Federal Functional Class (FC) categories for each of Ohio's 88 counties.

The AADT and Roadway length information provides a very accurate estimate of statewide total DVMT for the State Highway System (Interstate, US and State Routes). County total DVMT are consistent and considered a good source of county level DVMT for countywide emissions estimates. For roadways that are not part of the State Highway System, various representative counts were used, such as: railroad crossing counts, HPMS Sample Section Counts, etc. All traffic count data that was not collected during the current year had statewide growth factors applied to account for systematic growth. Given the previously mentioned methodologies, the DVMT data is more accurate on roads functionally classified as collector or above.

Table 61 Federal Functional Class Categories

01 - Rural Interstate
02 - Rural Principal Arterial
06 - Rural Minor Arterial
07 - Rural Major Collector
08 - Rural Minor Collector
09 - Rural Local
11 - Urban Interstate
12 - Urban Freeway & Expressway
14 - Urban Principal Arterial
16 - Urban Minor Arterial
17 - Urban Collector
19 - Urban Local

For PDF web based tables of 2005 DVMT by county see:
http://www.dot.state.oh.us/Divisions/Planning/TechServ/TIM/Documents/DVMT/VMT2005.pdf

Disclaimer by ODOT:
"The above PDF web based tables contain the State of Ohio's adjusted county DVMT's and road mileage for the years 1990 - 2005. Please be aware that the numbers are estimates only. The factoring process used annual, estimated, and statewide ADT (Average Daily Traffic) growth factors, derived from the output of a limited number of traffic counting stations around the state. Although the growth factors are available by functional class, they are more reliable for major roads such as interstates or expressways, which are relatively well-sampled, than for local roads or collectors. The numbers also do not allow for periodic, large-scale functional reclassification actions which reassign selected roads or road segments from one functional class to another.

The Ohio Department of Transportation therefore does not warrant the accuracy, completeness, or reliability of these estimates for your research. We also do not assume responsibility for any incorrectness that may occur."

6.1.8 VMT from Travel Demand Models (TDM)

Travel demand forecast modeling is performed by the Ohio Metropolitan Planning Organizations (MPOs) and ODOT for a multitude of purposes including the preparation of regional emissions estimates. The ODOT Office of Technical Services' Modeling & Forecasting Section recommends Ohio's TDMs and ODOT's conformity analysis methods be used to establish the roadway mobile source portion of Ohio's SIP budget to assure consistent methods are used for transportation conformity analysis and budgets. Therefore, ODOT provided both MPO regional TDM runs and statewide TDM runs with associated data to OEPA and LADCO. The ODOT provided model run data for years 2002, 2005, 2009, 2012, and 2018.

Data provided included loaded networks in both .csv format and GIS shape files, trip end summaries, zone boundary GIS shape files, intrazonal trip VMT estimates, and VMT summaries for each of the loaded networks. Additional post processing data was provided including but not limited to metadata describing the loaded networks, hourly distribution by functional class, speed profiles, day of week/weekend/monthly car and truck traffic profiles, 2009 & 2018 VMT RPO data sets, statewide VMT growth rates for local traffic, and a 2005 VMT summary comparison spreadsheet. It should be noted that among other things, the loaded TDM Networks contain distance and daily volumes from which VMT is computed.

Network volumes are post processed to estimate VMT by hour of day. The hourly volumes and capacity, posted speed limit, and type of roadway for each roadway segment are then used to estimate average hourly speeds needed for MOBILE6 based emissions estimates. Modeling by segment by hour of day in this way makes emissions estimates more sensitive to the effects of roadway improvements. This allows transportation planners to evaluate the relative emissions effect improvements have on individual roadways, the effect of packages of improvements and the effect of the entire set of planned roadway improvement projects of the construction programs.

6.1.9 Speed Distribution Profiles

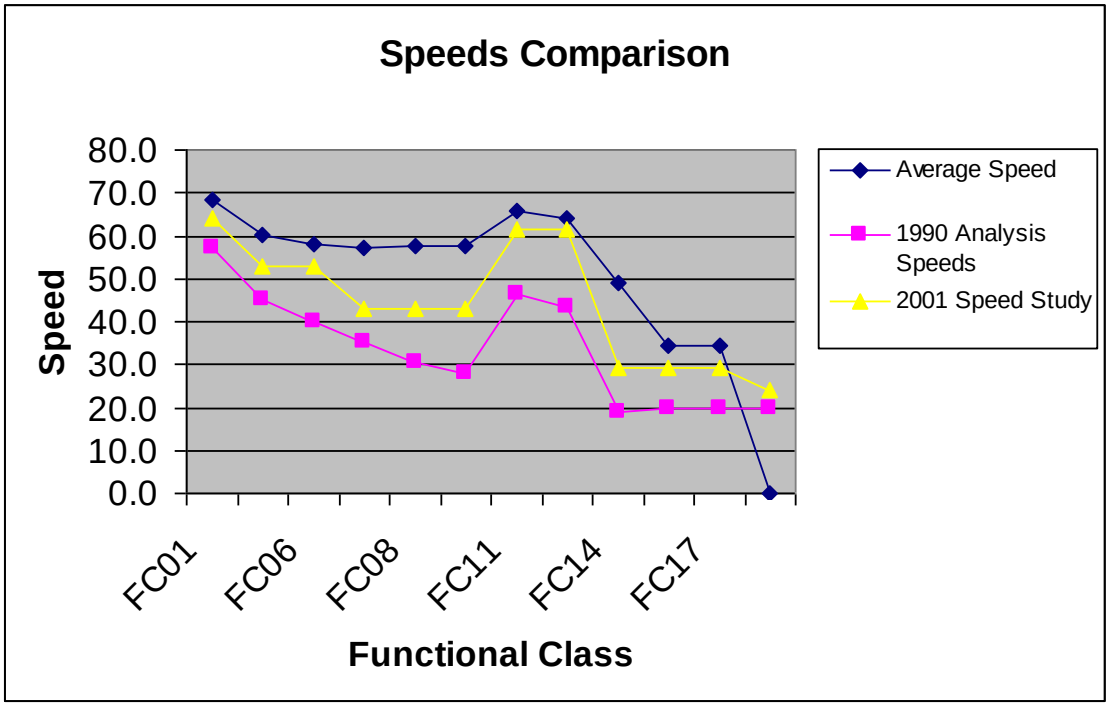
ODOT provided speed distribution profiles to LADCO. A couple of different sets of speed distribution profiles were provided to OEPA and LADCO for their use, a table of space mean speeds by functional class for use with DVMTs and link group speed curves for post processing travel demand model traffic forecasts. Both sets of speed profiles are based on the same speed study conducted by ODOT. The speed study is documented in "*Statewide Travel Time Study, May 2001 by Greg Giaimo, Ohio Department of Transportation*". When OEPA asked for speeds for use with MOBILE6 for development of CERR, ODOT provided a set of speeds based on that statewide travel time study. Those speeds are documented in a technical memorandum titled "*Estimation of Average Speed by Functional Class for MOBILE6 Runs*" dated 5/27/2004. Readers should refer to those documents for the details. Here, the contents of the technical memo, *Estimated Average Speed by Functional Class*, are summarized.

