pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

APPENDIX B

Nonpoint Sources

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Nonpoint Source Definition

For emission inventory development purposes, the term "nonpoint sources" traditionally refers to stationary air pollutant emission sources that are not inventoried at the facility level. While point sources are inventoried individually, nonpoint sources are typically inventoried at the county level (*Introduction to Nonpoint Source Emission Inventory Development Volume III: Chapter 1*).[1] Other sources, such as gasoline stations and dry cleaning establishments, are often treated as both point and nonpoint sources. The main reason they are not exclusively treated as point sources is that the effort required to gather data and estimate emissions for each individual facility is very great, while emissions per facility are generally small. For these sources, a cut-off point, typically based on annual emissions, usually defines the distinction between point and nonpoint. The Air Emissions Reporting Requirements (AERR) specifies reporting criteria air pollutant (CAP) thresholds for point and nonpoint sources, which vary depending on the pollutant and the attainment status of a county (http://www.epa.gov/ttn/chief/aerr/).

Individual emissions sources are grouped with other like sources into source categories. The source categories are grouped in a way that they can be estimated collectively using one methodology. Most nonpoint source categories do not have an analogue in the point source inventory. Commercial/consumer product use is an example. The geographic boundaries of the individual activities associated with nonpoint sources are often hard to determine or are, at best, arbitrary. Even within a point source facility, some activities occur that are more easily treated as nonpoint source emissions. In another example, some emissions associated with surface coating operations such as equipment cleaning can be more practically estimated using nonpoint source methods even though other equipment cleaning may be reported as part of the point source inventory.

Beginning with the 2008 inventory, in-flight aircraft emissions, locomotive emissions outside of the rail yards, and commercial marine vessel emissions (both underway and port emissions) are included in the nonpoint data category. Any aircraft or rail yard emissions excluded from Nonpoint are discussed in Appendix A: Point Sources.

The data files used for this document were obtained as a download from the EIS gateway. The SMOKE files from the gateway were imported into the EMF system in order to apply the necessary data filters and summer day averages.

General Methods for Estimating Nonpoint Source Activity and Emissions

Nonpoint source emissions are generally estimated by multiplying an emission factor by some known indicator or collective activity for each nonpoint source category at the county level. Several methodologies are available for estimating nonpoint source activity levels and emissions. For this 2011 nonpoint source inventory, estimates were derived by (1) treating nonpoint sources as point sources; (2) obtaining county-level activity data; (3) apportioning national or statewide activity data to counties; (4) use of per capita emission factors; and (5) use of per employee

[1] Eastern Research Group, Inc., "Emission Inventory Improvement Program, Document Series, Volume III, Nonpoint Sources, Chapter 1, Introduction to Nonpoint Source Emission Inventory Development (Revised Final)," prepared for the Nonpoint Sources Committee, Emission Inventory Improvement Program, January 2001.

emission factors. Each approach method has distinct advantages and disadvantages as discussed below.

Small sources that would normally be treated as nonpoint sources may be handled as point sources if county level activity data is not readily determinable for certain source categories. Municipal landfills provide an example of this situation. For some source categories where county activity data were not available, Commonwealth of Pennsylvania (Commonwealth or Pennsylvania) totals were apportioned to counties using data for a surrogate of the emissions activity. Commercial/Institutional and Industrial fuel combustion categories were handled in this manner. The major drawback of this approach is that additional data and resources are needed to apportion activity levels to the local level, and accuracy is lost in the process. If Commonwealth level data were not available, then national level data were used in a similar manner.

Sources in certain nonpoint source categories were not only numerous and diffuse, but were too difficult to include in an inventory by any of the above procedures. As an example, solvent evaporation from consumer and commercial products such as waxes, aerosol products and window cleaners cannot be routinely determined by the PA Department of Environmental Protection (DEP or Department). In addition, it would be resource-intensive to develop and implement a survey that would yield such information. Per capita or per employee emission factors are used to estimate emissions for these source categories. The use of per capita emission factors is based on the assumption that, for a given source category, emission activity can be reasonably associated with population. This assumption is valid over broad nonpoints for certain sources that fall under the Consumer and Commercial Products source category.

For categories that rely on a per capita emission factors, county population estimates for 2011 were obtained from the U.S. Bureau of the Census and/or Pennsylvania State Data Center.[2] For emissions that were calculated from per employee emission factors, county-level employment data for 2009 was obtained from the Bureau of the Census' *County Business Patterns*[3] (CBP) and compiled by the Environmental Protection Agency (EPA). The county employment data for the appropriate North American Industrial Classification System (NAICS) codes was obtained from the CBP and provided by the EPA,[4] county employment data for 2011 was not available until July 2012.

In some cases, the Census does not report the employment value for a particular NAICS code/county combination because of confidentiality concerns. In these cases, the Census provides employment data as a range (e.g., between 20 and 99 employees). When a precise number of employees was not available from CBP, an initial estimate was developed based on the mid-point of the reported range (e.g., 60 employees was used for the 20 to 99 employment

[2] U.S. Department of Commerce, Bureau of the Census, "Population Estimates: Datasets for all Geographies, CO-EST2011 - http://www.census.gov/popest/data/datasets.html. Prepared by the Pennsylvania State Data Center, released April 2012. http://pasdc.hbg.psu.edu/Data/Estimates/tabid/1012/Default.aspx.

[3] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA. County Business Patterns, 2009 State Data File: http://www.census.gov/econ/cbp/download/09_data/index.html.

[4] Divita, 2008: Divita, Frank, E.H. Pechan & Associates, Inc., memorandum to Roy Huntley, U.S. Environmental Protection Agency, "County Business Patterns Calculations," December 4, 2008.

range). For a given NAICS code, the mid-point estimates were then adjusted up or down to yield the Commonwealth-level employment for that NAICS code as reported in the CBP. The adjustments were estimated by first calculating the difference between the Commonwealth-level CBP employment and the total of the employment values for counties for which actual employment values were reported in the CBP. The resulting value represents employment for the counties for which the CBP reports an employment range value. This value was then divided by the sum of the mid-point employment estimates for the counties for which employment was reported as a range. The resulting ratio was multiplied by the mid-point estimates to yield the final county employment estimates.

The calculation spreadsheets provide each of the steps used in this estimation procedure. National, State and County level employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factor was performed (Divita, 2008).

1. Control Efficiency

Control efficiency (CE) is the emission reduction percentage associated with a control device, process change or reformulation. Control efficiencies can vary widely by source within a nonpoint source category. Nonpoint source control efficiency values represent the weighted average control for the category.

2. Rule Penetration

Because lower-emitting sources within a source category may not be covered by a regulation, it is important to reflect the extent to which total source category emissions are affected. Rule penetration (RP) represents the percentage of total source category emissions that are affected by a regulation.

3. Rule Effectiveness

Rule effectiveness (RE) is a factor used to adjust the control efficiency to account for failures and uncertainties that affect the actual performance of the control. For example, control equipment performance may be adversely affected by age of the equipment, lack of maintenance, or improper use. With the exception of Federal regulations, a default RE value of 80 percent was applied when information was not available to substantiate the true RE value.[5] An RE of 100 percent was applied to all Federal regulations that require national compliance.

[5] Eastern Research Group, Inc., "Emission Inventory Improvement Program, Document Series, Volume III, Nonpoint Sources, Chapter 1, Introduction to Nonpoint Source Emission Inventory Development (Revised Final)," prepared for the Nonpoint Sources Committee, Emission Inventory Improvement Program, January 2001.

4. Estimating Emissions Using Control Efficiency, Rule Penetration, and Rule Effectiveness

The RE factor is applied to the estimated control efficiency in the calculation of emissions from a source. The formula for the application of CE, RP, and RE is displayed below in the example equation:

Uncontrolled Emissions	=	50 pounds per day
Control Efficiency	=	90 percent
Rule Penetration	=	60 percent
Rule Effectiveness	=	80 percent

Controlled Emissions = Uncontrolled Emissions × (1 – CE/100 × RP/100 × RE/100)

Controlled Emissions = 50 × (1 – 0.9 × 0.6 × 0.8) = 50 × (1 – 0.432) = 28.4 pounds per day

An RE and/or RP value can substantially increase emission estimates when high control efficiencies are involved. For example, if RP was not applied in the above example (equivalent to a 100 percent RP assumption), then estimated emissions are:

Controlled Emissions = 50 × (1 – 0.9 × 0.8) = 50 × (1 – 0.72) = 14 pounds per day.

5. Point Source Subtractions

Source categories can appear in both the nonpoint source and point source inventories. For example, emissions from large dry cleaning establishments may be included in the point source inventory, while emissions from smaller dry cleaners (below some specified cutoff) are included in the nonpoint source inventory. When both a point source inventory and a nonpoint source inventory include emissions from the same process, the nonpoint source emission estimates are adjusted to avoid double counting. Although many nonpoint source categories (e.g., Architectural Surface Coating) do not have companion point source categories, there are many source categories in the nonpoint source inventory for which emissions are also reported in the point source inventory (see Table 1). This emissions adjustment is referred to as point subtraction, and was accomplished by one of two methods:

Ideally, this adjustment occurs in the nonpoint source emission calculation by subtracting point source emission activity (throughput) from total emission activity as shown below. If point source activity data is available, such as in the Commercial/Institutional and Industrial Fuel Combustion categories, this method was employed:

$$Area\ Source\ Activity = (Total\ Activity) - (Point\ Source\ Activity)$$

The Pennsylvania point source inventory does not report throughput activity for many sources. If point source activity data was not available, such as in many of the solvent working categories like Metal Furniture and Motor Vehicle Parts, it was necessary to

calculate the point source subtractions using total and point source emission estimates as identified below:

$$Area\ Emissions_p = (Total\ Emissions_p) - (Point\ Source\ Emissions_p)$$

where:

p = pollutant

To facilitate the point source subtractions, the annual emission records for all point SCCs associated with a nonpoint source category were summed for the county level. The county-level point source annual emissions were then subtracted from the nonpoint source category annual emissions using a nonpoint source category-to-point source category crosswalk developed for this project (Table 1). Note that in keeping with EIIP guidance, when the resulting nonpoint source emission estimate was negative, the nonpoint source emission value was set to zero.

Separate point source inventories were developed for Allegheny and Philadelphia counties by their county Health Departments and were submitted to Pennsylvania DEP's Air Inventory Management System (AIMS) database.

Total state-level commercial/institutional sector energy consumption data are available from the Energy Information Administration (EIA)'s State Energy Data System (SEDS), and were used for all source categories. The following presents an example of a point source subtraction calculation for SO_X emission in the Industrial Distillate Oil Combustion category (SCC 2102004000):

Pennsylvania Industrial Distillate Oil Consumption = 41,778 thousand gallons (SEDs) - 11,804 thousand gallons (Point Source) = 29,974 thousand gallons (Nonpoint)

$$\text{Annual SO2 Emissions} = \frac{42.6\ \text{lb SO2} \,/\, 1{,}000\text{gal distoil}}{\text{year}} \cdot 29{,}974{,}000\text{gallons} \cdot \frac{39{,}751\text{employees in county}}{574{,}683\ \text{employees in state}}$$

$$\text{Annual SO2 Emissions} = 88{,}323\text{lb SO2 per year} \cdot \frac{1\text{ton}}{2{,}000\ \text{lb}} = 44.2\ \text{tons SO2 per year}$$

Table 1. Nonpoint Source Inventory Categories with Point Source Activity Subtractions

SCC	SCC1DESC	SCC3DESC	SCC6DESC	SCC8DESC
2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types
2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/Sub-bituminous Coal	Total: All Boiler Types
2103001000	Stationary Source Fuel Combustion	Commercial/Institutional	Anthracite Coal	Total: All Boiler Types
2103002000	Stationary Source Fuel Combustion	Commercial/Institutional	Bituminous/Sub-bituminous Coal	Total: All Boiler Types
2103004000	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	Total: Boilers and IC Engines
2102004000	Stationary Source Fuel Combustion	Industrial	Distillate Oil	Total: Boilers and IC Engines
2103005000	Stationary Source Fuel Combustion	Commercial/Institutional	Residual Oil	Total: All Boiler Types
2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types
2103006000	Stationary Source Fuel Combustion	Commercial/Institutional	Natural Gas	Total: Boilers and IC Engines
2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines
2103007000	Stationary Source Fuel Combustion	Industrial	Liquefied Petroleum Gas (LPG)	Total: All Combustor Types
2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types
2103008000	Stationary Source Fuel Combustion	Commercial/Institutional	Wood	Total: All Boiler Types
2401015000	Solvent Utilization	Surface Coating	Factory Finished Wood	Total: All Solvent Types
2401020000	Solvent Utilization	Surface Coating	Wood Furniture	Total: All Solvent Types
2401040000	Solvent Utilization	Surface Coating	Metal Cans	Total: All Solvent Types
2401050000	Solvent Utilization	Surface Coating	Miscellaneous Finished Metals	Total: All Solvent Types
2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment	Total: All Solvent Types
2401090000	Solvent Utilization	Surface Coating	Miscellaneous Manufacturing	Total: All Solvent Types
2401070000	Solvent Utilization	Surface Coating	Motor Vehicles	Total: All Solvent Types
2415000000	Solvent Utilization	Degreasing	All Industries:	Total: All Solvent Types
2415300000	Solvent Utilization	Degreasing	All Industries: Cold Cleaning	Total: All Solvent Types
2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types

The following individual sections describe the annual emission estimation methodology for each nonpoint source category. Each section contains a brief description of the source category, identifies whether the category's emission estimates were subject to point source emission subtractions, and presents sample emission calculations.

Aircraft

The aircraft sector includes all aircraft types used for public, private, and military purposes. This includes four types of aircraft: (1) Commercial, (2) Air Taxis, (3) General Aviation, and (4) Military. It is important to note whether each aircraft is turbine or piston driven, as this impacts whether jet fuel or aviation gas are used, impacting the emissions estimation model accordingly. The fraction of turbine and piston driven aircraft is either collected or assumed for all aircraft types. 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 are usually smaller aircraft and operate on a more limited basis than commercial aircraft. General Aviation (GA) includes most other aircraft used for recreational flying and personal transportation. Finally, military aircraft are associated with military purposes, though they are sometimes active at non-military airports. The 2011 NEI also includes emission estimates for aircraft auxiliary power units (APUs) and aircraft ground support equipment (GSE) typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles, and equipment, aircraft towing vehicles, and passenger buses. These APUs and GSE are located at the airport facilities as point sources along with the aircraft exhaust emissions. However, these emissions are included in the Emission Inventory System (EIS) Sectors for Nonroad equipment (gasoline, diesel, and other) that EPA-developed emissions estimates associated with aircrafts' landing and takeoff (LTO) cycle.

The U.S. Environmental Protection Agency (EPA) estimated emissions related to aircraft activity for all known Pennsylvania airports, including seaplane ports and heliports. The aircraft sector includes the four aircraft types mentioned above that are used for public, private, and military purposes. A critical detail about the aircraft is whether each aircraft is turbine- or piston-driven, which allows the emissions estimation model to assign the fuel used, jet fuel or aviation gas, respectively.