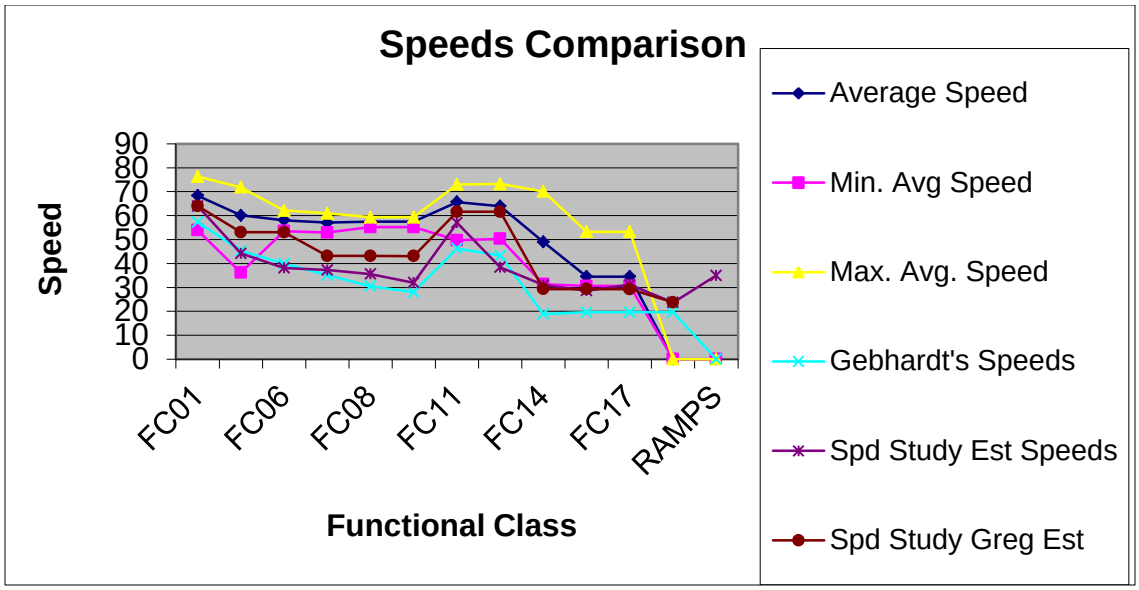
6.1.10 Space Mean Speeds by Functional Class for Use With County Level DVMT

The memo states the speeds which the Ohio Department of Transportation (ODOT) had been

using prior to 2004, for air quality analysis estimates based on County DVMT summaries, were developed by a former ODOT employee for addressing the one hour standard conformity rules established due to 1990 emissions exceedances. No documentation was found in ODOT's files on the origin of these average speed values or how they were estimated. In addition, Ohio EPA has requirements for using latest planning assumptions for air quality conformity analyses. Therefore, ODOT believed it was in the state's best interest to use the most recent available data to provide a new set of estimated average speeds consistent with those used for urban area travel demand models which were under development at that time. The memo contains comparisons of 2002 speed data obtained from traffic count equipment automatic traffic recorders (ATRs) which collect data continuously throughout the year. It also contains comparisons of the new speeds with those used to address the one hour standard Gebhart's. The graphs shown in Figure 1, taken from the memo, illustrate the comparisons. The first graph compares time mean speeds from the ATRs with space mean speeds from ODOTs travel time study done in 2001 and with the speeds used for addressing the one hour standard.

Figure 1 - Speed Comparison Graphs





The following caution statement was taken from the *Estimation of Average Speed by Functional Class* memo.

CAUTION: It should be noted that speeds on facilities falling in any one of the federal functional classifications vary greatly between roadways, between hour of the day, and day of the week. So these provide only very rough estimates of speed and should be used with caution. In addition, it is expected that these average statewide speeds are higher than the average speeds in the non-attainment areas because the non-attainment counties tend to be more populated and more congested. The document "Highway Vehicle Speed Estimation Procedures For Use in Emission Inventories", September 1991 by Earl Ruiter of Cambridge Systematics Inc. is referenced by EPA's documented procedures for emission inventory preparation. This document suggests post processing travel demand model traffic assignment results to estimate average speeds.

Final space mean speeds that ODOT provided are summarized in the Table 1 below:

Table 62 Speed by Federal Functional Class

Functional Class	1990 Analysis Speeds	2001 Speed Study Speeds
FC01	57.3	64.0
FC02	45.3	53.0
FC06	39.9	53.0
FC07	35.1	43.1
FC08	30.5	43.1
FC09	28.0	43.1
FC11	46.3	61.6
FC12	43.3	61.6
FC14	18.9	29.3
FC16	19.6	29.3
FC17	19.6	29.2
FC19	19.6	23.8

It was decided by mutual agreement among individuals within the ODOT Office of Technical Services that these new space mean speed based average speed estimates were reproducible and defensible since they are well documented. Therefore, they should be the speeds used with HPMS** VMT if any year 2002 emissions budget work is done using only the county level VMT summaries discussed in section 5.3.2 Daily Vehicle Miles Traveled (DVMT).

** Note that HPMS VMT is a statewide VMT estimate and the county level DVMT summaries are consistent with the HPMS VMT so the county level DVMT summaries are loosely referred to as HPMS VMTs even though, in fact, they are not.

6.1.11 Link Group Speed Curves:

The ODOT Modeling & Forecasting Section recommends Ohio's travel demand forecasting models and ODOT's conformity analysis methods be used to establish the roadway mobile source portion of Ohio's SIP budget for reasons already mentioned in 5.3.2 and to assure consistent methods are used for transportation conformity demonstration analyses and budgets. Therefore, ODOT provided travel demand model runs and the speed curves by link group that ODOT uses for the speed estimates within the post processing of travel demand model runs for estimating regional emissions. Table 2 shows these link group curves.