The national AT and GA fleet includes both jet- and piston-powered aircraft. Most of the AT and GA fleet are made up of larger piston-powered aircraft, though smaller business jets can also be found in these categories. Military aircraft cover a wide range of aircraft types such as training aircraft, fighter jets, helicopters, and jet-powered and piston-powered planes of varying sizes.

The 2011 NEI also includes emission estimates for aircraft auxiliary power units (APUs) and aircraft ground support equipment (GSE) typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles, and equipment, aircraft towing vehicles, and passenger buses. These APUs and GSE are located at the airport facilities as point sources along with the aircraft exhaust emissions. However, these emissions are included in the EIS Sectors for nonroad equipment (gasoline, diesel, and other), described in Section 4.5.

This sector includes the SCCs listed in Table 2:

Table 2. Source Classification Codes for the Aircraft Sector in the 2011 NEI SCC

	Data Category	SCC Description	EPA Estimates
2275001000	Point	Mobile Sources; Aircraft; Military Aircraft; Total	X
2275020000	Point	Mobile Sources; Aircraft; Commercial Aircraft; Total: All Types	X
2275050011	Point	Mobile Sources; Aircraft; General Aviation; Piston	X
2275050012	Point	Mobile Sources; Aircraft; General Aviation; Turbine	X
2275060011	Point	Mobile Sources; Aircraft; Air Taxi; Piston	X
2275060012	Point	Mobile Sources; Aircraft; Air Taxi; Turbine	X
2260008005	Point	Mobile Sources; Off-highway Vehicle Gasoline 2-Stroke; Aircraft Ground Support Equipment	X
2265008005	Point	Mobile Sources; Off-highway Vehicle Gasoline 4-Stroke; Aircraft Ground Support Equipment	X
2267008005	Point	Mobile Sources; LPG; Aircraft Ground Support Equipment	X
2268008005	Point	Mobile Sources; CNG; Aircraft Ground Support Equipment	X
2270008005	Point	Mobile Sources; Off-highway Vehicle Diesel; Aircraft Ground Support Equipment	X
2275070000	Point	Mobile Sources; Aircraft; Aircraft Auxiliary Power Total	X
2275085000	Nonpoint	Mobile Sources; Aircraft; Unpaved Airstrips; Total	X
2275087000	Nonpoint	Mobile Sources; Aircraft; In-flight (non-Landing-Takeoff cycle)	X

1. Sources of Data Overview and Selection Hierarchy

The aircraft sector includes data from two data components: State/local/tribal (S/L/T) agency-provided emissions data, and an EPA dataset that is enhanced with state- and local-provided model inputs. Pennsylvania did not provide any data.

A. EPA-Developed Aircraft Emissions Estimates

EPA developed emissions estimates associated with aircrafts' landing and takeoff (LTO) cycle. The cycle begins when the aircraft approaches the airport on its descent from cruising altitude, lands, taxis to the gate, and idles during passenger deplaning. It continues as the aircraft idles during passenger boarding, taxis back out onto the runway for subsequent takeoff, and ascent (climbout) to cruising

altitude. Thus, the five specific operating modes in an LTO are (1) Approach, (2) Taxi/idle-in, (3) Taxi/idle-out, (4) Takeoff, and (5) Climbout.

The LTO cycle provides a basis for calculating aircraft emissions. During each mode of operation, an aircraft engine operates at a fairly standard power setting for a given aircraft category. Emissions for one complete cycle are calculated using emission factors for each operating mode for each specific aircraft engine combined with the typical period of time the aircraft is in the operating mode.

In fall of 2012, the EPA posted preliminary LTO data for review prior to developing the aircraft inventory. EPA encouraged the S/L/T agencies to review the materials and provide comments on any necessary corrections. Pennsylvania did not provide any comments or data.

Refer to "Development of 2011 Aircraft Component for National Emissions Inventory," June 17, 2013,[6] for more detail on preparing the LTO data and running the Emissions and Dispersion Modeling System (EDMS), including a summary of EPA default values and S/L/T replacement/revisions.

B. Emissions for Aircraft with Detailed Aircraft-Specific Activity Data

For airports where the available LTO, from agencies or FAA data bases, included detailed aircraft-specific make and model information (e.g., Boeing 747-200 series), EPA used the FAA's EDMS, Version 5.1.[7] This type of detail is available for most LTOs at approximately three thousand larger airports that have commercial air traffic. Smaller and most GA-only airports would not have aircraft specific activity detail available.

Emissions for GSE and APUs associated with aircraft-specific activity were also estimated by EDMS, using the assumptions and defaults incorporated in the model. EPA's NONROAD model also estimates GSE emissions, but that method is deemed less accurate than EDMS's LTO-based estimates and an EIS critical error check prohibits GSE SCCs from being submitted to the Nonroad equipment data category which would duplicate emissions. Thus, the 2011 NEI uses only emissions data for GSEs and APUs generated by EDMS.

C. Emissions for Airports without Detailed Aircraft-Specific Activity Data

EPA estimated emissions for aircraft where detailed aircraft-specific activity data were not available by combining aircraft operations data from FAA's Terminal Area Forecasts (TAF) and 5010 forms.[8] These sources provide LTO estimates for

[6] Eastern Research Group (ERG), 2013. Memorandum: *Development of 2011 Aircraft Component for National Emissions Inventory*, June 17, 2013. ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_Aircraft_20130717.pdf
[7] Federal Aviation Administration (FAA), 2011. Emissions and Dispersion Modeling System, Version 5.1. September, 2011. http://www.faa.gov/about/office_org/headquarters_offices/aep/models/edms_model/
[8] http://www.faa.gov/airports/airport_safety/airportdata_5010/

general aviation airports. Because the aircraft make and models were not available, EPA used assumptions regarding the percent of these LTOs that were associated with piston-driven (using aviation gas) versus turbine-driven (using jet fuel) aircraft. These fractions were developed based on FAA's General Aviation and Part 135 Activity Surveys – CY 2010.[9] Then, EPA estimated emissions based on the percent of each aircraft type, LTOs, and emission factors.[10] These emissions are included in the nonpoint data category under SCC 227508700 (Mobile Sources; Aircraft; In-flight non-Landing-Takeoff cycle; Total).

Commercial Marine Vessels

The commercial marine vessel (CMV) sector includes boats and ships used either directly or indirectly in the conduct of commerce or military activity. The majority of vessels in this category are powered by diesel engines classified as Category 1 (C1), Category 2 (C2) or Category 3 (C3), based upon the type of fuel used to power the vessel. C1 and C2 use gasoline or number 2 distillate. C3 vessels use heavier fuels with higher sulfur content in addition to number 2 distillate. For the purpose of this inventory, EPA assumed that C3 vessels (engine displacement above 30 liters per cylinder) primarily use residual blends while C1 and C2 vessels typically used distillate fuels. The resulting inventory includes emissions from both propulsion and auxiliary engines used on these vessels, as well as those on gas and steam turbine vessels. Geographically, the inventories include port and interport emissions that occur within the area that extends 200 nautical miles (nm) from the official U.S. baseline, which is roughly equivalent to the border of the U.S. Exclusive Economic Zone. Only some of these emissions are allocated to states based on official state boundaries that typically extend 3 miles offshore. Naval vessels are not included in this inventory, though Coast Guard vessels are included as part of the C1 and C2 vessel classifications. The CMV source category does not include recreational marine vessels, which are generally less than 100 feet in length, most being less than 30 feet, and powered by either inboard or outboard engines. These emissions are included in those calculated by the NONROAD model; they reside in the nonroad data category and EIS "Mobile - Nonroad Equipment" sectors of the 2011 NEI.

EPA estimated CMV emissions as a collaborative effort between the Office of Transportation and Air Quality (OTAQ) and the Office of Air Quality Planning and Standards (OAQPS). EPA developed the C3 commercial marine inventories for a base year of 2002 and then projected to 2011 by applying regional adjustment factors to account for growth. In addition, EPA developed and applied NO_X adjustment factors to account for implementation of the NO_X Tier 1 standard. The C3 growth factors, NO_X adjustment factors by tier and calendar year, and NO_X adjustment factors by engine type and speed are defined in Appendix A of the project report Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory Methodology, March 30, 2010. EPA then allocated these emissions to individual GIS polygons using methods that varied by operating mode (i.e., hoteling, maneuvering, reduced speed zone,

[9] Federal Aviation Administration (FAA), 2012. General Aviation and Part 135 Activity Survey – Calendar Year 2010. http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2010/

[10] U.S. Environmental Protection Agency (US EPA), 2013. Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2011 National Emissions Inventory, EPA-420-B-13-040, September 2013. ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_AircraftLead_20130827

and underway). GIS polygons allowed the estimation/allocation of emissions to defined port, waterway, and coastal areas.

The C1 and C2 vessels tend to be smaller ships that operate closer to shore, and along inland and intercoastal waterways. Naval vessels are not included in this inventory, though Coast Guard vessels are included as part of the C1 and C2 vessels. More detailed definitions for C1 and C2 can be found at http://www.epa.gov/otaq/standards/nonroad/marineci.htm.

Each of the commercial marine SCCs requires an appropriate emissions type (M=maneuvering, H=hoteling, C=cruise, Z=reduced speed zone) because emission factors vary by emission type. Each SCC and emissions type combination was allocated to a shape file identifier in the nonpoint inventory. The allowed combinations are shown in Table 3 The default values are those assumed when the actual emission type may be unknown; for example, emissions that occur in shipping lanes are assumed to be 'cruising' and cannot be 'hoteling,' which only occurs at ports.

Table 3: Commercial Marine SCCs and Emission Types in EPA Estimates

SCC	SCC Description	Allowed	Default
2280002100	Marine Vessels, Commercial Diesel Port	M	M
2280002200	Marine Vessels, Commercial Diesel Underway	C	C
2280003100	Marine Vessels, Commercial Residual Port	H	H
2280003100	Marine Vessels, Commercial Residual Port	M	H
2280003200	Marine Vessels, Commercial Residual Underway	C	C
2280003200	Marine Vessels, Commercial Residual Underway	Z	C

Table 4 shows the selection hierarchy for the CMV sector. This hierarchy pulls the relevant datasets for this sector from the overall nonpoint sources hierarchy listed in ?.

Table 4: 2011 NEI Commercial Marine Vehicle Selection Hierarchy

Priority	Dataset Name	Dataset Content
1	State/Local/Tribal Data	Submitted Commercial Marine Vessel Emissions
2	2011EPA_PM-Augmentation	Completes PM Species in WA Submittal for Additional SCC

1. EPA-Developed Commercial Marine Vessel Emissions Data

EPA estimated CMV emissions as a collaborative effort between the Office of Transportation and Air Quality (OTAQ) and OAQPS. EPA developed the

C3 commercial marine inventories for a base year of 2002 and then projected to 2011 by applying regional adjustment factors to account for growth. In addition, EPA developed and applied NO_X adjustment factors to account for implementation of the NO_X Tier 1 standard. The C3 growth factors, NO_X adjustment factors by tier and calendar year, and NO_X adjustment factors by engine type and speed are defined in Appendix A of the project report, "Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory Methodology," March 30, 2010.[11] For C1 and C2 marine diesel engines, the emission estimates were consistent with the 2011 Locomotive and Marine federal rule making.[12] EPA then allocated these emissions to individual GIS polygons using methods that varied by operating mode (i.e., hoteling, maneuvering, reduced speed zone, and underway). For example, port emissions appear only in port polygons, federal water emissions in federal waters. EPA allocated emissions estimates based on activity to GIS polygons representing port and waterway. GIS polygons allowed the estimation/allocation of emissions to defined port, waterway, and coastal areas.

2. Allocation of Port and Underway Emissions

EPA developed port boundaries using a variety of resources to identify the most accurate port boundaries. First, GIS data or maps provided directly from the port were used. Next, maps or port descriptions from local port authorities, port districts, etc., were used in combination with existing GIS data to identify port boundaries. Finally, satellite imagery from tools such as Google Earth and street layers from StreetMap USA were used to delineate port areas. The shape file used for 2011 incorporated the efforts made in 2008. In all cases, polygons were created on land, bordering waterways and coastal areas, and were split by county boundary, such that no shape file crosses county lines and county total emission can be easily summed. Each polygon was identified by the port name and state and county FIPS in addition to a unique ShapeID. Smaller ports with C1 and C2 activities were mapped as small circles, such that the port is much like a point source, but without the complication of emissions appearing in both point and nonpoint inventories. Note that no C3 emissions were mapped to small circles. The set of port shape file GIS data is posted at:

http://www.epa.gov/ttn/chief/eis/2011nei/2011_ports_shapefile.zip

The shape files used for the underway emissions were unchanged from those used in the 2008 NEI and are available in the file:

http://www.epa.gov/ttn/chief/eis/2011nei/shippinglanes_112812_shapefile.zip

[11] Eastern Research Group (ERG), 2010. Project report: *Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory Methodology*. ERG No. 0245.02.302.001, March 30, 2010. http://www.epa.gov/ttn/chief/net/2008inventory.html#inventorydoc

[12] U.S. Environmental Protection Agency (US EPA), 2003. Final Regulatory Support Document: *Control of Emissions from New Marine Compression-Ignition Engines at or above 30 Liters per Cylinder*, EPA 420-R-03-004, January 2003. http://www.epa.gov/otaq/oceanvessels.htm

To develop emissions for the C1 and C2 part of the inventory, EPA started with criteria emissions and activity as a single national number. EPA allocated C1 and C2 vessels based on activity for the underlying vessel types (deepwater, ferries, fishing, government, Great Lake, offshore, research, and tugs) available in "*Category 2 Vessel Census, Activity, and Spatial Allocation Assessment and Category 1 and Category 2 In-port/At-sea Splits,"* (Census Report) February 16, 2007.[13] This method, described in the August 22, 2012, Memorandum from Eastern Research Group,[14] shifts the distribution used in previous NEIs from majority in ports to majority in underway.

These updates changed the allocation fractions of emissions to underway and port county/Shape ID combinations. Shape ID's are geometric representations of geographical coordinates on a map where emissions occur.

The C3 estimates were grown in gridded Emissions Control Area (ECA) model data from 2002 to 2011. The 2002 data are documented in *Technical Support Document (TSD) Preparation of Emissions Inventories for the Version 5.0, 2007, December 14, 2012* (http://epa.gov/ttn/chief/emch/2007v5/2007v5_2020base_EmisMod_TSD_13dec2012.pdf). Emissions Modeling Platform Criteria pollutant estimates from combined C3 SCCs from model platform were allocated to shapes by ratio to 2008 county/shape/emission type. In cases where model files had emissions in counties for which EPA had no shape IDs, the model file emissions were dropped. In all of these cases, emissions were very small and considered to be negligible. In cases where model files had emissions in counties with shape IDs that had no 2008 C3 estimates, emissions were allocated to shapes in those counties proportionately to shape area.

3. Summary of Quality Assurance Methods

EPA compared shape-, state-, and county-level sums in (1) EPA default data, (2) S/L/T agency submittals and (3) the resultant 2011 NEI selection by included pollutants, SCCs, SCC-Emission Types Emissions summed to agency and SCC level.