Table 63 Link Group Codes & Associated BPR Curves

Link Group	Facility Type	Free Flow Speed	Area type	a	b
1	Freeway	75	Any	0.39	6.3
2	Freeway	70	Any	0.32	7.0
3	Freeway	65	Any	0.25	9.0
4	Freeway	60	Any	0.18	8.5
5	Freeway	55	Any	0.10	10.0
6	Multi-Lane	60	Rural	0.09	6.0
7	Multi-Lane	55	Rural	0.08	6.0
8	Multi-Lane	50	Rural	0.07	6.0
9	Multi-Lane	45	Rural	0.07	6.0
10	2 Lane	Any	Rural	0.34	4.0
10	Urban Street	50	Suburban	0.34	4.0
11	Urban Street	50	Urban	0.74	5.0
12	Urban Street	50	CBD	1.16	6.0
13	Urban Street	40	Suburban	0.38	5.0
14	Urban Street	40	Urban	0.70	5.0
15	Urban Street	40	CBD	1.00	5.0
16	Urban Street	35	Suburban	0.96	5.0
17	Urban Street	35	Urban	1.00	5.0
18	Urban Street	35	CBD	1.40	5.0
19	Urban Street	30	Suburban	1.11	5.0
20	Urban Street	30	Urban	1.20	5.0
21	Urban Street	30	CBD	1.50	5.0

Note: a and b are the BPR curve parameters for the equation

$T = T_0\{1 + a * (V/C)^b\}$

More complete details about emissions modeling process employed by ODOT may be found in ODOT documentations. The document titled "Congestion Management & Air Quality Analysis (CMAQ) Program Documentation" dated December 2005 may be obtained from the ODOT web site at www.dot.state.oh.us/urban/data/cmaq.doc.

6.2 Mobile6 Inputs:

6.2.1 Ohio's 2005 MOBILE6 Inputs

The following tables are the result of a joint meeting between Ohio EPA, ODOT, and MPOs from around the state. At that meeting MOBILE6 inputs were discussed and efforts were made to verify the sources of data inputs for MOBILE6. Dialogue has continued between the parties.

For historical reference:

>>> Dave Moore <Dave.Moore1@dot.state.oh.us> 4/10/2006 2:13 PM >>>

All,

An air quality coordination meeting has been scheduled for April 27, 2006 at 10:00 AM at ODOT Central Office conference room GA. The primary purpose of this meeting is to discuss development of 2002 mobile source inventories for use in developing the Ohio 2007 8-Hour Ozone SIP Attainment Demonstrations. See meeting agenda below. OEPA is working toward a June 15, 2006 schedule for submitting the 2002 inventories to US EPA.

A key component of the meeting will be to review and confirm the MOBILE6.2 input parameters, by Ohio a/q area, for use in developing the 2002 mobile inventories. See draft template below. The Ohio MPO travel demand models will be used to generate the 2002 VMT inputs to MOBILE. Thanks, DM
DM

IMPORTANT NOTICE: The following tables are not to be used for inventory purposes as the data is subject to change. For the current input table, contact Ohio EPA, Division of Air Pollution Control.

Table 64 Mobile Inputs

Cleveland-Akron 2005 Ozone M6.2 Inputs	
Includes the following counties:	
Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit	
State Programs	
	Input
Stage II Refueling	93/3/86/86

Anti-tampering Programs	96/78/50/22222/21111111/1/12/098./12111112
I/M Programs	Yes
Exclude Ashtabula County - No I/M program	
Program	1 2004 2050 2 T/O OBD I/M
Model Years	1 1996 2050
Vehicles	1 22222 21111111 1
Stringency	1 30.0
Compliance	1 98.0
Waiver Rates	1 1.0 1.0
Cut points	
Exemption Age	1 25
Grace Period	1 4
NO TTC Credits	
Effectiveness	
DESC file	
Program	2 2004 2050 2 T/O EVAP OBD & GC
Model Years	2 1996 2050
Vehicles	2 22222 11111111 1
Stringency	
Compliance	2 98.0
Waiver Rates	2 1.0 1.0
Cut points	
Exemption Age	2 25
Grace Period	2 4
NO TTC Credits	
Effectiveness	
DESC file	
Program	3 2001 2003 2 T/O ASM 2525 PHASE-IN
Model Years	3 1996 2003
Vehicles	3 22222 21111111 1
Stringency	3 30.0
Compliance	3 98.0
Waiver Rates	3 3.0 1.0
Cut points	
Exemption Age	3 25
Grace Period	3 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	4 2001 2050 2 T/O ASM 2525 PHASE-IN
Model Years	4 1975 1995
Vehicles	4 22222 21111111 1
Stringency	4 30.0

Compliance	4 98.0
Waiver Rates	4 3.0 1.0
Cut points	
Exemption Age	4 25
Grace Period	4 4
NO TTC Credits	
Effectiveness	
DESC file	
Program	5 1998 2000 2 T/O LOADED/IDLE
Model Years	5 1975 2000
Vehicles	5 22222 21111111 1
Stringency	5 30.0
Compliance	5 98.0
Waiver Rates	5 3.0 1.0
Cut points	
Exemption Age	5 25
Grace Period	5 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	6 1996 1997 2 T/O IM240
Model Years	6 1975 1997
Vehicles	6 22222 21111111 1
Stringency	6 30.0
Compliance	6 98.0
Waiver Rates	6 3.0 1.0
Cut points	6 CUTPOINT.D
Exemption Age	6 25
Grace Period	6 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	7 1996 2050 2 T/O GC
Model Years	7 1975 1995
Vehicles	7 22222 21111111 1
Stringency	
Compliance	7 98.0
Waiver Rates	7 3.0 1.0
Cut points	
Exemption Age	7 25
Grace Period	7 2
NO TTC Credits	
Effectiveness	
DESC file	

Fuel Commands	
Fuel Program	1
Oxygenated Fuels	0.00 0.42 0.00 0.036 2
Fuel RVP	9
Alternative Emission Regulations and Control Measures	
Rebuild Effects	0.1
External Conditions Commands	
Calendar Year	2005
Evaluation Month	7
Min/Max Temperature	National Climatic Data Center
Vehicle Fleet Characteristic Commands	
Registration Distribution	Variable

Cincinnati-Dayton-Springfield 2005 Ozone M6.2 Inputs	
Includes the following counties:	
Ohio: Butler, Clark, Clermont, Clinton, Greene, Hamilton, Miami, Montgomery, Warren	
Indiana: Lawrenceburg Twp., Dearborn County	
Kentucky: Boone, Campbell and Kenton counties	
State Programs	
	Input
Note: Indiana and Kentucky inputs may not coincide with Ohio inputs	
Stage II Refueling	93/3/86/86
Anti-tampering Programs	96/78/05/22222/21111111/1/12/098./12111112
I/M Programs	Yes

Excludes Clinton Co. and Miami Co., OH, Dearborn County, IN - No I/M program	
Note: I/M inputs for Kentucky counties are not included	
Program	1 2004 2050 2 T/O OBD I/M
Model Years	1 1996 2050
Vehicles	1 22222 21111111 1
Stringency	1 30.0
Compliance	1 98.0
Waiver Rates	1 1.0 1.0
Cut points	
Exemption Age	1 25
Grace Period	1 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	2 2004 2050 2 T/O EVAP OBD & GC
Model Years	2 1996 2050
Vehicles	2 22222 11111111 1
Stringency	
Compliance	2 98.0
Waiver Rates	2 1.0 1.0
Cut points	
Exemption Age	2 25
Grace Period	2 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	3 2001 2003 2 T/O ASM 2525 PHASE-IN
Model Years	3 1996 2003
Vehicles	3 22222 21111111 1
Stringency	3 30.0
Compliance	3 98.0
Waiver Rates	3 3.0 1.0
Cut points	
Exemption Age	3 25
Grace Period	3 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	4 2001 2050 2 T/O ASM 2525 PHASE-IN
Model Years	4 1975 1995
Vehicles	4 22222 21111111 1
Stringency	4 30.0
Compliance	4 98.0

Waiver Rates	4 3.0 1.0
Cut points	
Exemption Age	4 25
Grace Period	4 4
NO TTC Credits	
Effectiveness	
DESC file	
Program	5 1998 2000 2 T/O LOADED/IDLE
Model Years	5 1975 2000
Vehicles	5 22222 21111111 1
Stringency	5 30.0
Compliance	5 98.0
Waiver Rates	5 3.0 1.0
Cut points	
Exemption Age	5 25
Grace Period	5 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	6 1996 1997 2 T/O IM240
Model Years	6 1975 1997
Vehicles	6 22222 21111111 1
Stringency	6 30.0
Compliance	6 98.0
Waiver Rates	6 3.0 1.0
Cut points	6 CUTPOINT.D
Exemption Age	6 25
Grace Period	6 2
NO TTC Credits	
Effectiveness	
DESC file	
Program	7 1996 2050 2 T/O GC
Model Years	7 1975 1995
Vehicles	7 22222 21111111 1
Stringency	
Compliance	7 98.0
Waiver Rates	7 3.0 1.0
Cut points	
Exemption Age	7 25
Grace Period	7 2
NO TTC Credits	
Effectiveness	
DESC file	

Fuel Commands	
Fuel Program	1
Oxygenated Fuels	0.00 0.42 0.00 0.036 2
Fuel RVP	9
Alternative Emission Regulations and Control Measures	
Rebuild Effects	0.1
External Conditions Commands	
Calendar Year	2005
Evaluation Month	7
Min/Max Temperature	National Climatic Data Center
Vehicle Fleet Characteristic Commands	
Registration Distribution	Variable

Other Areas (excluding NOACA/AMATS and OKI/MVRPC) Ozone M6.2 Inputs	
Includes the following counties:	
Ohio: Belmont, Columbiana, Delaware, Fairfield, Franklin, Jefferson, Knox, Licking,	
Lucas, Madison, Mahoning, Pickaway, Trumball, Wood	
Fuel Commands	
	Input
Fuel Program	1
Oxygenated Fuels	0.00 0.42 0.00 0.036 2
Fuel RVP	9

Alternative Emission Regulations and Control Measures	
Rebuild Effects	0.1 (0.30 for 2018)
External Conditions Commands	
Calendar Year	All
Evaluation Month	7
Min/Max Temperature	National Climatic Data Center
Vehicle Fleet Characteristic Commands	
Registration Distribution	Variable

6.2.2 Ohio's Mobile Emission Data Processed by LADCO:

2005 TDM and MOBILE6 input data were provided to the LADCO for processing. The data was processed by LADCO using the TDM transformation tool (T3) to prepare it as an input into the CONCEPT model. More information on T3 is available at:

http://www.epa.gov/ttnchie1/conference/ei14/session8/pollack.pdf

Additional information regarding CONCEPT please visit:

http://www.epa.gov/ttnchie1/conference/ei14/session11/loomis.pdf

6.2.3 LADCO Ohio Data Outputs for 2005:

The following LADCO outputs and documents can be found at: www.ladco.org/tech/emis/net05/index.html

Table 65 LADCO Data Output

State	Network	T3 Description DOC	M6 Inputs	VMT vs HPMS Excel	Average Day VMT (this should match conformity inventory)	County Emissions Report	All Pollutants After Speciation	Dropped VMT	M6 Run Summary	Pollutant Totals (Short)	Raw Summary (pol,veh, etype)	Hourly Temporal Summary	Hourly Veh Mix Summary	Hourly Speed Summary (with volume/ capacity)
OH	AKRON	AKRON	OH	OH	AKRON	1	1	1	1	1	1	1	1	1
OH	CANTON	CANTON	OH	OH	CANTON	1	1	1	1	1	1	1	1	1
OH	CINCI	CINCI	OH	OH	CINCI	1	1	1	1	1	1	1	1	1
OH	CLEVE	CLEVE	OH	OH	CLEVE	1	1	1	1	1	1	1	1	1
OH	COLUMBUS	COLUMBUS	OH	OH	COLUMBUS	1	1	1	1	1	1	1	1	1
OH	SPRINGFLD	SPRINGFLD	OH	OH	SPRINGFLD	1	1	1	1	1	1	1	1	1
OH	TOLEDO	TOLEDO	OH	OH	TOLEDO	1	1	1	1	1	1	1	1	1
OH	YNGSTOWN	YNGSTOWN	OH	OH	YNGSTOWN	1	1	1	1	1	1	1	1	1
OH	STATEWD	STATEWD	OH	OH	STATEWD	1	1	1	1	1	1	1	1	1