Although not submitted to the 2011 NEI, the LADCO regional program had significantly different values for CMV estimates in the Great Lakes region. EPA is re-evaluating C1 and C2 estimates that may over estimate tug traffic in the Great Lakes, for example.

[13] Eastern Research Group (ERG), 2007. Project report: *Category 2 Vessel Census, Activity, and Spatial Allocation Assessment and Category 2 and Category 2 In-port/At-Sea Splits*, February 16, 2007. ftp://ftp.epa.gov/EmisInventory/2011/doc/Category%202%20vessel%20census.pdf

[14] Eastern Research Group (ERG), 2012. Project report: *Category 1/Category 2 Commercial Marine Activity Spatial Allocation, August 22, 2012.* ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_CMV_Cat1%262_Activity_Spatial_Allocation_082212.pdf

Locomotives

1. Sector Description

The locomotive sector includes railroad locomotives powered by diesel-electric engines. A diesel-electric locomotive uses 2- or 4-stroke diesel engines and an alternator or a generator to produce the electricity required to power its traction motors. The locomotive source category is further divided up into categories: Class I line haul, Class II/III line haul, passenger, commuter, and yard. Classes of railroad companies are determined primarily by using the railroad companies' annual operating revenue. EPA's 2011 national rail estimates were developed by applying growth factors to the 2008 NEI values based on railroad freight traffic data from the 2008 and 2011 R-1 reports submitted by all Class I rail lines to the Surface Transportation Board and employment statistics from the American Short Lines and Regional Railroad Association for Class II and III. See the ERG project report, "Development of 2011 Railroad Component for National Emissions Inventory," September 5, 2012, for details. For more information on the 2008 methodology, refer to the 2008 documentation. The emissions were allocated to line haul shape IDs and yard locations based on 2008 allocations.

Table 5 below indicates locomotive SCCs and whether EPA estimated emissions. If EPA did not estimate the emissions, then all emissions from that SCC that appear in the inventory are from S/L/T agencies.

Table 5: Locomotive SCCs, Descriptions and EPA Estimation Status

SCC	Description	EPA Estimated?	Data Category
2285002006	Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	Yes In Shape Files	Nonpoint
2285002007	Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Class II/III Operations	Yes In Shape Files	Nonpoint
2285002008	Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	Yes	Nonpoint
2285002009	Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	No	Nonpoint
2285002010	Railroad Equipment Diesel Yard Locomotives	No	Nonpoint
28500201	Internal Combustion Engines Railroad Equipment Diesel Yard	Yes As Point Sources	Point

2. EPA-Developed Locomotive Emissions Data

EPA's 2011 national rail estimates were developed by applying growth factors to the 2008 NEI values based on railroad freight traffic data from the 2008 and 2011 R-1 reports submitted by all Class I rail lines to the Surface Transportation Board and employment statistics from the American Short Lines and Regional Railroad Association for Class II and III. See ERG project report, "*Development of 2011 Railroad Component for National Emissions Inventory, September 5, 2012,"* for details.[15] For more information on the 2008 methodology, refer to the 2008 documentation.[16] The emissions were allocated to line haul shape IDs and yard locations based on 2008 allocations.

3. Summary of Quality Assurance Methods

EPA default values were used at shape level, state, and county to EPA default values since Pennsylvania did not provide any data.

Adhesives and Sealants (SCC 2460600000)

Adhesives are formulated organic polymer compounds that adhere to, or form a bond between, one or more substrates. They are commonly referred to as cements, glues and pastes. Adhesives can be classified as water-based, solvent-based, hot melts, or radiation curable. Sealants and caulking compounds are organic polymers used to fill or seal gaps between surfaces. The primary solvents used in formulating adhesives and sealants are aliphatic hydrocarbons and ketones.

County-level emissions were calculated using a per capita emission factor which was obtained from the Emission Inventory Improvement Program (EIIP)[17] and U.S. Bureau of the Census 2011 estimated population data.[18] The emission factor represents pre-control emission rates. A CE of 8.3 percent[19] and an RP of 48.6 percent[20] were applied to reflect the Federal Rule for consumer products. There are no point sources associated with this category.

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[15] Eastern Research Group (ERG), 2012. Memorandum: Development of 2011 Railroad Component for National Emissions Inventory, September 5, 2012. ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_Locomotive.pdf.

[16] ERG, 2011. Project report: *Documentation for Locomotive Component of the National Emissions Inventory Methodology*, ERG No. 0245.03.402.001, May 3, 2011. ftp://ftp.epa.gov/EmisInventory/2011/doc/2008nei_locomotive_report.pdf

[17] ERG, "Emission Inventory Improvement Program, Document Series, Volume III, Nonpoint Sources, Chapter 5, Consumer and Commercial Solvent Use," Table 5.4-1, prepared for the Nonpoint Sources Committee, Emission Inventory Improvement Program, August 1996, available at http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html.

[18] U.S. Department of Commerce, Bureau of the Census, "Population Estimates: Datasets for all Geographies, CO-EST2011 - http://www.census.gov/popest/data/datasets.html. Prepared by the Pennsylvania State Data Center, released April 2012. http://pasdc.hbg.psu.edu/Data/Estimates/tabid/1012/Default.aspx.

[19] ERTAC Recommendation, Midwest RPO Inventory Comparability Project; revised June 2, 2009. Huntley, 2009: Huntley, Roy, U.S. Environmental Protection Agency, "SCCs & emission factors to be used in 2011 NEI to Bollman May 1 2009.mdb [electronic file]," May 1, 2009.

[20] E.H. Pechan & Associates, Inc., *Control Measure Development Support Analysis of Ozone Transport Commission Model Rules*, prepared for the Ozone Transport Commission, March 2001.

Each county's emissions are estimated per the sample calculations listed below.

SAMPLE VOC EMISSION CALCULATIONS:

$$\text{Annual VOC Emissions} = (\text{Emission Factor})(\text{Population})\left(1 - \frac{\text{CE}}{100} \cdot \frac{\text{RP}}{100} \cdot \frac{\text{RE}}{100}\right)$$

where:

Emission Factor = 0.57 *lb VOC/person/year*
Population = 1,227,066 persons (Allegheny County)
Control Efficiency = 8.3%
RP (Rule Penetration) = 48.6%
RE (Rule Effectiveness) = 100%

$$\textit{Annual VOC Emissions} = \left(1{,}227{,}066\,\textit{persons}\right)\left(\frac{0.57\,\textit{lb VOC}\,/\,\textit{person}}{\textit{year}}\right)\left(1 - \frac{8.3}{100} \cdot \frac{48.6}{100} \cdot \frac{100}{100}\right)$$

$$\textit{Annual VOC Emissions} = 671{,}214.1087\,\textit{lb per year} \cdot \left(\frac{1\ \textit{ton}}{2{,}000\ \textit{lb}}\right) = 335.61\,\textit{tons VOC per year}$$

Automotive Aftermarket Products (SCC 2460400000)

The EPA has divided automotive consumer products into two different major categories: (1) detailing products, and (2) maintenance and repair products. It is often difficult to distinguish the automotive aftermarket product subcategories and formulations for distinct product types because category descriptions and designations may overlap. In some cases, varying formulations may be due to the product form. There are a large number of individual VOCs in these products, including HAPs.

County-level emissions were calculated using a per capita emission factor which was obtained from the Emission Inventory Improvement Program (EIIP)[21] and U.S. Bureau of the Census 2011 estimated population data.[22] The emission factor represents pre-control emission rates. A CE of 8.97 percent[23] and an RP of 48.6 percent[24] were applied to reflect the Federal Rule for consumer products. There are no point sources associated with this category.

Each county's emissions are estimated per the sample calculations listed below.

SAMPLE VOC EMISSION CALCULATIONS:

$$Annual\ VOC\ Emissions = (EmissionFactor)(Population)\left(1-\frac{CE}{100}\cdot\frac{RP}{100}\cdot\frac{RE}{100}\right)$$

where:

Emission Factor = 1.36 *lb VOC/person/year*
Population = 1,227,066 persons (Allegheny County)
Control Efficiency = 8.97%
RP (Rule Penetration) = 48.6%
RE (Rule Effectiveness) = 100%

$$Annual\ VOC\ Emissions = \left(\frac{1.36\,lb VOC/person}{year}\right)(1{,}227{,}066\,persons)\left(1-\frac{8.97}{100}\cdot\frac{48.6}{100}\cdot\frac{100}{100}\right)$$

$$Annual\ VOC\ Emissions = 1{,}596{,}059.334\,lb\ per\ year\cdot\left(\frac{1\ ton}{2{,}000\ lb}\right) = 798.030\,tons\ VOC\ per\ year$$

[21] Eastern Research Group, "Emission Inventory Improvement Program, Document Series, Volume III, Nonpoint Sources, Chapter 5, Consumer and Commercial Solvent Use," Table 5.4-1, prepared for the Nonpoint Sources Committee, Emission Inventory Improvement Program, August 1996, available from http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html.
[22] U.S. Department of Commerce, Bureau of the Census, "Population Estimates: Datasets for all Geographies, CO-EST2011 - http://www.census.gov/popest/data/datasets.html. Prepared by the Pennsylvania State Data Center, released April 2012. http://pasdc.hbg.psu.edu/Data/Estimates/tabid/1012/Default.aspx.
[23] ERTAC Recommendation, Midwest RPO Inventory Comparability Project, revised June 2, 2009.
[24] E.H. Pechan & Associates, Inc., *Control Measure Development Support Analysis of Ozone Transport Commission Model Rules*, prepared for the Ozone Transport Commission, March 2001.

Coatings and Related Products (SCC 2460500000)

Aerosol spray paints and related products such as paint removers make up this consumer and commercial solvent product group. Other forms of coatings (besides aerosols) are not included in this group, but are included under architectural or industrial coatings, or autobody refinishing. Aerosols spray paints contain VOCs that function as both solvents and propellants. The most commonly used propellants in aerosol paints are propane, butane and isobutane.

Paint removers are classified as either application removers or immersion removers. Solvents such as methanol, ethanol and isopropanol are also used to enhance the action of the paint remover. Methylene chloride (53 percent) and methanol (41 percent) account for the majority of paint-removing solvents consumed (Frost & Sullivan, Inc., 1990).

County-level emissions were calculated using a per capita emission factor which was obtained from the Emission Inventory Improvement Program (EIIP)[25] and U.S. Bureau of the Census 2011 estimated population data.[26] The emission factor represents pre-control emission rates. There are no point sources associated with this category.

Each county's emissions are estimated per the sample calculations listed below.

SAMPLE VOC EMISSION CALCULATIONS:

$$Annual\ VOC\ Emissions = (EmissionFactor)(Population)$$

where:

Emission Factor = 0.95 *lb VOC/person/year*
Population = 1,227,066 persons (Allegheny County)

$$\text{Annual VOC Emissions} = \left(\frac{0.95\ \text{lb VOC} / \text{person}}{\text{year}}\right)(1{,}227{,}066\ \text{persons})$$

$$\text{Annual VOC Emissions} = 1{,}165{,}712.7\ \text{lb per year} \cdot \left(\frac{1\ \text{ton}}{2{,}000\ \text{lb}}\right) = 582.8564\ \text{tons VOC per year}$$

[25] Eastern Research Group, "Emission Inventory Improvement Program, Document Series, Volume III, Nonpoint Sources, Chapter 5, Consumer and Commercial Solvent Use," Table 5.4-1, prepared for the Nonpoint Sources Committee, Emission Inventory Improvement Program, August 1996, available from http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html.

[26] U.S. Department of Commerce, Bureau of the Census, "Population Estimates: Datasets for all Geographies, CO-EST2011 - http://www.census.gov/popest/data/datasets.html. Prepared by the Pennsylvania State Data Center, released April 2012. http://pasdc.hbg.psu.edu/Data/Estimates/tabid/1012/Default.aspx.

Cosmetics and Toiletries/Personal Care Products (SCC 2460100000)

Cosmetics and Toiletries (personal care products) include hair care products, deodorants and antiperspirants, perfumes, colognes, and nail care products. Ethanol and isopropanol are the primary solvents used in the formulation of these products. Each county's emissions were calculated using a per capita emission factor[27] which was obtained from ERTAC (Midwest RPO Inventory Comparability Project) and U.S. Bureau of the Census 2011 estimated population data.[28] A control efficiency of 12.11 percent[29] and a rule penetration of 48.6 percent[30] are applied in the 2011 inventory to reflect the Federal Rule for personal care products. There are no point sources associated with this category.

SAMPLE VOC EMISSION CALCULATIONS:

$$Annual\ VOC\ Emissions = (EmissionFactor)(Population)\left(1-\frac{CE}{100}\cdot\frac{RP}{100}\cdot\frac{RE}{100}\right)$$

where:

Emission Factor = 1.9 *lb VOC/person/year*
Population = 1,227,066 persons (Allegheny County)
Control Efficiency = 12.11%
RP (Rule Penetration) = 48.6%
RE (Rule Effectiveness) = 100%

$$Annual\ VOC\ Emissions = \left(\frac{1.9\ lb VOC\ /\ person}{year}\right)(1{,}227{,}066\ persons)\left(1-\frac{12.11}{100}\cdot\frac{48.6}{100}\cdot\frac{100}{100}\right)$$

$$Annual\ VOC\ Emissions = 2{,}194{,}210.291\ lb VOC per\ year\cdot\left(\frac{1\ ton}{2{,}000\ lb}\right) = 1097.1051\ tons\ VOC\ per\ year$$

Degreasing/Cleaning Products, Industrial and Institutional (SCC 2415000000)

Surface cleaning, also known as "degreasing," includes the solvent cleaning or conditioning of metal surfaces and parts, fabricated plastics, electronic and electrical components and other nonporous substrates. These cleaning processes are 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. Three basic types of surface cleaning operations are currently used: cold cleaning, vapor cleaning, and in-line or

[27] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[28] U.S. Department of Commerce, Bureau of the Census, "Population Estimates: Datasets for all Geographies, CO-EST2011 - http://www.census.gov/popest/data/datasets.html. Prepared by the Pennsylvania State Data Center, released April 2012. http://pasdc.hbg.psu.edu/Data/Estimates/tabid/1012/Default.aspx.
[29] ERTAC Recommendation, Midwest RPO Inventory Comparability Project, revised June 2, 2009.
[30] E.H. Pechan & Associates, Inc., *Control Measure Development Support Analysis of Ozone Transport Commission Model Rules*, prepared for the Ozone Transport Commission, March 2001.

conveyorized cleaning, which can be either a cold or vapor cleaning process. VOC emission results from the evaporation of solvents used in these processes.

Cold cleaning is a batch process in which solvents are applied at room temperature or slightly heated. Parts are immersed in a solvent, usually mineral spirits. Parts too large for immersion may be sprayed or wiped with a solvent. The primary cold cleaning application is cleaning of tools or metal parts at service and automotive repair stations and manufacturing facilities. Cold cleaning may incorporate covers or freeboards to limit the evaporative loss of solvents.