Additional related documents available on the LADCO website:

“Comparison to EPA's Default Model NMIM”

“How we Build the 2005 Vmt/Networks”

“Spreadsheet/Graphics on Vehicle Mix”

“Background on the T3 Tool “

6.2.4 MPO Contact Table

Table 66 County Summary Table of MPOs by County

FIPS	County	Model Network	MPO	Contact Person
39001	Adams	Statewide		
39003	Allen	Statewide	Lima Allen County Regional Planning Commission	Tom Mazur
39005	Ashland	Statewide		
39007	Ashtabula	Statewide		
39009	Athens	Statewide		
39011	Auglaize	Statewide		
39013	Belmont	Statewide	Bel-O-Mar Regional Council and Interstate Planning Commission	Rakesh Sharma
39015	Brown	Statewide		
39017	Butler	Cincinnat/Dayton	Ohio-Kentucky-Indiana Regional Council of Governments	Andy Reser
39019	Carroll	Statewide		
39021	Champaign	Statewide		
39023	Clark	Springfield	Coordinating Committee of the Clark County-Springfield Transportation Study	Eric Ottoson
39025	Clermont	Cincinnat/Dayton	Ohio-Kentucky-Indiana Regional Council of Governments	Andy Reser
39027	Clinton	Statewide		
39029	Columbiana	Statewide		
39031	Coshocton	Statewide		
39033	Crawford	Statewide		
39035	Cuyahoga	Cleveland	Northeast Ohio Areawide Coordinating Agency	Bill Davis
39037	Darke	Statewide		
39039	Defiance	Statewide		
39041	Delaware	Columbus	Mid-Ohio Regional Planning Commission	Nick Gill
39043	Erie	Statewide		
39045	Fairfield	Statewide		
39047	Fayette	Statewide		
39049	Franklin	Columbus	Mid-Ohio Regional Planning Commission	Nick Gill
39051	Fulton	Statewide		
39053	Gallia	Statewide		
39055	Geauga	Cleveland	Northeast Ohio Areawide	Bill Davis

FIPS	County	Model Network	MPO	Contact Person
			Coordinating Agency	
39057	Greene	Cincinnat/Dayton	Miami Valley Regional Planning Commission	Ana Ramirez
39059	Guernsey	Statewide		
39061	Hamilton	Cincinnat/Dayton	Ohio-Kentucky-Indiana Regional Council of Governments	Andy Reser
39063	Hancock	Statewide		
39065	Hardin	Statewide		
39067	Harrison	Statewide		
39069	Henry	Statewide		
39071	Highland	Statewide		
39073	Hocking	Statewide		
39075	Holmes	Statewide		
39077	Huron	Statewide		
39079	Jackson	Statewide		
39081	Jefferson	Statewide	Brooke-Hancock-Jefferson Transportation Study Policy Committee	Mike Proprocki
39083	Knox	Statewide		
39085	Lake	Cleveland	Northeast Ohio Areawide Coordinating Agency	Bill Davis
39087	Lawrence	Statewide	KYOVA Interstate Planning Commission	
39089	Licking	Columbus	Licking County Area Transportation Study	Matthew Hill
39091	Logan	Statewide		
39093	Lorain	Cleveland	Northeast Ohio Areawide Coordinating Agency	Bill Davis
39095	Lucas	Toledo	Toledo Metropolitan Area Council of Governments	Sujatha Mohanakrishnan
39097	Madison	Statewide		
39099	Mahoning	Youngstown	Eastgate Regional Council of Governments	R.P. Samulka
39101	Marion	Statewide		
39103	Medina	Cleveland	Northeast Ohio Areawide Coordinating Agency	Bill Davis
39105	Meigs	Statewide		
39107	Mercer	Statewide		
39109	Miami	Cincinnat/Dayton	Miami Valley Regional Planning Commission	Ana Ramirez
39111	Monroe	Statewide		
39113	Montgomery	Cincinnat/Dayton	Miami Valley Regional Planning Commission	Ana Ramirez
39115	Morgan	Statewide		

FIPS	County	Model Network	MPO	Contact Person
39117	Morrow	Statewide		
39119	Muskingum	Statewide		
39121	Noble	Statewide		
39123	Ottawa	Statewide		
39125	Paulding	Statewide		
39127	Perry	Statewide		
39129	Pickaway	Statewide		
39131	Pike	Statewide		
39133	Portage	Akron	Akron Metropolitan Area Transportation Study	Jason Segedy
39135	Preble	Statewide		
39137	Putnam	Statewide		
39139	Richland	Statewide	Richland County Regional Planning Commission	John Adams
39141	Ross	Statewide		
39143	Sandusky	Statewide		
39145	Scioto	Statewide		
39147	Seneca	Statewide		
39149	Shelby	Statewide		
39151	Stark	Canton	Stark County Regional Planning Commission	Dan Slicker
39153	Summit	Akron	Akron Metropolitan Area Transportation Study	Jason Segedy
39155	Trumbull	Youngstown (partial county model coverage)	Eastgate Regional Council of Governments	R.P. Samulka
39157	Tuscarawas	Statewide		
39159	Union	Statewide		
39161	Van Wert	Statewide		
39163	Vinton	Statewide		
39165	Warren	Cincinnat/Dayton	Ohio-Kentucky-Indiana Regional Council of Governments + Miami Valley Regional Planning Commission	Andy Reser, OKI + Ana Ramirez, MVRPC
39167	Washington	Statewide	Wood-Washington-Wirt Interstate Planning Commission	
39169	Wayne	Statewide		
39171	Williams	Statewide		
39173	Wood	Toledo	Toledo Metropolitan Area Council of Governments	Sujatha Mohanakrishnan
39175	Wyandot	Statewide		

NOTE: Complete MPO information can be found at, www.dot.state.oh.us/urban/mpomap.htm and at www.dot.state.oh.us/urban/mpolist.htm#Cleveland.

6.3 Off-Road NMIM Mobile Source Inventory

The non-road inventory is generated regionally by running U.S. EPA's National Mobile Inventory Model (NMIM) model. The Wisconsin Department of Natural Resources undertook the responsibility of customizing the NMIM input files and submitting the output file in NIF format to LADCO and U.S. EPA. LADCO processed the NMIM files in their emissions model and generated summer emissions rates. Grant Heatherington from the Wisconsin Department of Natural Resources provided the following descriptions:

The National Mobile Inventory Model (NMIM) developed by US EPA was used to estimate emissions for all other nonroad mobile categories. NMIM consolidates nonroad mobile emissions and onroad emissions modeling into a single modeling system. Only the nonroad emissions modeling portion of NMIM was used in the development of this emission's inventory. NMIM uses the US EPA's NONROAD model to calculate nonroad mobile emissions. The basic NONROAD algorithm for calculating emissions uses base year equipment populations, average load factors, available engine powers, activity hours and emission factors. Before NMIM was run, modifications and additions were made to the NMIM input data.

1) Added emission factors for diesel tampers/rammers provided by E.H. Pechan & Associates, Inc.. Diesel tampers/rammers are a type of construction equipment.

2) Revised PM2.5 ratios in SCC table to correctly calculate PM2.5 diesel emissions. This error was introduced with NMIM2005 and didn't exist in NMIM2004.

3) Revised gasoline parameters using updates provided by the states and E.H. Pechan & Associates, Inc.. Gasoline parameters include Reid Vapor Pressure (RVP), oxygenate content and sulfur content.

The NMIM NEI NIF files are on the LADCO ftp site at:
ftp://ftp.airtoxics.org/inv2005/nonroad/NMIM/Base_L_ph2/2005/

Revised NMIM2005 Input Data

Emission Factor Data

All states: Pechan revised the brake specific fuel consumption (BSFC) emission factor data to include diesel tampers/rammers (2270002006). The revised NMIM file is saved as revBSFC.EMF.

Population Data

For 26000.pop, replaced default file supplied with NMIM2005 with 26000_rev_NMIM05.pop that contains revised construction data missing from 26000.pop external file provided with NMIM2005. This Michigan construction data should have been added with the other LADCO states modified construction data but was overlooked.

SCC Data

The default SCC table of NCD20060201 is replaced by a version that contains corrections to the PM25fac field that earlier NCDs contained (i.e., changed from 0.92 to 0.97 for diesel nonroad equipment) in NONROAD2004.

Fuel Data

LADCO states: Pechan revised four tables (countyyear, countyyearmonth, datasource and gasoline) in the National County Database (NCD) used by NMIM to incorporate new fuel data. AIR revised gasoline characteristics per instructions from the states. Also, gasoline characteristic revisions for 2005 provided by states were incorporated. Additional revisions were incorporated into 2002 data for nonroad Stage 2 controls. Depending on the year being modeled, different versions of the revised tables are used. Also, the countynrfile, countyyear and datasource tables were revised to reference the new activity, allocation, growth, population and seasonality files described above. NCD tables with names ending in "def" are default versions of the table. See table below for the appropriate versions of the tables for the selected years.

Non-LADCO States: The countynrfile, countyyear and datasource tables were revised to reference the new activity, allocation and seasonality files described above. See Table 67 for the appropriate versions of the tables for the selected years.

Table 67 NMIM National County Database Tables for Specific Years and States

States	60. **Years**	
	1999 (WI only)	2002, 05, 07, 08, 09, 12 and 18
LADCO states	countynrfile_NMIM05_rev, countyyear_NMIM05_rev, countyyearmonth_NMIM05_w_05_12_18_rev, datasource_NMIM05_rev, gasoline_NMIM05_def SCC_NCD20060201_rev (used when NCD20060201 is used)	countynrfile_NMIM05_rev, countyyear_NMIM05_rev , countyyearmonth_NMIM05_w_05_12_18_rev, datasource_NMIM05_rev, gasoline_NMIM05_w_05_12_18_rev SCC_NCD20060201_rev (used when NCD20060201 is used)

6.4 MOVES Model Inputs

Onroad mobile source emissions were calculated by running US EPA Motor Vehicle Emission Simulator version 2010b (MOVES2010b). Emission estimates for the 2008 NEI were originally developed using US EPA's NMIM MOBILE6. Ohio provided state specific onroad inputs for the model. When development of the 2008 NEI began, the MOVES model had not yet been released. The 2008 NEI version 1 (v1) and previous NEIs included emissions estimates from MOBILE6. Once MOVES became available, US EPA converted the NMIM database to MOVES inputs. The 2008 NEI version 2 (v2) and version 3 (v3) used the MOVES model for onroad emission estimates.

MOVES2010b provides emissions estimates for pollutants including VOCs and NOx from mobile sources under a wide range of user-defined conditions. Ohio EPA relied on VMT data generated by the Ohio DOT Office of Planning and Programming and Metropolitan Planning Organizations (MPOs). Ohio DOT and MPOs used urban transportation planning methodologies approved by the Federal Highway Administration to generate the necessary VMT estimates. MOVES2010b was run using area-specific input values where available and national average defaults in other cases. More information about the Onroad emission estimate process is available at:

http://www.epa.gov/ttnchie1/net/2008_nei/nmim_documentation.pdf

6.5 Off-Road Mobile Source Inventory (Marine, Air, and Rail)

MAR sources are non-road sources which are significant enough in terms of emissions to be considered separately from the rest of the off-road mobile sources. The MAR inventory consists of commercial marines, aircraft and locomotive sources.

6.5.1 Commercial Marine Vessels

The emissions estimate for this category was completed by Environ and under a LADCO contract for the 2005 inventory year. Environ has an extensive experience with this inventory and was previously contracted to estimate regional 2002 emissions. The most substantial change to the estimates from 2002 was to incorporate specific activity and emission rates for Great Lakes deep draft vessels based on recent port calls to the ports of Cleveland and Duluth-Superior, where more of the ships use smaller engines and lower sulfur fuels than estimated in 2002. There was nothing new for the 2008 inventory year and all LADCO states applied a growth factor to grow the 2005 emissions.

Commercial marine emissions comprise a wide variety of vessel types and uses. Table 68 describes the different types of data sources used to estimate commercial marine activity. In some cases, it was necessary to split the activity of similar vessels based on the available activity data. For instance, the Tennessee Valley Authority (TVA, 2006) provided accurate fuel consumption estimates for push boats only on river systems while the same types of vessels that operate in the Great Lakes (primarily Lake Michigan between Milwaukee or Burn Harbor and Chicago) were estimated from other freight data by link as provided by the US Army Corps of Engineers (USACE, 2006). Also, ENVIRON defined source category codes (SCC) that do not appear in the official US EPA list of SCC to retain as much disaggregation as possible though all SCC 2280002021 through 2280002029 can be summed into 2280002020 that is an official code designation.