In-line cleaners use automated load systems (typically conveyors) to maintain a continuous feed to the cleaning unit. These units use both cold and vapor-cleaning methods as described above, with the majority formerly being halogenated solvent cleaning systems. These units are used for large-scale operations and are usually enclosed except to the conveyor inlet or exit. A common application of in-line cleaners is cleaning printed circuit boards for the electronic and electrical component industries.

Emissions for each county were estimated per the sample calculations below using an employment-based emission factor[31] and the number of 2010 employees in NAICS codes 331///, 332///, 333///, 334///, 335///, 336///, 337///, 339///, 441///, 483///, 484///, 485///, 488///, 8111// and 8112//. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATIONS:

Annual VOC Emissions = (Emission Factor)(Number of Employees)

where:

Emission Factor = 36.965 lb VOC/employee/year
Employees = 47,205(Allegheny County)

$$Annual\ VOC\ Emissions = \left(\frac{36.965\ lb VOC / employee}{year} \right) (47{,}205\ employees)$$

$$Annual\ VOC\ Emissions = 1{,}744{,}933\ lb\ VOC\ per\ year \cdot \frac{1\ ton}{2{,}000\ lb} = 872.47\ tons\ \text{VOC per year}$$

Point Source Subtraction for Allegheny County (2011 PADEP AIMS)

872.47 Tons VOC/year - 793.34 Tons VOC/year = 79.122 Tons/year

[31] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).

Factory Finished Wood (SCC 2401015000)

The VOC emissions from this source category result from the evaporation of the solvent used in the gluing and coating process. The emissions for each county were calculated using an employment-based emission factor[32] and employees numbers in NAICS codes 321XX.[33] The number of employees in each county was collected from County Business patterns and the adjusted employee numbers were provided by EPA, using employment midpoint and adjustment factors for any ranges obtained. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATIONS:

Annual VOC Emissions = (Emission Factor)(Number of Employees)

where:

Emission Factor = 48.07 lb VOC/employee/year
Employees =811 (Bradford County)[33]

Point Source Subtraction for Bradford County (2011 PADEP AIMs Point Source Inventory):

19.4923 Tons VOC/year – 170.7304 Ton VOC/year = 0 Tons/year = 0 lb HAPs/year

$$Annual\ VOC\ Emissions = \left(\frac{48.07\ lbVOC \,/\, employee}{year} \right) (811\ employees)$$

$$Annual\ VOC\ Emissions = 38{,}984.77\ pounds\ VOC\ per\ year \cdot \frac{1 ton}{2{,}000\ pounds} = 19.4923\ tons\ \text{VOC per year}$$

Federal Insecticide, Fungicide and Rodenticide Act Regulated Products (SCC 2460800000)

Pesticides defined by Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) include substances or mixtures that are used to prevent, destroy, repel, or mitigate pests, as well as substances used as plant regulators, defoliators, and desiccants. Consumer pesticides are used in the home and garden, as well as in commercial and governmental applications. Disinfectants and antimicrobial products are included. Household uses include pet care products, disinfectants and insecticides. All consumer and commercial pesticides contain VOCs. Aerosol and liquid sprays contain VOCs as solvents, usually ethanol and isobutane. Pesticides products can be grouped according to their target pest, but should also be grouped according to their form (solid, liquid or aerosol) when considering control measures.

[32] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[33] National, state and county level government employment data downloaded from US Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.

County-level emissions were calculated using a per capita emission factor which was obtained from the Emission Inventory Improvement Program (EIIP)[34] and U.S. Bureau of the Census 2011 estimated population data.[35] The emission factor represents pre-control emission rates. A CE of 20 percent[36] and an RP of 48.6 percent[37] were applied to reflect the Federal Rule for consumer products. There are no point sources associated with this category.

Each county's emissions are estimated per the sample calculations listed below.

SAMPLE VOC EMISSION CALCULATIONS:

$$Annual\ VOC\ Emissions = (EmissionFactor)(Population)\left(1-\frac{CE}{100}\cdot\frac{RP}{100}\cdot\frac{RE}{100}\right)$$

where:

Emission Factor = 1.78 lb per person/year
Population = 1,227,066 persons (Allegheny County)
Control Efficiency = 20%
RP (Rule Penetration) = 48.6%
RE (Rule Effectiveness) = 100%

$$Annual\ VOC\ Emissions = \left(\frac{1.78\,lbs\,VOC\,/\,person}{year}\right)(1{,}227{,}066\,persons)\left(1-\frac{20}{100}\cdot\frac{48.6}{100}\cdot\frac{100}{100}\right)$$

$$Annual\ VOC\ Emissions = 1{,}971{,}875.429\ pounds\ per\ year\cdot\left(\frac{1\ ton}{2{,}000\ lbs}\right) = 985.9377\ tons\ VOC\ per\ year$$

[34] Eastern Research Group, "Emission Inventory Improvement Program, Document Series, Volume III, Nonpoint Sources, Chapter 5, Consumer and Commercial Solvent Use," Table 5.4-1, prepared for the Nonpoint Sources Committee, Emission Inventory Improvement Program, August 1996, available from http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html.

[35] U.S. Department of Commerce, Bureau of the Census, "Population Estimates: Datasets for all Geographies, CO-EST2011 - http://www.census.gov/popest/data/datasets.html. Prepared by the Pennsylvania State Data Center, released April 2012. http://pasdc.hbg.psu.edu/Data/Estimates/tabid/1012/Default.aspx.

[36] 63 FR 48819, 1998: *Federal Register*, "National Volatile Organic Compound Emission Standards for Consumer Products, Final Rule," Volume 63, Number 176, September 11, 1998.

[37] E.H. Pechan & Associates, Inc., *Control Measure Development Support Analysis of Ozone Transport Commission Model Rules*, prepared for the Ozone Transport Commission, March 2001.

Fuel Combustion – Commercial/Institutional (8 SCCs: 2103001000, 2103002000, 2103004000, 2103005000, 2103006000, 2103007000, 2103008000 and 2103011000)

1. Source Category Description

This sub-sector covers emissions from fuel combustion at stationary non-point sources within the commercial/institutional sector. References are listed at the end of the Fuel Combustion - commercial/institutional section. The following are the fuel types that will be included in the inventory for the commercial/institutional non-point source sub-sector: anthracite coal, bituminous/sub-bituminous coal, distillate oil, residual oil, natural gas, LPG, wood, and kerosene. Motor gasoline is not included as a non-point source, because it is expected that all non-point gasoline combustion in this sector is included in the non-road inventory.

The approach to be used in calculating emissions for commercial/institutional fuel combustion is to first develop state-level fuel consumption estimates, then to allocate these to the county-level, and then to multiply the resulting county-level consumption estimates by appropriate emission factors.

There are additional types of energy that are consumed in the commercial/institutional sector: asphalt and road oil; feed-stocks, naphtha (less than 401°F); feed-stocks, other oils (greater than 401°F); lubricants; motor gasoline; miscellaneous petroleum products; pentanes plus; special naphthas; and waxes. With the exception of motor gasoline, all of these additional fossil fuels are not actually combusted (oxidized) but are used as chemical feed-stocks, construction materials, lubricants, solvents, or reducing agents. Therefore, there are no commercial/institutional sector combustion emissions from these fuel types. As described in more detail later, most of the fuel types that are included in the commercial/institutional combustion sector, also have a non-fuel use component. Therefore, it is necessary to exclude this component in calculating non-point source commercial/institutional fuel combustion activity/emissions. Motor gasoline is not inventoried as a non-point source because it is expected that gasoline combustion in this sector is included in the non-road inventory.

2. Source Classification and Activity Data

Table 2 displays the non-point SCCs associated with commercial/institutional fuel combustion and summarizes this sector's non-point source activity data, units, and data source. Total state-level commercial/institutional sector energy consumption data are available from the Energy Information Administration (EIA)'s State Energy Data System (SEDS), and were used for all source categories. Year 2010 SEDS data and 2009 Employee Allocation data were used to estimate 2011 emissions because these were the latest year consumption data available at the time this work was performed in 2012.

Table 6. Nonpoint Source Commercial/Institutional Fuel Combustion Activity Data

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Activity	Activity Data Source
2103001000	Stationary Source Fuel Combustion	Commercial/ Institutional	Anthracite Coal	Total: All Boiler Types	Thousand short tons of coal consumed	EIA's SEDS[a]
2103002000	Stationary Source Fuel Combustion	Commercial/ Institutional	Bituminous/ Sub-bituminous Coal	Total: All Boiler Types	Thousand short tons of coal consumed	EIA's SEDS[a]
2103004000	Stationary Source Fuel Combustion	Commercial/ Institutional	Distillate Oil	Total: All Boiler Types	Thousand barrels of distillate oil consumed	EIA's SEDs
2103005000	Stationary Source Fuel Combustion	Commercial/ Institutional	Residual Oil	Total: All Boiler Types	Thousand barrels of residual oil consumed	EIA's SEDs
2103006000	Stationary Source Fuel Combustion	Commercial/ Institutional	Natural Gas	Total: All Boiler Types	Million cubic feet of natural gas consumed	EIA's SEDs
2103007000	Stationary Source Fuel Combustion	Commercial/ Institutional	Liquefied Petroleum Gas (LPG)	Total: All Combustor Types	Thousand barrels of LPG consumed	EIA's SEDs
2103008000	Stationary Source Fuel Combustion	Commercial/ Institutional	Wood	Total: All Boiler Types	Billion Btu of wood consumed	EIA's SEDs
2103011000	Stationary Source Fuel Combustion	Commercial/ Institutional	Kerosene	Total: All Combustor Types	Thousand barrels of kerosene consumed	EIA's SEDs

[a] With feedstock adjustments that are described in the text of this section.

3. Non-Fuel Use Energy Adjustment

Some commercial/institutional sector energy is consumed for non-fuel purposes (feedstocks). For example, natural gas is used as a feedstock in chemical manufacturing plants and to make nitrogenous fertilizer, and LPG is used to create intermediate products that are made into plastics. To estimate the volume of fuel that is associated with commercial/institutional combustion, it is necessary to subtract the volume of fuel consumption for non-energy uses (feedstocks) from the volume of total fuel consumption. EIA's 2006 *Manufacturing Energy Consumption Survey* (MECS) was utilized for each type of commercial/institutional sector energy consumed in 2010.

4. Point Source Energy Adjustment

Because the point source inventory also includes commercial/institutional fuel combustion source categories, it is necessary to subtract point source inventory fuel use from the SEDS commercial/institutional fuel consumption estimates. Table 3, on the following page, displays the crosswalk between commercial/institutional fuel combustion non-point SCCs and associated point source SCCs that PA used in the subtraction procedure. The subtractions were performed after summing the point source throughput estimates to the state-level.

Table 7. Point Source Subtraction SCCs Relevant to Nonpoint Source Commercial/Institutional Fuel Combustion

SCC	SCC Level 1	SCC Level 2	SCC Level 3 (Fuel - If Not Specified at Level 3)
2103001000 & 2103002000 – Commercial/Institutional; Anthracite Coal; Total: All Boiler Types and Bituminous/Sub-bituminous Coal; Total: All Boiler Types			
103002xx	External Combustion Boilers	Commercial/Institutional	Bituminous/Sub-bituminous Coal
10500202	External Combustion Boilers	Space Heaters	Commercial/Institutional (Coal)
50190002	Waste Disposal	Solid Waste Disposal - Government	Auxiliary Fuel/No Emissions (Coal)
50290002	Waste Disposal	Solid Waste Disposal - Commercial/Institutional	Auxiliary Fuel/No Emissions (Coal)
2103004000 – Commercial/Institutional; Distillate Oil; Total: Boilers and IC Engines			
103005xx	External Combustion Boilers	Commercial/Institutional	Distillate Oil
10500205	External Combustion Boilers	Space Heaters	Commercial/Institutional (Distillate Oil)
50190005	Waste Disposal	Solid Waste Disposal - Government	Auxiliary Fuel/No Emissions (Distillate Oil)
50290005	Waste Disposal	Solid Waste Disposal - Commercial/Institutional	Auxiliary Fuel/No Emissions (Distillate Oil)
2103005000 – Commercial/Institutional; Residual Oil; Total: All Boiler Types			
103004xx	External Combustion Boilers	Commercial/Institutional	Residual Oil
2103006000 – Commercial/Institutional; Natural Gas; Total: Boilers and IC Engines			
103006xx	External Combustion Boilers	Commercial/Institutional	Natural Gas
10500206	External Combustion Boilers	Space Heaters	Commercial/Institutional (Natural Gas)
203002xx	Internal Combustion Engines	Commercial/Institutional	Natural Gas
50190006	Waste Disposal	Solid Waste Disposal - Government	Auxiliary Fuel/No Emissions (Natural Gas)
50290006	Waste Disposal	Solid Waste Disposal - Commercial/Institutional	Auxiliary Fuel/No Emissions (Natural Gas)
2103007000 – Commercial/Institutional; Liquid Petroleum Gas; Total: All Combustor Types			
103010xx	External Combustion Boilers	Commercial/Institutional	Liquefied Petroleum Gas (LPG)
10500210	External Combustion Boilers	Space Heaters	Commercial/Institutional (LPG)
203010xx	Internal Combustion Engines	Commercial/Institutional	Liquefied Petroleum Gas (LPG)
50190010	Waste Disposal	Solid Waste Disposal - Government	Auxiliary Fuel/No Emissions (LPG)
50290010	Waste Disposal	Solid Waste Disposal - Commercial/Institutional	Auxiliary Fuel/No Emissions (LPG)
2103008000 – Commercial/Institutional; Wood; Total: All Boiler Types			
103009xx	External Combustion Boilers	Commercial/Institutional	Wood/Bark Waste
10500209	External Combustion Boilers	Space Heaters	Commercial/Institutional (Wood)
2103011000 – Commercial/Institutional; Kerosene; Total: All Combustor Types			
203009xx	Internal Combustion Engines	Commercial/Institutional	Kerosene/Naphtha (Jet Fuel)
50100603	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting (Kerosene)

5. County Allocation of State Activity Data

Year 2011 county-level activity estimates were developed by allocating the state-level activity resulting from the adjustments to the SEDS data described above. The EPA compiled 2011 estimates of commercial/institutional sector (NAICS codes 42 through 81) employment from the Bureau of Census' *County Business Patterns 2009* for use in this procedure (Census, 2009). A separate document describes how withheld *County Business Patterns* employment data were estimated (Divita, 2008). The EPA also added 2011 county-level estimates of institutional sector (NAICS code 92) employment from 2007 local government employment data in the 2007 *Census of Governments.* State-level commercial/institutional fuel combustion by fuel type was allocated to each county using the ratio of the number of commercial/institutional sector employees in each county to the total number of commercial/institutional sector employees in the state.

6. Emission Factors

The EPA has compiled criteria and hazardous air pollutant emission factors for non-point source commercial/institutional fuel combustion categories (Huntley, 2009). These emission factors, which are too numerous to list here, are included in a spreadsheet within the ICI fuel combustion workbook.[38] In most cases, these are the same emission factors that were used in preparing the 2008 non-point source NEI (Pechan, 2006).