Table 68 Commercial vessel types (All engine types are diesel except those marked)

Source Category Code (SCC)	Source Definition	Purpose	Geographic Area	Data Source
2280002023	Push Boats	Barge Freight	River Traffic Lake Traffic	TVA and USACE Lock USACE Freight Links
2280002021	Tugs	Vessel assist and support functions	Near port	USACE Vessel Lists
2280003200 2280003100	Deep draft	Laker and ocean-going large vessels	Mid-Great Lakes Near port	USACE Freight Links This work
2280002022	Ferries	River or lake ferrying	Regular routes	USACE Vessel Lists
2280002024	Other Commercial Vessels	Excursion boats primarily	Near dock	USACE Vessel Lists
2280002025	Dredges	Dredging projects	Varies	USACE Dredging Contracts
2280002030, 2280004030[1]	Support Vessels	General work boats	Near Port	USACE Vessel Lists
2280002029	Commercial Fishing	Market fishing	Great Lakes	State registration and catch tonnage
2280002040, 2280004040[1]	Military	Coast Guard and Navy	Great Lakes	Coast Guard Fuel Purchases

It is necessary to define our vessel type terms especially for potentially confusing types. Push boats and tugs are typically vessels of similar design except push boats are used exclusively to push barges, while tugs are self-propelled support vessels with a V-shaped bow designed for vessel assist and other general purposes usually near port as opposed to long-haul freight movements by push boats. Deep draft vessels can be generally defined as those with drafts greater than 14 feet, and in the Great Lakes are described as ‘salty’ (ocean-going) and ‘laker’ (primarily freighters, such as bulk carriers or tankers dedicated to the large fresh water lakes) designed to tolerate storm conditions mid-lake. Push boats (tug and barge combinations) move other freight in the Great Lakes, but these are restricted to within 5 miles of shore. Other vessels include ferries, excursion boats (including such vessels that might be used for group day trips, dinner cruises, and casinos), dredges (of various types), and commercial fishing vessels. In other areas, such as in the U.S. gulf coast or near naval ports, supply vessels (for off-shore oil wells or cable-laying) and military vessels are often found in high numbers but both appear in limited numbers in the Great Lakes.

6.5.2 Commercial Marine Methodology

The approach to commercial marine emission estimates needed to be flexible because the

activity data was available in many formats. Emission estimates were determined either by multiplying engine power, load factor, hours per year of operation, or on the basis of the number of gallons of fuel consumed.

Emissions were determined for ten subclasses of vessel types: Deep draft vessels (DDV) at port, DDV mid-late, push boats (rivers/lakes), tugs, ferries, other special (excursion) vessels, support vessels, dredges, commercial fishing, and military vessels (Coast Guard). These were linked to various Ohio lakes and rivers.

The actual methodology is provided in great detail in the 32 page Environ document that was published by Chrsitian E. Lindhjem, on March 2, 2007, "LADCO 2005 COMMERCIAL MARINE EMISSIONS".

Emissions for the 2008 inventory were grown from the 2005 inventory using the appropriate growth factors. That is, the 2005 emission rate was multiplied by the appropriate growth factor to obtain 2008 emissions.

The Environ grown 2008 inventory was incorporated into Ohio's State Implementation Plan (SIP) inventory for 2008. Additionally, LADCO submitted the grown inventory to US EPA on behalf of Ohio.

6.5.3 Commercial Marine Emissions Summary

The emissions summary can be seen on LADCO's website.

http://www.ladco.org/tech/emis/current/index.php

6.5.4 Marine References

1. Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory. Eastern Research Group, March 30, 2010.
2. LADCO 2005 COMMERCIAL MARINE EMISSIONS. ENVIRON, March 2, 2007
3. Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory, Volume I – Methodology. Prepared by E.H. Pechan & Associates, Inc. for the Emissions, Monitoring and Analysis Division of the EPA, Sept 2005. ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/-mobile/2002nei_mobile_nonroad_methods.pdf

6.5.5 Railroad Locomotives

Based on work performed in past inventory years, locomotives are found to be the most important source of NOX, PM and SO2 emissions from off-road engines. Ohio is an important rail center in the nation and it ranks second in Midwestern rail activity after the State of Illinois.

Rail activity is broken into five subcategories or Source Classification codes (SCCs) as shown in Table 69.

Table 69 Railroad SCCs

SCC	EPA Description	Rail Description	LADCO region Relative Fuel Use (2002)
2285002006	Class I line- haul.	Union Pacific (UP), Norfolk (NS), Canadian National and Canadian Pacific (CP)	84.3%
2285002007	Class II/III line-haul.	Regional and local rail line-haul	2.6%
2285002008	Passenger trains	AMTRAK	1.5%
2285002009	Commuter lines	No commuter in Ohio	4.2%
2285002010	Yard operations	Switching	7.4%

Class I railroad operations are the largest and most important railroads and have been split into two categories, which are considered to be line-haul (SCC 2285002006) and switching (SCC 2285002010) activity. Class II and III railroad operations are a significant lower rail activity in terms of fuel usage but they include a large number of railroads. Similar to Class I, the Class II and III operations are split into two categories: in line-haul (SCC 2285002007) and switching (SCC 2285002010) activity. A passenger train worth mentioning in Ohio is AMTRAK. There are a few other small excursion lines that may operate sporadically across the state but they are largely unidentified. There are no commuter trains in Ohio. The switching (SCC 2285002010) category includes Class I and Class II and III rail activity.

Line Haul engines are large diesel engines with approximately 4000 horsepower.
Switching engines are generally smaller engines with approximately 2500 horsepower.

6.5.6 Railroad Calculation of Emissions

For the 2008 inventory, the Eastern Regional Technical Advisory Committee (ERTAC) was established by a group of states to support effective air quality planning. One of the categories of interest to standardize the inventory and improve data quality was the calculation of railroad locomotives. The major goal of the group was to build a link-level, spatially and temporally allocated emission inventory.

The calculation of emissions for locomotives is similar to that of on-road mobile sources. Each railroad company operates on certain rail lines. Each company has a set of locomotives each with a different emission factor. Based upon the mix of locomotives a company has, a weighted emission factor for that company can be obtained. The fuel use by each company can then be multiplied by the appropriate emission factor to obtain the appropriate emission rate.