7. Fuel-Specific Activity Data Adjustments

A. Coal

Because anthracite is mined in the eastern half of the Commonwealth, while bituminous is mined in the western half, the emission calculations assume that eastern counties burn anthracite coal, while western counties burn bituminous coal.

However, Nonpoint Coal Consumption was calculated to be zero tons after point subtraction. This was found by taking the total 2010 SEDs Pennsylvania Commercial/Institutional Coal Consumption (anthracite plus bituminous) and subtracting the 2011PADEP AIMs reported point source Commercial/Institutional Coal usage. This resulted in the category of total Nonpoint Coal Usage being zeroed out.

[38] Documentation for the Draft 2002 Nonpoint Source National Emission Inventory for Criteria and Hazardous Air Pollutants (March 2005 Version), Appendix A, E.H. Pechan and Associates Inc., March 2005.

1) Commercial/Institutional Coal Combustion

$$Annual\ \ Emissions = (Pollutant\ \ Emission\ Factor)(Coal\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.3 lb/ton anthracite coal/year; 0.05 lb/ton bituminous coal/year
NO_X Emission Factor = 9 lb/ton anthracite coal/year; 11 lb/ton bituminous coal/year
CO Emission Factor = 0.6 lb/ton anthracite coal/year; 5.0 lb/ton bituminous coal/year
Pb Emission Factor = 0.00042 lb/ton anthracite coal/year and bituminous coal/year
SO_2 Emission Factor =34.71 lb/ton anthracite coal/year; 35.34 lbs/ton bituminous coal/year
PM10-FIL Emission Factor = 14.718 lb/ton anthracite coal/year; 12 lb/ton bituminous coal/year
PM25-FIL Emission Factor = 6.4224 lb/ton anthracite coal/year; 1.4 lb/ton bituminous coal/year
PM-CON Emission Factor = 1.0704 lb/ton anthracite coal/year; 1.04 lb/ton bituminous coal/year

Commercial/Institutional Anthracite Coal Sulfur Content = 0.89%
Commercial/Institutional Bituminous Coal Sulfur Content = 0.93%
Commercial/Institutional Anthracite Coal Ash Content = 13.38% ash

where:
Number of Commercial County Employees (Allegheny County) = 634,225
Number of Pennsylvania's Commercial Employees = 4,529,604

Pennsylvania Commercial/Institutional Coal Consumption = 151,590 tons (SEDs) - 162,272.5 tons (Point Source) = 0.00 tons (Nonpoint)

<u>NO_X Emissions</u>:

$$Annual\ \ NOX\ Emissions = \frac{11\ lbs\ \ NOx \Big/ \text{ton bituminous coal}}{year} \cdot 0\ tons \cdot \frac{634{,}225\ employees\ \ in\ \ county}{4{,}529{,}604\ employees\ \ in\ \ state}$$

$$Annual\ \ NOX\ Emissions = 0 lb\ NOx\ per\ year \cdot \frac{1 ton}{2{,}000\ lb} = 0\ tons\ \ NOx\ per\ year$$

B. Distillate Oil, Residual Oil and LPG

2010 SEDS Commercial/Institutional sector distillate oil and LPG consumption data (after feedstock subtraction) was point subtracted using 2011 PA DEP Commercial/Institutional AIMs reported point source consumptions. 2009 State and county employee allocations were used, since this data was the most recent provided by the US Census, County Business Pattern. Due to percent feedstock considerations, total distillate oil consumption will be 23 percent less than that reported in 2008.

1) Commercial/Institutional Distillate Oil Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(Oil\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.34 lb/1,000 gal. distillate oil/year
NO_X Emission Factor = 20 lb/1,000 gal. distillate oil/year
CO Emission Factor = 5.0 lb/1,000 gal. distillate oil/year
Pb Emission Factor = 0.00126 lb/1,000 gal. distillate oil/year
SO_2 Emission Factor = 42.6 lb/1,000 gal. distillate oil/year
PM10-FIL Emission Factor = 1.08 lb/1,000 gal. distillate oil/year
PM25-FIL Emission Factor = 0.83 lb/1,000 gal. distillate oil/year
PM-CON Emission Factor = 1.3 lb/1,000 gal. distillate oil/year
NH3 Emission Factor = 0.8 lb/1,000 gal. distillate oil/year

where:

Number of Allegheny County Commercial Employees = 634,225
Number of Pennsylvania Commercial Employees = 4,529,604

Pennsylvania Commercial/Institutional Distillate Oil Consumption = 1,922,286 barrels = 80,736.01 thous. gal. (SEDs) – 8,907.54 thous. gal. (Point Source) = 71,828.46 thous. gal. (Nonpoint)

<u>NOx Emissions</u>:

$$Annual\ \ NO2\ Emissions = \frac{20\ lbs\ \ NO2 \Big/ 1{,}000\ gallons}{year} \cdot 71{,}828.46\ thousgallons \cdot \frac{634{,}225\ employees\ \ in\ \ county}{4{,}526{,}604\ employees\ \ in\ \ state}$$

$$Annual\ \ NO\ Emissions = 201{,}278.5\ lb\ NO2\ per\ year \cdot \frac{1\ ton}{2{,}000\ lb} = 100.6393\ tons\ \ NO2\ per\ year$$

2) Commercial/Institutional Residual Oil Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(Oil\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 1.13 lb/1,000 gal. residual oil/year
NO_X Emission Factor = 55 lb/1,000 gal. residual oil/year
CO Emission Factor = 5.0 lb/1,000 gal. residual oil/year
Pb Emission Factor = 0.00165 lb/1,000 gal. residual oil/year
SO_2 Emission Factor = 353.25 lb/1,000 gal. residual oil/year
PM_{10}-FIL Emission Factor = 14.9413 lb/1,000 gal. residual oil/year
$PM_{2.5}$-FIL Emission Factor = 5.5488 lb/1,000 gal. residual oil/year
PM-CON Emission Factor = 1.5 lb/1,000 gal. residual oil/year
NH_3 Emission Factor = 0.8 lb/1,000 gal. residual oil/year

where:

Number of Commercial/Institutional County Employees (Allegheny County) = 634,225
Number of Pennsylvania Commercial/Institutional Employees = 4,529,604

Pennsylvania Commercial/Institutional Residual Consumption = 287,000 barrels = 4,578,000 thousand gal. (SEDs) – 256,640 thousand gal. (Point Source) = 4,321.36 thousand gal. (Nonpoint)

<u>VOC Emissions</u>:

$$Annual\ VOC\ Emissions = \frac{1.13\ lb\,VOC \,/\, 1000\,gal\,\text{Res.oil}}{year} \cdot 4{,}321.36 \frac{634{,}225\ employees\ \ in\ \ county}{4{,}529{,}604\ employees\ \ in\ \ state}$$

$$Annual\ VOC\ Emissions = 683.7259 lb\,VOC\ per\ year \cdot \frac{1 ton}{2{,}000\ lb} = 0.34186\ tons\ VOC\ per\ year$$

3) Commercial/Institutional LPG Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(LPG\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.5 lb/1,000 gal. LPG/year
NO_X Emission Factor = 14.23 lb/1,000 gal. LPG/year
CO Emission Factor = 7.97 lb/1,000 gal. LPG/year
Pb Emission Factor = 4.34905E-5 lb/1,000 gal. LPG/year
SO_2 Emission Factor = 0.06 lb/1,000 gal. LPG/year
PM10-FIL Emission Factor = 0.02 lb/1,000 gal. LPG/year
PM25-FIL Emission Factor = 0.01 lb/1,000 gal. LPG/year
PM-CON Emission Factor = 0.03 lb/1,000 gal. LPG/year

where:

Number of Allegheny County Industrial Employees = 634,225
Number of Pennsylvania Industrial Employees = 4,529,604

Pennsylvania Commercial/Institutional LPG Consumption
= 38,294,000 thousand gal. (SEDs) – 36,010 thousand gal. (Point Source)
= 38,257.99 thousand gal. (Nonpoint)

<u>VOC Emissions</u>:

$$Annual\ VOC\ Emissions = \frac{0.52 lb\ VOC \Big/ 1{,}000 GAL}{year} \cdot 38{,}257.990 GAL \cdot \frac{634{,}225 employees\ in\ county}{4{,}529{,}604\ employees\ in\ state}$$

$$Annual\ VOC\ Emissions = 2{,}785.67 lb\ VOC\ per\ year \cdot \frac{1 ton}{2{,}000\ lb} = 1.3928 tons\ VOC\ per\ year$$

4) Commercial/Institutional Natural Gas Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(NG\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 5.5 lb/million cubic feet (MMCF) natural gas/year
NO_X Emission Factor = 100 lb/MMCF natural gas/year
CO Emission Factor = 84 lb/MMCF natural gas/year
Pb Emission Factor =0 .0005 lb/MMCF natural gas/year
SO_2 Emission Factor = 0.6 lb/MMCF natural gas/year
PM10-FIL Emission Factor = 0.2 lb/MMCF natural gas/year
PM25-FIL Emission Factor = 0.11 lb/MMCF natural gas/year
PM-CON Emission Factor = 0.32 lb/MMCF natural gas/year

where:

Number of Allegheny County Commercial Employees = 634,225
Number of Pennsylvania Commercial Employees = 4,529,604

Pennsylvania Commercial/Institutional NG Consumption
= 141,077 MMCF (SEDs) – 25,039.49 MMCF (Point Source)
= 116,037.51 MMCF (Nonpoint)

<u>CO Emissions</u>:

$$Annual\ \ CO\ Emissions = \frac{84\ lbs\ CO \big/ MMCFNG}{year} \cdot 116{,}038 MMCFNG \cdot \frac{634{,}225\ employees\ in\ count}{4{,}529{,}604 employees\ in\ state}$$

$$Annual\ \ CO\ Emissions = 1{,}364779.98 lb\ CO\ per\ year \cdot \frac{1 ton}{2{,}000\ lbs} = 682.39\ tons\ CO\ per\ year$$

5) Commercial/Institutional Wood Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(Wood\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.017 lb/MMBTU Wood/year
NO_X Emission Factor = 0.22 lb/MMBTU Wood/year
CO Emission Factor = 0.6 lb/MMBTU Wood/year
SO_2 Emission Factor = 0.025 lb/MMBTU Wood/year
PM_{10}-FIL Emission Factor = 0.5 lb/MMBTU Wood/year
$PM_{2.5}$-FIL Emission Factor = 0.43 lb/MMBTU Wood/year
PM-CON Emission Factor = 0.017 lb/MMBTU Wood/year
NH_3 Emission Factor = 0.005 lb/MMBTU Wood/year
CH_4-FIL Emission Factor = 0.021 lb/MMBTU Wood/year
CO_2 Emission Factor = 195 lb/MMBTU Wood/year

where:

Number of Allegheny County Industrial Employees = 634,255
Number of Pennsylvania Industrial Employees = 4,529,604

Pennsylvania Commercial/Institutional Wood Consumption
= 2,527,000 MMBTU (SEDs) -106,080 MMBTU (Point Source)
= 2,420,920 MMBTU (Nonpoint)

<u>CO_2 Emissions</u>:

$$Annual\ \ CO_2\ Emissions = \frac{195\ lbs CO_2 / MMBTU}{year} \cdot 2{,}420{,}920 MMBTU \cdot \frac{634{,}225\ employees\ \ in\ \ county}{4{,}529{,}604\ employees\ \ in\ \ state}$$

$$Annual\ \ CO_2\ Emissions = 66{,}099{,}499.5 lb\ CO_2\ per\ year \cdot \frac{1 ton}{2000\ lbs} = 33{,}049.7\ tons\ CO_2\ per\ year$$

6) Commercial/Institutional Kerosene Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(Kerosene\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.3278571 lb/1,000 gal. Kerosene/year
NO_X Emission Factor = 19.28572 lb/1,000 gal. Kerosene/year
CO Emission Factor = 4.821429 lb/1,000 gal. Kerosene/year
Pb Emission Factor = 0.001215 lb/1,000 gal. Kerosene/year
SO_2 Emission Factor = 42.6 lb/1,000 gal. Kerosene/year
PM_{10}-FIL Emission Factor = 1.041429 lb/1,000 gal. Kerosene/year
$PM_{2.5}$-FIL Emission Factor = 0.8003572 lb/1,000 gal. Kerosene/year
PM-CON Emission Factor = 1.25 lb/1,000 gal. Kerosene/year

where:

Number of Allegheny County Industrial Employees = 634,255
Number of Pennsylvania Industrial Employees = 4,529,604
Pennsylvania Commercial/Institutional Kerosene Consumption = 133,000 barrels
= 5,586,000 gallons (SEDs) - 2,840 gallons(Point Source)
= 5,583,160 gallons(Nonpoint)

<u>SO_2 Emissions</u>:

$$Annual\ \ SO_2\ Emissions = \frac{42.6\ lbs\ \ SO_2 \big/ 1{,}000\ gal}{year} \cdot 5{,}583{,}200\ gal \cdot \frac{634{,}225\ employees\ \ in\ \ county}{4{,}529{,}604\ employees\ \ in\ \ state}$$

$$Annual\ \ SO_2\ Emissions = 33{,}302.9\ lb\ SO_2\ \ per\ year \cdot \frac{1\ ton}{2{,}000\ lbs} = 16.65\ tons\ \ SO_2\ \ per\ year$$

8. Additional References for Fuel Combustion – Commercial/Institutional

1. National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA. 2007 Employee allocations: http://www.census.gov/govs/cog/historical_data_2007.html and County Business Patterns, 2009 State Data File: http://www.census.gov/econ/cbp/download/09_data/index.html.

2. Divita, 2008: Divita, Frank, E.H. Pechan & Associates, Inc., memorandum to Roy Huntley, U.S. Environmental Protection Agency, "County Business Patterns Calculations," December 4, 2008.

3. EIA, 2010a: Energy Information Administration, U.S. Department of Energy, *State Energy Data System – Consumption, Physical Units, 1960-2010,* available from *http://www.eia.gov/state/seds/seds-data-complete.cfm*, released in 2012.

4. Energy Information Administration, U.S. Department of Energy, *2006 Manufacturing Energy Consumption Survey*, U.S. Department of Energy, Energy Information Administration, accessed from: *http://www.eia.gov/emeu/mecs/mecs2006/2006tables.html*. Released, Nov. 2009.

5. EIA, 2007b: Energy Information Administration, US Department of Energy, *Documentation for Emissions of Greenhouse Gases in the United States 2005*, DOE/EIA-0638 (2005), October 2007.

6. Percent sulfur content of coal from EIA's "Quarterly Coal Report, October-December 2009" (Tables 43 and 44), *http://205.254.135.7/coal/production/quarterly/archive/0121094q.pdf*. Provided at Emissions Inventories Clearinghouse Technology Transfer Network, U.S. EPA.

7. Huntley, 2009: Huntley, Roy, U.S. Environmental Protection Agency, "SCCs & emission factors to be used in 2008 NEI to Bollman May 1 2009.mdb [electronic file]."

8. Pechan, 2009b: E.H. Pechan & Associates, Inc., "Evaluation of ICI Combustion Coal Sulfur Content, Technical Memorandum," prepared for Central Regional Air Planning Association, March 28, 2009.

9. Pechan, 2006: E.H. Pechan & Associates, Inc. "Documentation for the Final 2002 Non-point Sector (Feb 06 Version) National Emission Inventory for Criteria and Hazardous Air Pollutants," prepared for U.S. Environmental Protection Agency, July 2006.

Fuel Combustion – Industrial (8 SCCs: 2102001000, 2102002000, 2102004000, 2102005000, 2102006000, 2102007000, 2102008000 and 2102011000)

1. Source Category Description

This sub-sector covers emissions from fuel combustion at stationary non-point sources within the industrial sector (i.e., sources that are not reported in the point source inventory because their emissions are too small). References are listed at the end of the Fuel Combustion - Industrial section. Industrial fuel combustion emissions will be computed for the following fuel types: anthracite coal, bituminous/sub-bituminous coal, distillate oil, residual oil, natural gas, LPG, wood, and kerosene.

The approach to be used in calculating emissions for industrial fuel combustion is to first develop state-level fuel consumption estimates, then to allocate these to the county-level, and then to multiply the resulting county-level consumption estimates by appropriate emission factors.

There are additional types of energy that are consumed in the industrial sector: asphalt and road oil; feed-stocks, naphtha (less than 401°F); feed-stocks, other oils (greater than 401°F); lubricants; motor gasoline; miscellaneous petroleum products; pentanes plus; special naphthas; and waxes. With the exception of motor gasoline, all of these additional fossil fuels are not actually combusted (oxidized) but are used as chemical feed-stocks, construction materials, lubricants, solvents, or reducing agents. Therefore, there are no industrial sector combustion emissions from these fuel types. As described in more detail later, 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 non-point source industrial fuel combustion activity/emissions. Motor gasoline is not inventoried as a non-point source because it is expected that gasoline combustion in this sector is included in the non-road inventory.

2. Source Classification and Activity Data

Table 4 displays the non-point SCCs associated with industrial fuel combustion and summarizes this sector's non-point source activity data, units, and data source. Total state-level industrial sector energy consumption data are available from the Energy Information Administration (EIA)'s State Energy Data System (SEDS), and were used for all source categories. Year 2010 SEDS data and 2009 Employee Allocation data were used to estimate 2011 emissions because these were the latest year consumption data available at the time this work was performed in 2012.

Table 8. Nonpoint Source Industrial Fuel Combustion Activity Data

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Activity	Activity Data Source
2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types	Thousand short tons of coal consumed	EIA's SEDS[a]
2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/ Sub-bituminous Coal	Total: All Boiler Types	Thousand short tons of coal consumed	EIA's SEDS[a]
2102004000	Stationary Source Fuel Combustion	Industrial	Distillate Oil	Total: Boilers and IC Engines	Thousand gallons of distillate oil consumed	EIS's SEDs
2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types	Thousand gallons of residual oil consumed	EIS's SEDs
2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines	Million cubic feet of natural gas consumed	EIS's SEDs
2102007000	Stationary Source Fuel Combustion	Industrial	Liquefied Petroleum Gas (LPG)	Total: All Boiler Types	Thousand gallons of LPG consumed	EIS's SEDs
2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types	Billion Btu of wood consumed	EIS's SEDs
2102011000	Stationary Source Fuel Combustion	Industrial	Kerosene	Total: All Boiler Types	Thousand gallons of kerosene consumed	EIS's SEDs

[a] With feedstock adjustments that are described in the text of this section.

3. Non-Fuel Use Energy Adjustment

Some industrial sector energy is consumed for non-fuel purposes (feedstocks). For example, natural gas is used as a feedstock in chemical manufacturing plants and to make nitrogenous fertilizer, and LPG is used to create intermediate products that are made into 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 (feedstocks) from the volume of total fuel consumption. EIA's 2006 *Manufacturing Energy Consumption Survey* (MECS) was utilized for each type of industrial sector energy consumed in 2010.

4. Point Source Energy Adjustment

Because the point source inventory also includes industrial fuel combustion categories, it is necessary to subtract point source inventory fuel use from the SEDs industrial fuel consumption estimates. Table 5 displays a crosswalk between industrial fuel combustion non-point SCCs and associated point SCCs that PA used in the subtraction procedure.[39] The subtractions were performed after summing the point source throughput estimates to the state-level.

Table 9. Point Source Subtraction SCCs Relevant to Nonpoint Source Industrial Fuel Combustion

SCC	SCC Level 1	SCC Level 2	SCC Level 3 (Fuel – If Not Specified at Level 3)
2102001000 & 2102002000 – Industrial; Anthracite & Bituminous/Sub-bituminous Coal; Total: All Boiler Types			
102002xx	External Combustion Boilers	Industrial	Bituminous/Sub-bituminous Coal
10500102	External Combustion Boilers	Space Heaters	Industrial (Coal)
390002xx	Industrial Processes	In-Process Fuel Use	Bituminous Coal
50390002	Waste Disposal	Solid Waste Disposal – Industrial	Auxiliary Fuel/No Emissions (Coal)
2102004000 – Industrial; Distillate Oil; Total: All Boilers and IC Engines			
102005xx	External Combustion Boilers	Industrial	Distillate Oil
10201403	External Combustion Boilers	Industrial	CO Boiler (Distillate Oil)
10500105	External Combustion Boilers	Space Heaters	Industrial (Distillate Oil)
202001xx	Internal Combustion Engines	Industrial	Distillate Oil (Diesel)
20200401	Internal Combustion Engines	Industrial	Large Bore Engine (Diesel)
20200405	Internal Combustion Engines	Industrial	Crankcase Blowby (Diesel)
20200406	Internal Combustion Engines	Industrial	Evaporative Losses (Fuel Storage and Delivery System) (Diesel)
20200407	Internal Combustion Engines	Industrial	Exhaust (Diesel)
27000320	Internal Combustion Engines	Off-Highway Diesel Engines	Industrial Equipment

[39] As noted in a footnote to Table 2, it is important to exclude any natural gas pipeline fuel use from the point source subtraction procedure because SEDS includes such use in the Transportation sector rather than the Industrial sector.

SCC	SCC Level 1	SCC Level 2	SCC Level 3 (Fuel – If Not Specified at Level 3)
30190001	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Distillate Oil)
30190011	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Distillate Oil)
30190021	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Distillate Oil)
30290001	Industrial Processes	Food and Agriculture	Fuel Fired Equipment (Distillate Oil)
30390001	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Distillate Oil)
30390011	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Distillate Oil)
30390021	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Distillate Oil)
30400406	Industrial Processes	Secondary Metal Production	Lead (Distillate Oil)
30490001	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Distillate Oil)
30490011	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Distillate Oil)
30490021	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Distillate Oil)
30490031	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Distillate Oil)
30500208	Industrial Processes	Mineral Products	Asphalt Concrete (Distillate Oil)
30505022	Industrial Processes	Mineral Products	Asphalt Processing (Blowing) (Distillate Oil)
30590001	Industrial Processes	Mineral Products	Fuel Fired Equipment (Distillate Oil)
30590011	Industrial Processes	Mineral Products	Fuel Fired Equipment (Distillate Oil)
30590021	Industrial Processes	Mineral Products	Fuel Fired Equipment (Distillate Oil)
30600901	Industrial Processes	Petroleum Industry	Flares (Distillate Oil)
30609901	Industrial Processes	Petroleum Industry	Incinerators (Distillate Oil)
30790001	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Distillate Oil)
30790011	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Distillate Oil)
30790021	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Distillate Oil)
30890001	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Distillate Oil)
30890011	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Distillate Oil)
30890021	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Distillate Oil)
30990001	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment (Distillate Oil)
30990011	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment (Distillate Oil)
31000401	Industrial Processes	Oil and Gas Production	Process Heaters (Distillate Oil)
31000411	Industrial Processes	Oil and Gas Production	Process Heaters (Distillate Oil)
31390001	Industrial Processes	Electrical Equipment	Process Heaters (Distillate Oil)
390005xx	Industrial Processes	In-Process Fuel Use	Distillate Oil
39900501	Industrial Processes	Miscellaneous Manufacturing Industries	Process Heater/Furnace (Distillate Oil)
39990001	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Distillate Oil)
39990011	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Distillate Oil)
39990021	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Distillate Oil)
40201002	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven Heater (Distillate Oil)
40290011	Petroleum and Solvent Evaporation	Surface Coating Operations	Fuel Fired Equipment (Distillate Oil)
49090011	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment (Distillate Oil)

SCC	SCC Level 1	SCC Level 2	SCC Level 3 (Fuel – If Not Specified at Level 3)
49090021	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment (Distillate Oil)
50390005	Waste Disposal	Solid Waste Disposal – Industrial	Auxiliary Fuel/No Emissions (Distillate Oil)
2102005000 – Industrial; Residual Oil; Total: All Boiler Types			
102004xx	External Combustion Boilers	Industrial	Residual Oil
10201404	External Combustion Boilers	Industrial	CO Boiler (Residual Oil)
202005xx	Internal Combustion Boilers	Industrial	Residual/Crude Oil
30190002	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Residual Oil)
30190012	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Residual Oil)
30190022	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Residual Oil)
30290002	Industrial Processes	Food and Agriculture	Fuel Fired Equipment (Residual Oil)
30390002	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Residual Oil)
30390012	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Residual Oil)
30390022	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Residual Oil)
30490002	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Residual Oil)
30490012	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Residual Oil)
30490022	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Residual Oil)
30490032	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Residual Oil)
30500207	Industrial Processes	Mineral Products	Asphalt Concrete (Residual Oil)
30505021	Industrial Processes	Mineral Products	Asphalt Processing (Blowing) (Residual Oil)
30590002	Industrial Processes	Mineral Products	Fuel Fired Equipment (Residual Oil)
30590012	Industrial Processes	Mineral Products	Fuel Fired Equipment (Residual Oil)
30600111	Industrial Processes	Petroleum Industry	Process Heaters (Residual Oil)
30600902	Industrial Processes	Petroleum Industry	Flares (Residual Oil)
30609902	Industrial Processes	Petroleum Industry	Incinerators (Residual Oil)
30790002	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Residual Oil)
30790012	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Residual Oil)
30790022	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Residual Oil)
30890002	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Residual Oil)
30890012	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Residual Oil)
30890022	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Residual Oil)
30990002	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment (Residual Oil)
30990012	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment (Residual Oil)
31000402	Industrial Processes	Oil and Gas Production	Process Heaters (Residual Oil)
31000412	Industrial Processes	Oil and Gas Production	Process Heaters (Residual Oil)
31390002	Industrial Processes	Electrical Equipment	Process Heaters (Residual Oil)
390004xx	Industrial Processes	In-Process Fuel Use	Residual Oil
39990002	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Residual Oil)
39990012	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Residual Oil)

SCC	SCC Level 1	SCC Level 2	SCC Level 3 (Fuel – If Not Specified at Level 3)
39990022	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Residual Oil)
40201003	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven Heater (Residual Oil)
40290012	Petroleum and Solvent Evaporation	Surface Coating Operations	Fuel Fired Equipment (Residual Oil)
49090012	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment (Residual Oil)
49090022	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment (Residual Oil)
2102006000 – Industrial; Natural Gas; Total: Boilers and IC Engines			
102006xx	External Combustion Boilers	Industrial	Natural Gas
10201401	External Combustion Boilers	Industrial	CO Boiler (Natural Gas)
10500106	External Combustion Boilers	Space Heaters	Commercial/Institutional (Natural Gas)
202002xx[a]	Internal Combustion Engines	Industrial	Natural Gas
30190003	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Natural Gas)
30190013	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Natural Gas)
30190023	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment (Natural Gas)
30290003	Industrial Processes	Food and Agriculture	Fuel Fired Equipment (Natural Gas)
30291001	Industrial Processes	Food and Agriculture	Fuel Fired Equipment (Natural Gas)
30390003	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Natural Gas)
30390013	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Natural Gas)
30390023	Industrial Processes	Primary Metal Production	Fuel Fired Equipment (Natural Gas)
30400407	Industrial Processes	Secondary Metal Production	Lead (Natural Gas)
30490003	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Natural Gas)
30490013	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Natural Gas)
30490023	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Natural Gas)
30490033	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Natural Gas)
30500206	Industrial Processes	Mineral Products	Asphalt Concrete (Natural Gas)
30505020	Industrial Processes	Mineral Products	Asphalt Processing (Blowing) (Natural Gas)
30590003	Industrial Processes	Mineral Products	Fuel Fired Equipment (Natural Gas)
30590013	Industrial Processes	Mineral Products	Fuel Fired Equipment (Natural Gas)
30590023	Industrial Processes	Mineral Products	Fuel Fired Equipment (Natural Gas)
30600105	Industrial Processes	Petroleum Industry	Process Heaters (Natural Gas)
30600903	Industrial Processes	Petroleum Industry	Flares (Natural Gas)
30602401	Industrial Processes	Petroleum Industry	Reciprocating Engine Compressors (Natural Gas)
30609903	Industrial Processes	Petroleum Industry	Incinerators (Natural Gas)
30622003	Industrial Processes	Petroleum Industry	Underground Storage and Other Remediation: Soil: Natural Gas
30622403	Industrial Processes	Petroleum Industry	Underground Storage and Other Remediation: Air Stripping: Natural Gas
30790003	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Natural Gas)
30790013	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Natural Gas)
30790023	Industrial Processes	Pulp and Paper and Wood Products	Fuel Fired Equipment (Natural Gas)
30890003	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Natural Gas)
30890013	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Natural Gas)