The ERTAC Rail group used annual gross ton miles (GTM) and total amount of fuel used for each railroad to calculate a railroad fuel consumption index for each railroad in terms of GTM/gallon fuel. The GTM for a given link was then divided by the average fuel consumption index for all railroads on that link to obtain the fuel consumption for the link. In cases where more than one railroad operated on the link, the resulting average fuel consumption index was the straight average of the number of railroads operating on the link. The fuel use was then multiplied by the emission factor to obtain emissions for the link. Using a GIS, the links were summed to the appropriate counties to obtain county level emissions. Daily emissions were calculated by dividing the annual emissions by 365.

6.5.7 Locomotive Emissions Summary

The emissions summary can be seen on LADCO's website.

http://www.ladco.org/tech/emis/current/index.php

6.5.8 Railroad References

1. EPA. 1997: "Locomotive Emission Standards." Regulatory Support Document, United States Environmental Protection Agency, Office of Mobile Sources, April. And EPA 1997, Emission Factors for Locomotives," Environmental Protection Agency, EPA420-F-97-051, December.
2. LADCO 2005 Midwest Rail Document http://www.ertac.us/rail/index.html
3. Introductions to Railroads http://www.ertac.us/rail/index.html
4. Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory, Volume I – Methodology. Prepared by E.H. Pechan & Associates, Inc. for the Emissions, Monitoring and Analysis Division of the EPA, Sept 2005. *ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/-mobile/2002nei_mobile_nonroad_methods.pdf*

6.5.9 Aircraft

The aircraft source category includes all aircraft types used for public, private, and military purposes. This includes four types of aircraft (US EPA, 1992):

1) Commercial;
2) Air Taxis;
3) General Aviation; and
4) Military.

Commercial aircraft include those used for transporting passengers, freight, or both.
Commercial aircraft tend to be larger aircraft powered with jet engines.
Air Taxis (AT) carry passengers, freight, or both, but usually are smaller aircraft and operate on a more limited basis than the commercial carriers. General Aviation (GA) includes most other aircraft used for recreational flying and personal transportation. Aircraft that support business travel, usually on an unscheduled basis, are included in the category of general aviation.

The national AT and GA fleet includes both jet and piston-powered aircraft. Most of the AT and GA fleet are made up of piston powered aircraft, though smaller business jets can also be found in these categories. According to a 2008 Federal Aviation Administration GA and AT Activity Survey, 66% of all GA and AT activity are powered by piston-powered aircraft and 34% are jet (or turbine) driven. US EPA has used this estimate as a national-scale default value in recently published studies investigating lead emissions from aviation sources (US EPA, 2008). The piston powered aircraft tend to have higher VOC, PM, and CO emissions and lower NOX emissions than larger jet-powered aircraft (EPA, 1992). Military aircraft cover a wide range of aircraft types such as training aircraft, fighter jets, helicopters, jet, and a small number of piston powered planes of varying sizes.

Aircraft operate chiefly in five modes:

1) Taxi/Idle: at very low power when idling or during taxiing before taking off or after landing.
2) Takeoff: at full power during takeoff until the aircraft is about 500 feet above the ground.
3) Climbout: at slightly reduced power during which the aircraft climbs to its cruising altitude.
4) Cruise: at further reduced power level at cruise where the aircraft maintains a constant speed and altitude. Cruising emissions are not included in the inventory
5) Approach: at a moderate to low power level during descent and the approach to landing.

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6.5.10 Calculation of Aircraft Emissions

Emission factors for aircraft are usually expressed as mass of pollutant per LTO (Landing and Take Off) and are derived from measurements made by engine manufacturers. The emission factor for a given aircraft is a function of the make and model of the aircraft and its engine(s), the number of engines on the aircraft, the fuel flow rate for each mode and the time the aircraft spends in each mode.

Emissions are calculated by summing the emissions factors for each of the four modes of operation (taxi, takeoff, climbout and approach) to obtain a single emission factor for a single LTO. This value is then multiplied by the number of LTOs for the given aircraft/engine type to obtain emissions.

Up until 2008 inventory year, Ohio EPA inventoried aircraft emissions based on information from the Ohio Department of transportation (ODOT), www.dot.state.oh.us/aviation. ODOT tracks operations for around 164 towered and non-towered airports. An operation is either a landing or a takeoff. Two operations make up one LTO. Where there was specific aircraft model data the emission factors were derived using the FAA's Emission Dispersion Modeling System (EDMS). EDMS is a combined emissions and dispersion model for assessing air quality at civilian airports and military air bases. The model was developed by the Federal Aviation Administration (FAA) in cooperation with the United States Air Force (USAF). Where specific aircraft model data was not available, US EPA default fleet average emission factors were taken from "Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory, 2005, see Appendix A, Aircraft Emission Estimation Methodology." Finally, the aircraft emission's inventory was derived by taking the number of Landings and Take Offs (LTOs) per year and multiplying by the emission factor.

For inventory year 2008, US EPA contracted with Eastern Research Group (ERG) and generated a detailed aircraft inventory for the entire nation. The Ohio airport inventory accounted for 724 Airports, including for the first time emissions from gliderports, heliports, sea plane bases, STOLports and ultra-light fields. However, Airport specific LTO/Engine type information was only known for the large airports. For the majority of the remaining ports, ERG used either regression equations to calculate the LTOs or other documented procedures as explained in the following pdf file:

http://www.epa.gov/ttn/chief/net/2008_nei/aircraft_report_final.pdf

Ohio EPA thoroughly reviewed the 2008 US EPA inventory and it was deemed representative

for Ohio.

The aircraft emissions were uploaded to EIS gateway by Laurel Driver, US EPA's Environmental Engineer on mobile inventories. The inventory was imported and processed in LADCO's emissions modeling system CONCEPT. Emissions summary can be seen on LADCO's website.

http://www.ladco.org/tech/emis/current/index.php

6.5.11 Aircraft References

1. Documentation for Aircraft Component of the National Emissions Inventory Methodology, EPA January 27, 2011, Prepared by Eastern Research Group under contract to E.H. Pechan & Associates, Inc. http://www.epa.gov/ttn/chief/-net/2008_nei/aircraft_report_final.pdf
2. Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory, Volume I – Methodology. Prepared by E.H. Pechan & Associates, Inc. for the Emissions, Monitoring and Analysis Division of the EPA, Sept 2005. *ftp://ftp.epa.gov/EmisInventory/2002finalnei-/documentation/mobile/2002nei_mobile_nonroad_methods.pdf*