SCC	SCC Level 1	SCC Level 2	SCC Level 3 (Fuel – If Not Specified at Level 3)
30890023	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (Natural Gas)
30990003	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment (Natural Gas)
30990013	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment (Natural Gas)
30990023	Industrial Processes	Fabricated Metal Products	Fuel Fired Equipment (Natural Gas)
31000404	Industrial Processes	Oil and Gas Production	Process Heaters (Natural Gas)
31000414	Industrial Processes	Oil and Gas Production	Process Heaters (Natural Gas)
31390003	Industrial Processes	Electrical Equipment	Process Heaters (Natural Gas)
390006xx	Industrial Processes	In-process Fuel Use	Natural Gas
39900601	Industrial Processes	Miscellaneous Manufacturing Industries	Process Heater/Furnace (Natural Gas)
39990003	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Natural Gas)
39990013	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Natural Gas)
39990023	Industrial Processes	Miscellaneous Manufacturing Industries	Miscellaneous Manufacturing Industries (Natural Gas)
40201001	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven Heater (Natural Gas)
40290013	Petroleum and Solvent Evaporation	Surface Coating Operations	Fuel Fired Equipment (Natural Gas)
40290023	Petroleum and Solvent Evaporation	Surface Coating Operations	Fuel Fired Equipment (Natural Gas)
49090013	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment (Natural Gas)
49090023	Petroleum and Solvent Evaporation	Organic Solvent Evaporation	Fuel Fired Equipment (Natural Gas)
50390006	Waste Disposal	Solid Waste Disposal – Industrial	Auxiliary Fuel/No Emissions (Natural Gas)
2102007000 – Industrial; LPG; Total: All Boiler Types			
102010xx	External Combustion Boilers	Industrial	Liquefied Petroleum Gas
10500110	External Combustion Boilers	Space Heaters	Industrial (LPG)
202010xx	Internal Combustion Engines	Industrial	Liquefied Petroleum Gas
27300320	Internal Combustion Engines	Off-highway LPG-fueled Engines	Industrial Equipment
30290005	Industrial Processes	Food and Agriculture	Fuel Fired Equipment (LPG)
30490035	Industrial Processes	Secondary Metal Production	Fuel Fired Equipment (Propane)
30500209	Industrial Processes	Mineral Products	Asphalt Concrete (LPG)
30505023	Industrial Processes	Mineral Products	Asphalt Processing (Blowing) (LPG)
30590005	Industrial Processes	Mineral Products	Fuel Fired Equipment (LPG)
30600107	Industrial Processes	Petroleum Industry	Process Heaters (LPG)
30600905	Industrial Processes	Petroleum Industry	Flares (LPG)
30609905	Industrial Processes	Petroleum Industry	Incinerators (LPG)
30890004	Industrial Processes	Rubber and Miscellaneous Plastics Products	Fuel Fired Equipment (LPG)
31000406	Industrial Processes	Oil and Gas Production	Process Heaters (Propane/Butane)
390010xx	Industrial Processes	In-process Fuel Use	Liquefied Petroleum Gas
39901001	Industrial Processes	Miscellaneous Manufacturing Industries	Process Heater/Furnace (LPG)
40201004	Petroleum and Solvent Evaporation	Surface Coating Operations	Coating Oven Heater (LPG)
50390010	Waste Disposal	Solid Waste Disposal - Industrial	Auxiliary Fuel/No Emissions (LPG)

SCC	SCC Level 1	SCC Level 2	SCC Level 3 (Fuel – If Not Specified at Level 3)
2102008000 – Industrial; Wood; Total: All Boiler Types			
102009xx	External Combustion Boilers	Industrial	Wood/Bark Waste
390009xx	Industrial Processes	In-process Fuel Use	Wood
2102011000 – Industrial; Kerosene; Total: All Boiler Types			
202009xx	Internal Combustion Engines	Industrial	Kerosene/Naphtha (Jet Fuel)

[a] Note that EIA's SEDS includes natural gas used as pipeline fuel (e.g., for use in compressor engines) in the Transportation sector rather than the Industrial sector. Therefore, such pipeline use should not be included in the point source subtraction procedure.

5. County Allocation of State Activity Data

Year 2011 county-level activity estimates were developed by allocating the state-level activity resulting from the adjustments to the EIA data described above. The EPA compiled 2011 estimates of manufacturing sector employment from the Bureau of Census' *County Business Patterns 2009* for use in this procedure (Census, 2009). State-level industrial fuel combustion by fuel type will be allocated to each county using the ratio of the number of manufacturing sector (NAICS codes 31-33) employees in each county to the total number of manufacturing sector employees in the state.

A separate document describes how withheld *County Business Patterns* employment data were estimated (Divita, 2008).

6. Emission Factors

The EPA has compiled criteria and hazardous air pollutant emission factors for non-point source industrial fuel combustion categories (Huntley, 2009). These emission factors, which are too numerous to list here, are included in a spreadsheet within the EPA's ICI fuel combustion workbook. In most cases, these are the same emission factors that were used in preparing the 2008 non-point source NEI (Pechan, 2006).

A. Coal

The SEDS data provide coal consumption estimates by type of coal (i.e., anthracite versus bituminous/sub-bituminous) and in some cases, CAP emission factors differ between the two. Because anthracite is mined in the eastern half of the Commonwealth, while bituminous is mined in the western half, the emission calculations assume that eastern counties burn anthracite coal while western counties burn bituminous coal.

1) Industrial Coal Combustion

$$Annual\ \ Emissions = (Pollutant\ \ Emission\ Factor)(Coal\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.3 lb/ton anthracite coal/year; 0.05 lb/ton bituminous coal/year
NO_X Emission Factor = 9 lb/ton anthracite coal/year; 11 lb/ton bituminous coal/year
CO Emission Factor = 0.6 lb/ton anthracite coal/year; 5.0 lb/ton bituminous coal/year
Pb Emission Factor = 0.00042 lb/ton anthracite coal/year and bituminous coal/year
SO_2 Emission Factor =34.71 lb/ton anthracite coal/year; 38.76 lb/ton bituminous coal/year
PM_{10}-FIL Emission Factor = 14.718 lb/ton anthracite coal/year; 12 lb/ton bituminous coal/year
$PM_{2.5}$-FIL Emission Factor = 6.4224 lb/ton anthracite coal/year; 1.4 lb/ton bituminous coal/year
PM-CON Emission Factor = 1.0704 lb/ton anthracite coal/year; 1.04 lb/ton bituminous coal/year
NH_3 Emission Factor = 0.03 lbs/ton anthracite coal/year; 0.03 lbs/ton bituminous coal/year
Anthracite Coal Sulfur Content = 0.89%
Bituminous Coal Sulfur Content = 1.02%
Anthracite Coal Ash Content = 13.38% ash

where:

Number of Industrial County Employees (Allegheny County) = 39,751
Number of Pennsylvania Industrial Employees = 574,683

Pennsylvania Industrial Coal Consumption = 2,148,300 tons (SEDs) - 1,601,256 tons (Point Source) = 547,044 tons (Nonpoint)

<u>CO Emissions</u>:

$$Annual\ \ CO\ Emissions = \frac{5\ lb\ CO \big/ \text{ton bituminous coal}}{year} \cdot 547{,}044 \text{tons} \cdot \frac{39{,}751\ employees\ in\ county}{574{,}683\ employees\ in\ state}$$

$$Annual\ \ CO\ Emissions = 189{,}196 lb\ CO\ per\ year \cdot \frac{1 ton}{2{,}000\ lbs} = 94.60\ tons\ CO\ per\ year$$

2) Industrial Distillate Oil Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(Oil\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.20 lb/1,000 gal. distillate oil/year
NO_X Emission Factor = 20 lb/1,000 gal. distillate oil/year
CO Emission Factor = 5.0 lb/1,000 gal. distillate oil/year
Pb Emission Factor = 0.00126 lb/1,000 gal. distillate oil/year
SO_2 Emission Factor = 42.6 lb/1,000 gal. distillate oil/year
PM_{10}-FIL Emission Factor = 1 lb/1,000 gal. distillate oil/year
$PM_{2.5}$-FIL Emission Factor = 0.25 lb/1,000 gal. distillate oil/year
PM-CON Emission Factor = 1.3 lb/1,000 gal. distillate oil/year
NH_3 Emission Factor = 0.03 lb/1,000 gal. distillate oil/year

where:

Number of Allegheny County Industrial Employees = 39,751
Number of Pennsylvania Industrial Employees = 574,683

Pennsylvania Industrial Distillate Oil Consumption = 41,778 thousand gallons (SEDs) -11,804 thousand gallons (Point Source) = 29,974 thousand gallons (Nonpoint)

<u>SO_2 Emissions</u>:

$$Annual\ \ SO2\ Emissions = \frac{42.6\ lbs\ \ SO2 \Big/ 1000\,gal\ \text{distoil}}{year} \cdot 29{,}974{,}000\,gal \cdot \frac{39{,}751 employees\ \ in\ \ county}{574{,}683\ employees\ \ in\ \ state}$$

$$Annual\ \ SO2\ Emissions = 88{,}323 lb\ SO2\ \ per\ \ year \cdot \frac{1 ton}{2{,}000\ lbs} = 44.2\ tons\ \ SO2\ \ per\ \ year$$

3) Industrial Residual Oil Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(Oil\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.28 lb/1,000 gal. residual oil/year
NO_X Emission Factor = 55.0 lb/1,000 gal. residual oil/year
CO Emission Factor = 5.0 lb/1,000 gal. residual oil/year
Pb Emission Factor = 0.00165 lb/1,000 gal. residual oil/year
SO_2 Emission Factor = 353.25 lb/1,000 gal. residual oil/year
PM_{10}-FIL Emission Factor = 20.7213 lb/1,000 gal. residual oil/year
$PM_{2.5}$-FIL Emission Factor = 13.4963 lb/1,000 gal. residual oil/year
PM-CON Emission Factor = 1.5 lb/1,000 gal. residual oil/year
NH_3 Emission Factor = 0.8 lb/1,000 gal. residual oil/year

where:

Number of Allegheny County Industrial Employees = 39,751
Number of Pennsylvania Industrial Employees = 574,683
Pennsylvania Industrial Residual Oil Consumption = 31,374 thousand gallons (SEDs) -14,533 thousand gallons (Point Source) = 16,841 thousand gallons (Nonpoint)

<u>PM_{10}-FIL Emissions</u>:

$$Annual\ \ PM10-FIL\ Emissions = \frac{20.7213\ \ lbs\ \ PM10-FIL \Big/ 1000 gal\ \text{Re}\ s.oil}{year} \cdot 16{,}841 thousgallons \cdot \frac{39{,}751\ employees\ \ in\ \ county}{574{,}683 employees\ \ in\ \ state}$$

$$Annual\ \ PM10-FIL\ Emissions = 24{,}138 pounds\ PM10-FIL\ \ per\ \ year \cdot \frac{1 ton}{2{,}000\ lbs} = 12.07\ \ tons\ \ PM10-FIL\ \ per\ \ year$$

4) Industrial Natural Gas Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(NG\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 5.5 lb/MMCF natural gas/year
NO_X Emission Factor = 100 lb/MMCF natural gas/year
CO Emission Factor = 84 lb/MMCF natural gas/year
Pb Emission Factor = .0005 lb/MMCF natural gas/year
SO_2 Emission Factor = 0.6 lb/MMCF natural gas/year
PM_{10}-FIL Emission Factor = 0.2 lb/MMCF natural gas/year
$PM_{2.5}$-FIL Emission Factor = 0.11 lb/MMCF natural gas/year
PM-CON Emission Factor = 0.32 lb/MMCF natural gas/year
NH_3 Emission Factor = 0.32 lb/MMCF natural gas/year

where:

Number of Allegheny County Industrial Employees = 39,751
Number of Pennsylvania Industrial Employees = 574,683

Pennsylvania Natural Gas Consumption = 200,506 MMCF
(SEDs) - 621,836 MMCF (Point Source) = 0.0 MMCF (Nonpoint)

<u>NO_X Emissions</u>:

$$Annual\ \ NOx\ Emissions = \frac{100\ lb\ \ NOx \big/ MMCF}{year} \cdot 0.0 MMCF \cdot \frac{39{,}751\ employees\ \ in\ \ county}{574{,}683\ employees\ \ in\ \ state}$$

$$Annual\ \ NOx\ Emissions = 0.0 lb\ NOx\ per\ year \cdot \frac{1 ton}{2{,}000\ lb} = 0.0\ tons\ \ NOx\ per\ year$$

5) Industrial LPG Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(LPG\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.52 lb/1,000 gal. LPG/year
NO_X Emission Factor = 14.23 lb/1,000 gal. LPG/year
CO Emission Factor = 7.97 lb/1,000 gal. LPG/year
Pb Emission Factor = 0.00018266 lb/1,000 gal. LPG/year
SO_2 Emission Factor = 0.06 lb/1,000 gal. LPG/year
PM_{10}-FIL Emission Factor = 0.02 lb/1,000 gal. LPG/year
$PM_{2.5}$-FIL Emission Factor = 0.01 lb/1,000 gal. LPG/year
PM-CON Emission Factor = 0.03 lb/1,000 gal. LPG/year
NH_3 Emission Factor = 0.3 lb/1,000 gal. LPG/year

where:

Number of Allegheny County Industrial Employees = 39,751
Number of Pennsylvania Industrial Employees = 574,683

Pennsylvania Industrial LPG Consumption = 184,682,000 (SEDs) - 864.4 thousand gallons (Point Source) = 183,818 thousand gallons (Nonpoint)

<u>CO Emissions</u>:

$$Annual\ \ CO\ Emissions = \frac{7.97\ lb\ \ CO \Big/ 1{,}000\ gal}{year} \cdot 183{,}818{,}000 \cdot \frac{39{,}751\ employees\ \ in\ \ county}{574{,}683\ employees\ \ in\ \ state}$$

$$Annual\ \ CO\ Emissions = 101{,}366\ lb\ CO\ per\ year \cdot \frac{1\ ton}{2{,}000\ lbs} = 50.66\ tons\ \ CO\ per\ year$$

6) Industrial Kerosene Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(Kerosene\,Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.1928471 lb/1,000 gal. Kerosene/year
NO_X Emission Factor = 19.29 lb/1,000 gal. Kerosene/year
CO Emission Factor = 4.82 lb/1,000 gal. Kerosene/year
Pb Emission Factor = 0.001215 lb/1,000 gal. Kerosene/year
SO_2 Emission Factor = 42.6 lb/1,000 gal. Kerosene/year
PM_{10}-FIL Emission Factor = 0.96 lb/1,000 gal. Kerosene/year
$PM_{2.5}$-FIL Emission Factor = 0.24 lb/1,000 gal. Kerosene/year
PM-CON Emission Factor = 1.25 lb/1,000 gal. Kerosene/year
NH_3 Emission Factor = 0.77 lb/1,000 gal. Kerosene/year

where:

Number of Allegheny County Industrial Employees = 39,751
Number of Pennsylvania Industrial Employees = 574,683

Pennsylvania Industrial Kerosene Consumption = 2,100 thousand gallons (SEDs) -37.3 thousand gallons (Point Source) = 2,063 thousand gallons (Nonpoint)

<u>SO_2 Emissions</u>:

$$Annual\ \ SO_2\ Emissions = \frac{42.6\,lb\ \ SO_2 \big/ E6Gal}{year}\,2{,}063E6GAL \cdot \frac{39{,}751 employees\ \ in\ \ county}{574{,}633\ employees\ \ in\ \ state}$$

$$Annual\ \ SO_2\ Emissions = 6{,}079.478 lb\ SO_2\ per\ year \cdot \frac{1 ton}{2{,}000\ lbs} = 3.04\ tons\ \ SO_2\ per\ year$$

7) Industrial Wood Combustion

$$Annual\ \ Emissions = (\text{Pollutant Emission Factor})(Wood\ Consumption)\left(\frac{Number\ of\ \ County\ Employees}{Number\ of\ \ State\ Employees}\right)$$

VOC Emission Factor = 0.017 lb/MMBTU Wood/year
NO_X Emission Factor = 0.22 lb/MMBTU Wood/year
CO Emission Factor = 0.6 lb/MMBTU Wood/year
SO_2 Emission Factor = 0.025 lb/MMBTU Wood/year
PM_{10}-FIL Emission Factor = 0.5 lb/MMBTU Wood/year
$PM_{2.5}$-FIL Emission Factor = 0.43 lb/MMBTU Wood/year
PM-CON Emission Factor = 0.017 lb/MMBTU Wood/year
NH_3 Emission Factor = 0.007 lb/MMBTU Wood/year
CH_4-FIL Emission Factor = 0.021 lb/MMBTU Wood/year
CO_2 Emission Factor = 195 lb/MMBTU Wood/year

where:

Number of Allegheny County Industrial Employees = 39,751
Number of Pennsylvania Industrial Employees = 574,683

Pennsylvania Industrial Wood Consumption = 29,753,000 MMBTU (SEDs) – 1,881,547 MMBTU (Point Source) = 27,871,452 MMBTU (Nonpoint)

<u>CO_2 Emissions</u>:

$$Annual\ \ CO_2\ Emissions = \frac{195\ lb CO_2 \big/ MMBTU}{year} \cdot 27{,}871{,}452 MMBTU \cdot \frac{39{,}751 employees\ \ in\ \ county}{574{,}683\ employees\ \ in\ \ state}$$

$$Annual\ \ CO_2\ Emissions = 375{,}935{,}998 lb\ CO_2\ \ per\ \ year \cdot \frac{1 ton}{2{,}000\ lb} = 187{,}968 tons\ \ CO_2\ \ per\ \ year$$

7. Additional References for Fuel Combustion – Industrial

1. National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA. County Business Patterns, 2009 State Data File: *http://www.census.gov/econ/cbp/download/09_data/index.html*.

2. Divita, 2008: Divita, Frank, E.H. Pechan & Associates, Inc., memorandum to Roy Huntley, U.S. Environmental Protection Agency, "County Business Patterns Calculations," December 4, 2008.

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5. EIA, 2007b: Energy Information Administration, U.S. Department of Energy, *Documentation for Emissions of Greenhouse Gases in the United States 2005*, DOE/EIA-0638 (2005), October 2007.

6. Percent sulfur content of coal from EIA's "Quarterly Coal Report, October-December 2009" (Tables 43 and 44), *http://205.254.135.7/coal/production/quarterly/archive/0121094q.pdf*. Provided at Emissions Inventories Clearinghouse Technology Transfer Network, U.S. EPA.

7. Huntley, 2009: Huntley, Roy, U.S. Environmental Protection Agency, "SCCs & emission factors to be used in 2008 NEI to Bollman May 1 2009.mdb [electronic file]."

8. Pechan, 2009b: E.H. Pechan & Associates, Inc., "Evaluation of ICI Combustion Coal Sulfur Content, Technical Memorandum," prepared for Central Regional Air Planning Association, March 28, 2009.

9. Pechan, 2006: E.H. Pechan & Associates, Inc. "Documentation for the Final 2002 Non-point Sector (Feb 06 Version) National Emission Inventory for Criteria and Hazardous Air Pollutants," prepared for U.S. Environmental Protection Agency, July 2006.

Graphic Arts (SCC 2425000000)

The graphic arts industry can be divided by technology into six different printing segments: rotogravure, flexographic, offset lithographic, letterpress, screen, and plateless (xerographic, electrostatic, magnetic, thermal, ink-jet, etc.). Graphic arts include operations that are involved in the printing of publications, such as newspapers, magazines, books, and advertising, and also printed packaging on various substrates such as paper, plastic, foil bags, wrappers, cardboard cartons, and metal cans. Paper can be coated or uncoated. Films include polyethylene and a number of other polymers. Other products include wall and floor coverings, greeting cards, and paper towels. Textiles are specifically excluded from the graphic arts operations source category.

Emissions of VOCs result from evaporation of solvents used in inks and cleaning. The emissions for each county were calculated using an employment-based emission factor[40] and 2010 County Business Patterns employee data.[41] Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATIONS:

$$Annual\ VOC\ Emissions = (Emission\ Factor)(Employees)$$

where:

Emission Factor = 201 lb VOC/employee/year
Employees = 2,200 (Allegheny County)[18]

$$Annual\ VOC\ Emissions = \frac{201 lb\ VOC / person}{year} \cdot (201\ employees)$$

$$Annual\ VOC\ Emissions = 442{,}200\ pounds\ VOC\ per\ year \cdot \frac{1\ ton}{2{,}000\ lb} = 221.1\ tons\ VOC\ per\ year$$

[40] ERTAC Nonpoint Source Inventory Project, November, 2009.
[41] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.

Household Products (SCC 2460200000)

Household products consist primarily of cleaning products for hard surfaces, clothing, carpet, dishes waxes and polishes. Other products include air fresheners and charcoal lighter fluids. These products have air emissions such as special napthas, alcohols, carbonyls and other organics that contain VOCs. The amount of VOCs emitted primarily depends on the VOC content of the product and the amount of product used.

County-level emissions were calculated using a per capita emission factor[42] and U.S. Bureau of the Census 2011 estimated population data.[43] The emission factor represents pre-control emission rates. A CE of 10.94 percent[44] and an RP of 48.6 percent[45] were applied to reflect the Federal Rule for consumer products. There is no point source emissions associated with this category.

SAMPLE VOC EMISSION CALCULATIONS:

$$Annual\ VOC\ Emissions = (EmissionFactor)(Population)\left(1-\frac{CE}{100}\cdot\frac{RP}{100}\cdot\frac{RE}{100}\right)$$

where:

Emission Factor = 1.8 lb VOC/person/year
Population = 1,227,066 persons (Allegheny County)
Control Efficiency = 10.94%
RP (Rule Penetration) = 48.6%
RE (Rule Effectiveness) = 100%

$$Annual\ VOC\ Emissions = \left(\frac{1.8\,lb VOC/person}{year}\right)(1{,}227{,}066)\left(1-\frac{10.94}{100}\cdot\frac{48.6}{100}\cdot\frac{100}{100}\right)$$

$$Annual\ VOC\ Emissions = 2{,}091{,}285\ pounds\ per\ year\cdot\left(\frac{1\ ton}{2{,}000\ lb}\right) = 1045.6\ tons\ VOC\ per\ year$$

[42] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[43] U.S. Department of Commerce, Bureau of the Census, "Population Estimates: Datasets for all Geographies, CO-EST2011 – http://www.census.gov/popest/data/datasets.html. Prepared by the Pennsylvania State Data Center, released April 2012. http://pasdc.hbg.psu.edu/Data/Estimates/tabid/1012/Default.aspx.
[44] ERTAC Recommendation, Midwest RPO Inventory Comparability Project; March – August 2009.
[45] E.H. Pechan & Associates, Inc., *Control Measure Development Support Analysis of Ozone Transport Commission Model Rules*, prepared for the Ozone Transport Commission, March 2001.

Machinery and Equipment (SCC 2401055000)

The VOC emissions from this source category result from the evaporation of the solvent used in the coating process in manufacturing facilities of such as engines, turbines, farm and garden equipment, computers, and office machinery. The emissions for each county were calculated using an employment-based emission factor[46] and employee data from NAICS Codes 3331XX, 3332XX, 3333XX and 33341XX obtained from the U.S. Census Bureau, *County Business Patterns*[47] for year 2010, prepared by EPA, who performed calculations for midpoints and adjustment factors for any ranges that were obtained. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATIONS:

Annual VOC Emissions = (Emission Factor)(Number of Employees)

where:

VOC Emission Factor = 51.64 lb VOC/employee/year
Employees = 1,073 employees (Allegheny County)

$$Annual\ VOC\ Emissions = \left(\frac{51.64\, lb\ VOC \,/\, employee}{year} \right) \left(1073\, employees \right)$$

$$Annual\ VOC\ Emissions = 55{,}409.7 lb\ VOC\ per\ year \cdot \frac{1\, ton}{2000\, lb} = 27.7\ \ tons\ VOC\ per\ year$$

[46] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[47] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.

Metal Cans (SCC 2401040000)

This source category includes the manufacturing of metal cans, barrels, drums, kegs, and pails. The emissions for each county were calculated per the calculation below using an employment-based emission factor[48] and employee data from NAICS Code 332431, obtained from the U.S. Census Bureau, *County Business Patterns*[49] for year 2010, prepared by EPA, who performed calculations for midpoints and adjustment factors for any ranges that were obtained. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATION:

Annual VOC Emissions = (Emission Factor)(Number of Employees)

where:

Emission Factor = 3035 lb VOC/employee/year
Employees =9 employees (Allegheny County)

$$Annual\ VOC\ Emissions = \left(\frac{3035\ lbVOC \big/ Employee}{year} \right) (9\ Employees)$$

$$Annual\ VOC\ Emissions = 27{,}315 lb\ \ VOC\ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 13.66\ tons\ VOC\ per\ year$$

[48] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[49] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.

Metal Furniture (SCC 2401025000)

This source category includes manufacturing metal household and office furniture, such as beds, cabinets, desks, bookcases, and chairs. The emissions for each county were calculated per the sample calculations below using an employment-based emission factor[50] and employee data for NAICS codes 337124, 337127, 337214, and 337215. Previously used NAICS code 339111 has been discontinued. The number of employees in each county was obtained from the U.S. Census Bureau, *County Business Patterns*[51] for year 2010, prepared by EPA, who performed calculations for midpoints and adjustment factors for any ranges that were obtained. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATIONS:

Annual VOC Emissions = (Emission Factor)(Number of Employees)

where:

Emission Factor = 887.8025 lb VOC/employee/year
Employees = 38 employees (Allegheny County)

$$Annual\ VOC\ Emissions = \left(\frac{887.8025\ lbVOC \,/\, employee}{year} \right) (38\ employees)$$

$$Annual\ VOC\ Emissions = 33{,}736\ lb\ VOC\ per\ year \cdot \frac{1\ ton}{2000\ lb} = 16.87\ tons\ VOC\ per\ year$$

[50] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[51] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.

Miscellaneous Manufacturing (SCC 2401090000)

This source category includes small industrial surface coating establishments primarily engaged in manufacturing products not classified in any other group such as jewelry, silverware, musical instruments, dolls, toys, games, pens, pencils, buttons, brooms, and caskets. Operations involve applying a thin layer of coating, such as paint, lacquer, enamel and varnish, to an object for decorative purposes. The surface coating products are either water-based or solvent-based liquid carriers that mostly evaporate in the drying or curing process.

The emissions for each county were calculated per the sample calculations below using an employment-based emission factor[52] and employee data for NAICS codes 339// and 3369//. The number of employees in each county was obtained from the U.S. Census Bureau, *County Business Patterns*[53] for year 2010, prepared by EPA, who performed calculations for midpoints and adjustment factors for any ranges that were obtained. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATIONS:

Annual VOC Emissions = (Emission Factor)(Number of Employees)

where:

Emission Factor = 92.42051 lb VOC/employee/year
Employees = 1,675 employees (Allegheny County)

$$Annual\ VOC\ Emissions = \left(\frac{92.42051\ lb VOC \,/\, employee}{year} \right) (1{,}675\ employees)$$

$$Annual\ VOC\ Emissions = 154{,}804\ lb\ VOC\ per\ year \cdot \frac{1\ ton}{2000\ lb} = 77.40\ tons\ VOC\ per\ year$$

[52] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[53] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.

Motor Vehicles (SCC 2401070000)

This source category comprises establishments engaged in manufacturing, assembly and rebuilding of body and chassis, engine parts, components and accessories for all types of motor vehicles, including passenger cars, trucks, buses, trailers and mobile homes. The products made may be sold separately or may be assembled on purchased chassis and sold as complete vehicles.

VOC emissions from this source category result from the evaporation of solvent from surface coating products used to coat individual pieces.

The emissions for each county were calculated per the sample calculations below using an employment-based emission factor[54] and employee data for NAICS codes 339// and 3369//. The number of employees in each county was obtained from the U.S. Census Bureau, *County Business Patterns*[55] for year 2010, prepared by EPA, who performed calculations for midpoints and adjustment factors for any ranges that were obtained. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATIONS:

Annual VOC Emissions = (Emission Factor)(Number of Employees)

where:

Emission Factor = 194 lb VOC/employee/year
Employees = 225 employees (Allegheny County)

$$Annual\ VOC\ Emissions = \left(\frac{194 lb VOC / employee}{year} \right) \left(225\ employees \right)$$

$$Annual\ VOC\ Emissions = 43{,}650 lb\ VOC\ per\ year \cdot \frac{1\ ton}{2{,}000\ lb} = 21.83 tons\ VOC\ per\ year$$

[54] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[55] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.

Paper, Foil and Film (SCC 2401030000)

This source category includes the manufacturing of paper, foil and film. Emissions for each county were calculated per the calculation below using an employment-based emission factor[56] and employee data from NAICS Codes 322221, 322222, 322223, 322225 and 322226. The number of employees in each county was obtained from the U.S. Census Bureau, *County Business Patterns*[57] for year 2010, prepared by EPA, who performed calculations for midpoints and adjustment factors for any ranges that were obtained. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATION:

Annual VOC Emissions = (Emission Factor)(Number of Employees)

where:

Emission Factor = 609.3887738 lb VOC/employee/year
Employees = 667 employees (York County)
Point Source Emissions = 87.11 Tons

$$Annual\ VOC\ Emissions = \left(\frac{609.3887738\ lb VOC \,/\, Employee}{year} \right) (667\ Employees)$$

$$Annual\ VOC\ Emissions = 406{,}462\, lb\ \ VOC\ per\ year \cdot \frac{1\ ton}{2000\ lb} = 203.23 tons\ VOC\ per\ year$$

[56] ERTAC Nonpoint Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[57] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.

Wood Furniture and Fixtures (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. Each county's emissions were calculated according to the sample calculations below using an employee emission factor[58] and the number of employees in NAICS codes 337110, 337121, 337122,337127,337129, 337211, 337212 and 337215. NAICS code 339111, which was previously used, has been discontinued. The number of employees in each county was obtained from the U.S. Census Bureau, *County Business Patterns*[59] for year 2010, prepared by EPA, who performed calculations for midpoints and adjustment factors for any ranges that were obtained. Point source emissions, where present, were subtracted from emission estimates directly at the county level, since there were no throughput data available for subtraction at the state activity level.

SAMPLE VOC EMISSION CALCULATION:

Annual VOC Emissions = (Emission Factor)(Employees)

where:

Emission Factor = 524.1249 lb VOC/employee/year
Employees =344 employees (Allegheny County)

$$Annual\ \ VOC\ \ Emissions = \left(\frac{524.1249 \quad lb\ VOC \,/\, employee}{year} \right) (344\ \ employees)$$

$$Annual\ \ VOC\ \ Emissions = 108{,}299\, lb\ VOC \quad per\ year \cdot \frac{1\ \ ton}{2{,}000\ \ lb} = 90.15\ tons\ \ VOC\ \ per\ year$$

[58] ERTAC Area Source Inventory Project, Emission Factors for Solvents, August 8, 2009 (Version 4).
[59] National, state and county level government employment data downloaded from U.S. Census Bureau, mapping of employment flag letters reported by County Business Patterns to the range and midpoints of the range, and calculated final activity data using the employment midpoint and adjustment factors, provided by EPA: County Business Patterns, 2010 County Business Patterns: http://www.census.gov/econ/cbp/download/index.htm.